What's the Big Idea?

A Publication of the K-12 Allance: A WestEd Program

MAY 2011 ▪ VOL. 10, NO. 4

# Scaffolding for Learning

*(Editor's note: We began this school year with a continuation of the series on sense-making notebooks that we published last year. We recognize the importance of notebooks as a place where students can gather data, communicate their understanding, and reflect on what they learned. For teachers, student notebook entries are windows into student thinking, providing valuable information about what they know and don't know.*

*Previous articles explored the transition from "teacher directed" to "student directed" notebook entries for experimental design including observations, displaying data, selecting and developing graphs, writing summary statements and conclusions This article provides yet another look at the experimental design—that of procedural writing. Often teachers provide procedures for students to follow. In this article, our goal is to show how these scaffolds can be replaced to help students design and edit their own experiments including the steps in the procedure.)*

Wayne Porte had just returned from a K-12 Alliance professional development session where he had a "light bulb" moment. Wayne wanted his students to understand that science is testable and repeatable; one factor that contributes to replication is the detail of the procedural directions. At the training, he recognized that he always provided the procedure scaffold for what students should do in an experiment – almost like a cookbook. He wanted to change the "recipe" to make these procedures more student-directed.

In the classroom, Wayne asked his students to take out a piece of paper and a pencil. Then he read these directions, with no clarification, asking student to follow the instructions. (You might want to try this as you read along.)

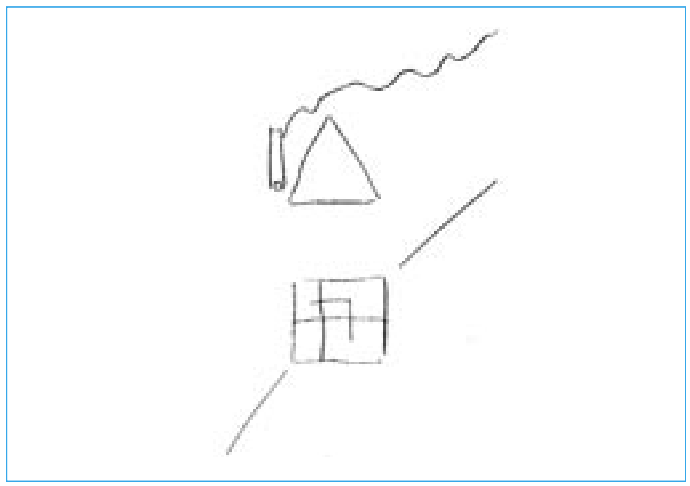
"Draw a triangle in the middle of the paper. Draw a square underneath the triangle. Draw two diagonal lines from the square. Draw four rectangles inside the square and one rectangle on the side of the triangle. In three of the rectangles draw intersecting lines. In one rectangle draw a circle. Draw a squiggly line connected to one rectangle."

Groups of four students were asked to look at each other's drawings. Here is what they drew:

## IN THIS ISSUE...



**Student A**



**Student B**

*SEE SCAFFOLDING, PAGE 10*

# Changing People One Program at a Time: What's in Your Bag?

By Kathy DiRanna

Last month, 52 K-5 teachers and their administrators stood in a closing circle after three years of intensive leadership development. The facilitator had just told everyone about the "possibles bag" used by pioneers to prepare themselves for their journeys. In this bag, our early settlers would put items they might need on the trail — flint and steel, ammo, trail mix — anything you might possibly need.

In our metaphorical world of professional development, our bag is filled with vision, knowledge, skills and habits of mind. It's also filled with the joy of learning, love of children, and the recognition that each child is a unique and precious resource.

These educators shared what would be in their bag — how the training helped to prepare them for their journey.

> **"I've never been in a program like this before where you were able to meet me where I was and help me learn the new ways of thinking."**
> **"I learned the importance of setting goals and meandering toward them."**
> **"In my bag, I would put everything I learned about collaboration because I really now recognize that I need friends, support and encouragement to stay the course in these uncertain times."**
> **"I learned to think, that instead of saying 'It won't work' try "If it could work, what would it look like?' That changed how I think about everything, including my work, my personal life."**
> **"My possibles bag has a reservation at the Hotel California, reminding me that once I check in, I won't check out. You've made me recognize quality teaching and learning and I am transformed."**
> **"While my school will never be supportive as a whole, I've learned that the people in this academy can turn my power of one into the power of many."**
> **"We took baby steps, and three years later, look at what we accomplished."**

Professional development changes peoples' lives and viewpoints when it's built on quality factors: recognize and honor the expertise that adult participants bring to the table; engage them in meaningful learning experiences that mirror what you want to see in their context; challenge them to dislodge "the same old, same old" into new lenses to view quality work; support participants in the implementation and arm them with skills and knowledge, celebrate their success and have a hankie when things get rough.

These 52 educators were part of a leadership program and a new collaboration between the K-12 Alliance and FOSS. Each organization has been successful in developing and implementing other programs in the past and both were able to contribute to the expertise and design that has become the FOSS Leadership Academy. The program grew as the participants grew, and once again, the "fire in our belly" to stay the course, to ensure students have quality science experiences, to stand up for problem solving, reasoning and critical thinking helped change peoples lives.

As the school year enters spring testing, as your core beliefs about how students learn (not by bubbling in answers!) are challenged, as you wonder if the budget crisis can get any worse...

**Stop!**

Think about what is in your "possibles bag" and make a commitment to quality science and mathematics for all students. Believe me; it's all in there! ■

**K-12 ALLIANCE CONTACTS**

**Kathy DiRanna**
Statewide Director
(714) 438-3802 | kdirann@wested.org

**GENERAL QUESTIONS:**
**Doris Waters**
Administrative Program Manager
(714) 438-3802 | dwaters@wested.org

**REGIONAL DIRECTORS AND SERVICE AREAS**

**David Harris**
(619) 518-4292 | dharris5@earthlink.net
Escondido Union School District

**Karen Cerwin**
(909) 337-9131 | kcerwin@wested.org
Coachella Valley

**Susan Gomez-Zwiep**
(562) 972-4115 | sgomezwp@csulb.edu
Montebello CPEC-K2

**Rita Starnes**
(559) 332-2123 | rstarne@wested.org
Kings Canyon (Emeritus)

**Jo Topps**
(562) 597-8523 | jtopps@wested.org
Greater Los Angeles (Los Angeles and Northern Orange Counties), San Diego Area

**Melissa Smith**
(951) 907-6048
melissa.smith@leusd.k12.ca.us
Lake Elsinore/Temecula Area

**Jody Skidmore Sherriff**
(916) 774-6540 | jskidmo@wested.org
Greater Sacramento Area (Alpine, Colusa, El Dorado, Nevada, Placer, Sacramento, Sierra, Sutter, Yolo, Yuba). Far North (Butte, Del Norte, Glenn, Humboldt, Lassen, Modoc, Plumas, Shasta, Siskiyou, Tehama, Trinity)

**WHAT'S THE BIG IDEA EDITOR**
**Brenda Rees**

**"What's The Big Idea?" is an independent publication sponsored and paid for by the K-12 Alliance.**

For Further Information, Contact:
What's The Big Idea?
K-12 Alliance
2720 South Harbor Boulevard, #A
Santa Ana, CA 92704-5822
Phone: (714) 438-3802 or 3803, Fax (714) 438-3808

# The Leadership Journey

ByTim Williamson

***"It's been a wild and crazy ride and I wouldn't change one bit of it..."***

Tim Williamson

Leadership does not happen overnight. Leadership requires skilled mentoring, perseverance, dedication, opportunity, a little luck and just plain old hard work. The development of my leadership skills in science education enlisted the use of all of these qualities.

My elementary classroom was always a "science based" classroom usually having more critters than students. My love and passion for teaching science slowly emerge by the time I moved to Southern California in 1980 after teaching in Indiana and Arizona for 12 years.

At this point I never really considered any type of leadership role in science education, but that was soon to change. As I shared my science knowledge with other teachers at Bret Harte Elementary in Long Beach Unified, I soon became known as the "go-to" person for anything and everything related to science.

In 1985 I was asked to be a science specialist at the school and opened the first elementary science lab in LBUSD. I worked with all K-6 grade levels in the lab doing "hands-on, minds-on" science lessons while the classroom teachers did textbook assignments. I began to attend as many science professional development offerings in Southern California as possible, including Project RISE and SUN-RISE at UCLA.

In the late '80s, I heard about a science advocacy professional development group called the California Science Implementation Network (CSIN), now part of the K-12 Alliance. I soon became a part of that group and secured a position as a staff developer in the L.A. region. This is when my true leadership in science education began to take shape.

My K-12 Alliance mentors were Jo Topps and Steve Kemp, and of course the energetic and very dedicated Kathy DiRanna. They took my deep love for science education and began to mold me into a science education leader.

In 1990 I transferred to Carver Elementary in Long Beach and took on a similar leadership role at that school. In the mid '90s the science lab at Carver was closed due to budget constraints and I returned to the classroom. I continued, however, to attend all of the science education professional development courses I could get my hands on.

In 1998 I was hired by CSULB to become a part-time elementary science methods lecturer. Working with college pre-service seniors was a new and very enjoyable experience for me. I looked forward to my evenings at CSULB and continued to enhance my science pedagogical knowledge.

That same year, I was asked to lead the Science/Math Resource Center at the Teacher Resource Center in Long Beach Unified. I was concerned about leaving the classroom but those fears soon faded as I settled into my new position. Through the K-12 Alliance, I developed a toolkit of science content and pedagogical skills that I was anxious to share with all elementary teachers in Long Beach.

All of these leadership building experiences led me to secure an exciting position with the L.A. County Office of Education in 2002 as the county's elementary science consultant. This position allowed me to work with all 80+ school districts in L.A. County and share with them the content and pedagogy knowledge I had acquired over the years.

It was at this time that I became involved with the California Science Teacher's Association and was elected to their Board of Directors, eventually becoming their President in 2009. My presidency expires this June.

I retired from LACOE in 2009 after 40 years in public education but continued my methods teaching at CSULB and was soon asked to be the Single Subject Science Credential Coordinator for the university. It's a part-time position and it allows me to continue to learn, grow and enhance my knowledge of science education.

It's been a wild and crazy ride and I wouldn't change one bit of it. Thanks K-12 Alliance for everything. I couldn't have done it without you! ■

# Science Roles for Literature Circles

By William Straits

In the last issue of *What's the Big Idea?*, I described literature circles as a technique for guiding students' reading of and discussions about texts. Here, I'd like to provide more details about "literature circle roles" – specific tasks students perform as they read to enhance discussion and understanding. Roles guide students to develop understanding of particular concepts as they explore the text and thereby promote meaningful student participation in subsequent small-group discussions (*Daniels 1994*).

However, during discussion, students' participation is not limited to simply reading the information they gathered through their roles; roles are meant to enrich conversations, not delineate them. As discussions aim to be open conversations where "personal connections, digressions, and open-ended questions are welcome" (Daniels 1994), it is important to teach how to have an appropriate discussion. Encourage your students to be:

- *focused*, using good posture and eye contact;
- *active*, responding verbally and nonverbally to others; questioning, asking for clarification;
- *respectful*, talking one at a time, responding positively, and encouraging others to contribute; and
- *constructive*, expanding on the ideas of others, disagreeing politely, and supporting ideas with information from the text (Hill, Schlick Noe, and Johnson 2001).

I've used the following roles with students to help encourage them to see science as a human endeavor while reading historical non-fiction. Two caveats: this list is far from exhaustive and not all roles are appropriate for all grade-levels. This list is meant to serve as a starting point for you as you develop roles that best serve your instructional needs.

**Science Translator**
As you read, take note of science vocabulary and concepts in the book and record the term and the page number it is found on. Then use the internet, textbook, and other sources to find out more information about these ideas. Share your findings with the group.

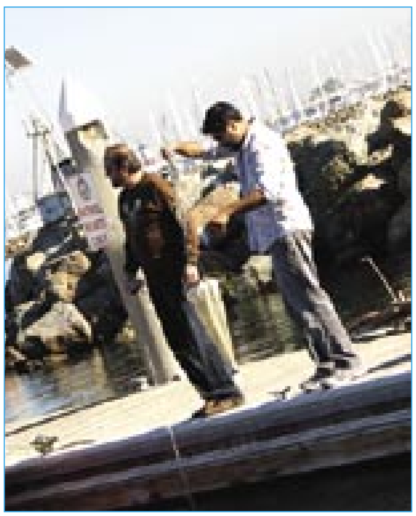
**Science Skeptic**
Analyze how science is done in the book. How does it compare to our inquiry investigations? Remember our discussions about fair tests and experimental design. Raise questions about their techniques and challenge the validity of their data and conclusions. For example, are scientists in the book controlling variables, repeating their tests, avoiding bias, and using a large enough sample size?

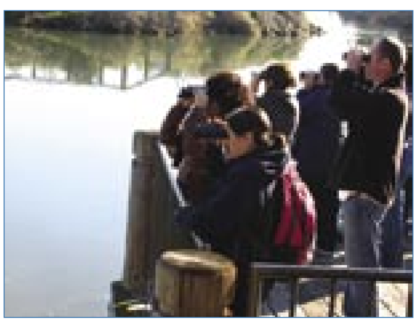
**Science Biographer**
As you read about different people doing science, record their names and the pages they're found on. Then use the library, textbook, and internet to discover more information about that person. Share your findings with the group.

**Nature of Science Investigator**
As discussed in class, there are several factors that accurately describe science (scientific knowledge is based on evidence; scientists can never

SEE SCIENCE ROLES, PAGE 9

# Learning Fun Among the Fishes





Last summer, the Montebello/Garvey Institute participated in a fantastic field trip to the Cabrillo Marine Aquarium (CMA) in San Pedro. After a day full of field-based inquiry activities about marine environments, everyone wanted to know when they could come back to this fantastic seaside locale.

Those requests were answered this last January, when teachers at Bell Gardens Elementary School returned to CMA for a TLC/fieldtrip combination day.

The day started with a quick tour through the aquatic nursery where CMA staff – along with local high school and college students – are researching and studying local marine animals, such as garibaldi, grunion and black sea nettles. Next, teachers were given a tour of the exhibit hall where they learned how CMA features the local marine environment which includes their gigantic touch tank filled with sea stars, sea slugs and urchins. BGE teachers joined in the hands-on experience by collecting data in the field. They towed for plankton and observed it in the classroom (along with other invertebrates under microscopes) and did bird watching in the salt marsh.

This first portion of the day ended with an overview of CMA's public education and teacher support programs. The teachers loved learning how they can bring their students to the aquarium to participate in a fish dissection or how to arrange the CMA outreach team to come to their school and work with BGE students. CMA has amazing opportunities for students and teachers alike to learn about a variety of life science topics.

After lunch, it was time for the teachers to roll up the sleeves, put up the chart stands and get to work on TLC planning. CMA also provided teachers on-site space so they could continue working together after exploring the aquarium. Armed with an unlimited supply of sharpies and post-it notes, teachers spent the afternoon in grade level groups planning TLC lessons. At the end of the day, everyone went home exhausted but excited about their new learning and TLC lessons.

Once again, the CMA provided local teachers with professional content, educational opportunities and gracious hospitality. Just like last summer, these teachers are counting down the days when they can return to this wonderful resource to discover more about the natural world and the learning process! ■

**TEACHERS AT WORK: (top to bottom): Art Navar and Feliciano Rodriguez investigate the touch tank; Cabrillo's estuary offers some excellent bird watching with snowy egrets, black-crowned night herons and brown pelicans commonly seen; Ricardo Ramirez pulling up the plankton net. (right) Leslie Hiatt guides her team as they build a "mini" conceptual flow as part of their TLC lesson planning.**

# Science and Art: “All About Observations!”

As the official eyeballs of the world, scientists and artists use observations to experience, understand and learn about life on planet Earth. Scientists use observations to gathering data or make meticulous notes, whether it’s in the field or in the lab. Artists use observations to see clearly the details of what is being replicated, noting how things are constructed.

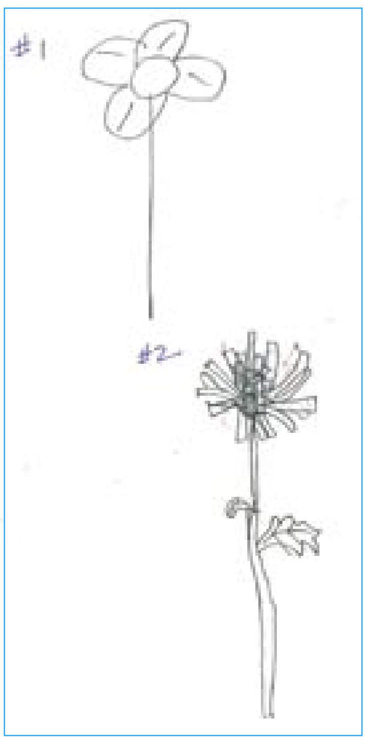
The authentic connection between art and science was the topic of a recent lesson study for four middle school teachers from Temecula Unified School District.

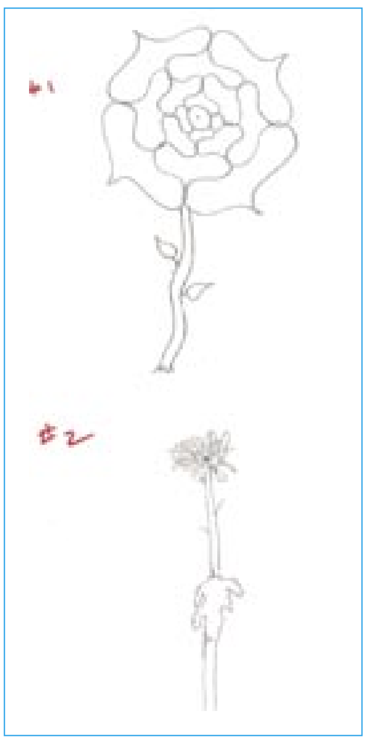
Overall, this lesson was part of a series on how to integrate technology into both science and art. After three lessons done in the science classroom, the teacher team challenged themselves to do the last lesson in the art room since it was only fair for the solo art teacher on the team.

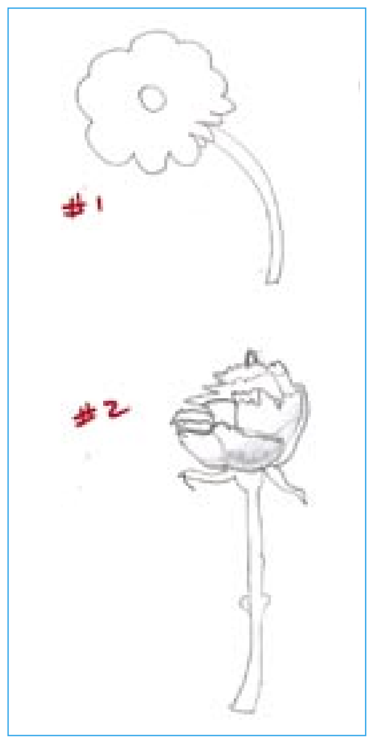
Historically, botanical drawings are superb examples of artist’s drawings intended to replicate or represent nature. Our teacher team used that art form for their lesson that involved contour drawing using a variety of flower subjects.

With flowers on their tables, students were first asked to draw a flower without instruction (results are flower number 1 in each set). Most students did not use the flower as a model, opting for “quick drawings” from memory or “cartoon” stylized drawings.

The second drawing in each set represents more observational drawings after students were given instruction of looking closely at one flower. In addition, technology used in the lesson allowed quick access to professional examples of botanical drawings as well as instruction in contour drawing skills. Notice the changes in detail in the drawings at the beginning of the lesson and the end.





The student work provided concrete examples for the team to discuss how each content area could enhance the other. The drawings became the beginning of two different lessons – one in art, one in science.

In the art lesson, the teachers wanted to build on the idea that artists use accurate drawings as a starting point to convey their artistic message. The original drawing may be altered for the artists’ purpose of conveying a feeling or meaning. The art teacher planned to ask students to alter their drawings to depict emotions through various color choices.

The science teachers wanted students to recognize that scientists use observations including drawings as a way to take accurate notes on phenomena. Drawings and notes become data to be analyzed for patterns and these patterns

***SEE SCIENCE AND ART, PAGE 9***

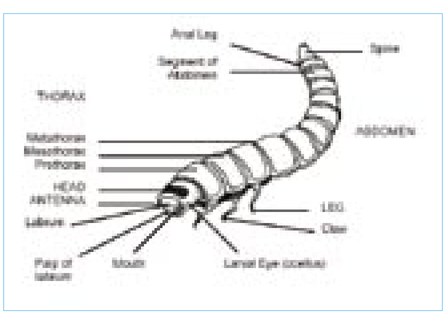
# New CPEC Grant at Oasis School: An Oasis of Science for ELL Students

A new CPEC grant, Science Writing Impacts Real Learning (SWIRL), brought a buzz of excitement in a second grade class at Oasis School, located in a remote part of the Coachella Valley Unified School District.

When the teacher announced it was time for science, students cheered – which signaled the unofficial start of this grant aimed to bring science to English Language Learners (ELL) at an early level.

Today, “real mealworms” became the focus of a classroom investigation. Students moved magnifying glasses closer or further from their eyes in order to see the tiny legs and antennae of the mealworms. Asked if they had used magnifying glasses previously, more than 80 percent of the class said it was their first time.

The energy in the room was so compelling, that a senior citizen volunteer who usually comes to read with students, stopped cataloguing books to come closer to see why the students were excited.




The students’ curiosity and thirst for learning underscore the goals of SWIRL which seeks to provide authentic experiences for students to develop academic language and deepen their content learning. Historically, ELL students are engaged in English-language arts instruction to the exclusion of science. ELL students often do have science until they can read, and then only if there is time in the instructional day. But the exploration of mealworms directly tells us that students hunger for science in their school days.

SWIRL builds on the idea that real world applications and experiences are necessary to develop language arts skills of reading writing, listening and speaking, especially for ELLs. Science is a natural vehicle for concrete experiences that can lead to conceptual understanding. The idea of science as a catalyst for language arts instruction is being implemented in grades K-6 at this 97-percent free lunch and 94-percent ELL population school.

Partners in the grant include; California State University, San Bernardino, K-12 Alliance, Coachella Valley Unified School District (Oasis School) and Lawrence Hall of Science. Together, the partners have high hopes for teachers and students exemplified by the following:

*“I hope the SWIRL grant instills a culture of doing science for students and teachers at Oasis, focused on broader ideas like ‘science matters’ and ‘science is fun.’ Science matters in our classes, our community, and our daily lives. Oasis students and teachers should be afforded a rich, exciting exposure to science, and reap a lifetime of rewards that early and continuous exposure to science can bring.” Dr. David Polcyn, PI SWIRL CSUSB*

*“Providing access to science is an appropriate strategy for effectively learning language but, even more importantly, access to science is every student’s right in order to equalize opportunities for their future. One cannot be introduced to science in middle or high school and hope to be competitive with students that have been provided science since kindergarten.” Karen Cerwin, K-12 Alliance Professional Development*

***SEE OASIS, PAGE 8***

*OASIS (CONTINUED FROM PAGE 7)*

*"I want the SWIRL project to (a) provide teachers with the knowledge and skills to use hands-on curricular materials such as FOSS to engage students in inquiry learning, (b) increase teachers' knowledge of science content, (c) enhance teachers' efficacy to teach science with an emphasis on inquiry, (d) encourage teachers to teach science on a regular basis even when there are administrative pressures to do otherwise, (e) enhance students' attitudes toward science, and (f) engage students in scientific discourse that will lead to improved language skills (i.e., speaking, reading, and writing). I also hope the SWIRL project will demonstrate that students enjoy learning especially when the content is meaningful and engaging." Dr. Joseph Jesunathadas, Research Director, CSUSB*

*"My wish is that the SWIRL program gives teachers a quality opportunity to really learn science—not just the facts, but also how scientists come to know what they know. . I hope the students get to practice being scientists and are excited about how science helps us understand our world .." Dr. Cathy Spencer, CSUSB School of Education*

*"I hope the SWIRL grant creates an avenue for developing writing, reading and critical thinking skills in our students who are in so much need of all of these tools, and in dire need of instruction in science. I hope it keeps their mind inquisitive and turns our students and teachers into lifelong learners. I hope our teachers lose the fear of teaching science and I hope our students receive the same opportunities afforded to English speakers in science education. Finally, I hope parents, teachers and students understand the importance of science education in their daily lives as citizens, as members of a productive society, and as members of our biome." -- Richard Pimentel, student facilitator*

The leadership team meets monthly and has effectively shepherded the challenges of implementing this grant into real-world practices.

The first challenge was to provide enough kit materials and kit trainings so the staff could start teaching and engaging the students in science experiences and using their science notebooks.

The district had adopted FOSS, but only purchased materials for grades 4 and 5. Through the efforts of FOSS curriculum developers, Linda De Lucchi and Larry Malone, the Lawrence Hall of Science and Delta Education generously donated approximately 20 additional kits to the school expanding the program to grades K-3. Likewise, It's About Time has agreed to donate Investigation Earth Systems hands-on materials for sixth grade students.

SWIRL goals are to increase science conceptual understanding and writing through five major strategies:

- All teachers (K-5) will teach FOSS science units and 6th grade teachers will teach It's About Time science units with fidelity to the curriculum design.

- All students will write in science notebooks on a daily basis building both communication and science knowledge.

- A parent program, implemented in the fall, will teach parents of grades K- 2 students how to facilitate one FOSS unit during afterschool sessions, thereby engaging the community in supporting the teaching of science.

- All teachers will attend a summer institute session which will provide specific content and pedagogy for their instructional units.

- Lesson study and grade level meetings will be conducted throughout the year to clarify content, help teachers learn how to use student work in notebooks as formative assessment, as well as trouble-shoot management of materials.

Overall, SWIRL brings exciting opportunities for students and teachers at Oasis. With its motto: "It's not about a new beginning, it's about a new ending," SWIRL offers science access and equity for ELL students, showing them how the wonders of science and the beauty of language go hand-in-hand. ■

*SCIENCE ROLES (CONTINUED FROM PAGE 4)*

know for certain that a conclusion is correct; scientific knowledge changes over time; there are multiple ways to solve problems in science; scientists are often very creative in their attempts to solve problems; and scientists are people, influenced by their own personal beliefs and by society). While reading, look for examples of these factors in the book.

**Everyday Life Connector**
Your job is to search the reading for events, ideas, characters, and objects that remind you of everyday life. Be sure to record page numbers and pay particular attention to science concepts. Share your findings with the group.

**Science and Culture Connector**
Science is greatly influenced by culture (the beliefs and values of particular societies at particular times in history). Consider ways science was influenced by culture in the past and ways that our culture influences how science is done today.

### Why Literature Circles Work

Readers may approach texts from a more information-based or emotion-based stance depending on their individual purposes for reading. The information-based stance emphasizes the meaning readers take from the book, whereas the emotion-based stance prioritizes the previous experiences that readers bring to the text (Rosenblatt 1978). As they are reading a book, individual readers may be oriented to any point along the continuum between information- and emotional-based stances, based on textual clues and an individual's expectations and reasons for reading.

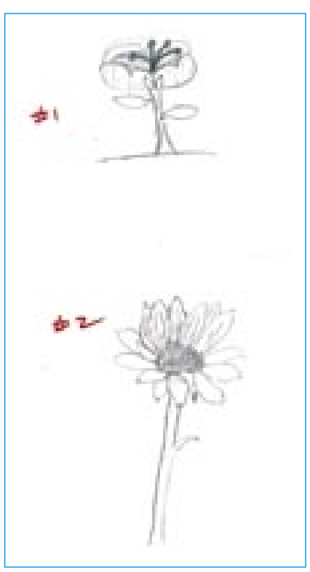
For example, most fictional books orient readers toward the emotional, consider the attachments you've formed with your favorite character. Although they're just ink and paper, these books can make us angry, sad, or elated. Now consider a phone book – again ink and paper, but unlike most fiction we generally don't form emotional attachments with the content; we come to these texts for information.

Likewise, students come pre-positioned toward information-based stances while reading most assigned science texts. Although, their science textbooks may also anger/depress students, generally the purpose for reading these texts is to take away – not to personally connect to – the information presented.

To identify with science and to see it truly as a human struggle, passion, and need, students must be presented with text that more authentically represent science as a human endeavor and must be taken explicitly from their information stances and guided to view science reading from a more emotional stance. Literature-circle roles are invaluable as they can guide learners toward both theses stances as they interact with text. ■

*William Straits (wstraits@csulb.edu) is an associate professor in the Department of Science Education at California State University, Long Beach in Long Beach, California.*

---



*SCIENCE AND ART (CONTINUED FROM PAGE 6)*

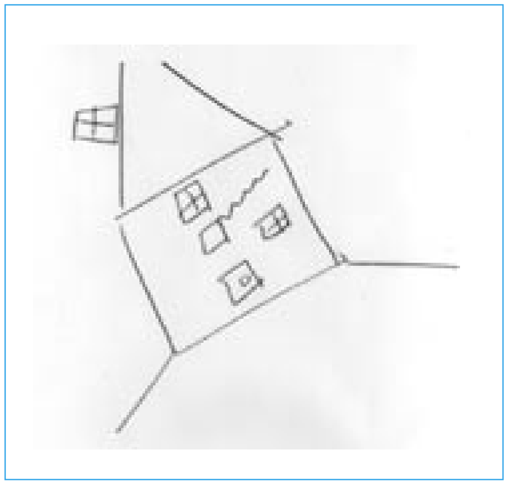
often lead to questions and further scientific investigations. The science teacher planned to use the drawings as a beginning to a lesson on flower dissections, identifying variations in structures (stamen, sepals, carpels, etc.) that perform a particular function for different flowers.

At the end of this final lesson in the series, the team members were excitedly throwing out ideas on how each content area could support the other. With so many thoughts "bubbling over," they decided to meet for a full day of curriculum planning to create an integrated unit around observation to be used in the middle school in the fall.

Once again, the power and resourcefulness of collective teachers, especially those who typically don't work together, shine through with this example. Bringing art and science together is just one way educators can learn from one another as they support and encourage their fellow teacher – and students as well. ■

**Student C**

**Student D**



(How do these drawings compare to what you drew?)

Wayne conducted a class discussion, asking groups what was alike in their drawings? What was different? He talked why the drawings were so different and the resounding answer was: "The directions were not clear!"

When asked how they might edit the directions, students' hands shot up in the air with lots of specific suggestions. Wayne distributed large whiteboards to each group of partner students and asked students to edit the original directions. He reminded the class that their edited directions would be given to another class to "test the procedure."

The following edits were made by one group:

Edit 1: "Draw an equilateral triangle in the middle of the paper. Draw a large square underneath the triangle, connecting the ends of the square to each end of the triangle. Draw two diagonal lines from the bottom of the square and angle the lines to the right. Draw three equal rectangles inside the top half of the square and one larger rectangle at the center of the bottom line of the square. Draw a rectangle on the side of the equilateral triangle. In the three equal rectangles draw intersecting lines. On the right side inside the large rectangle draw a small circle. Draw a squiggly line connected to the rectangle on the side of the equilateral triangle."

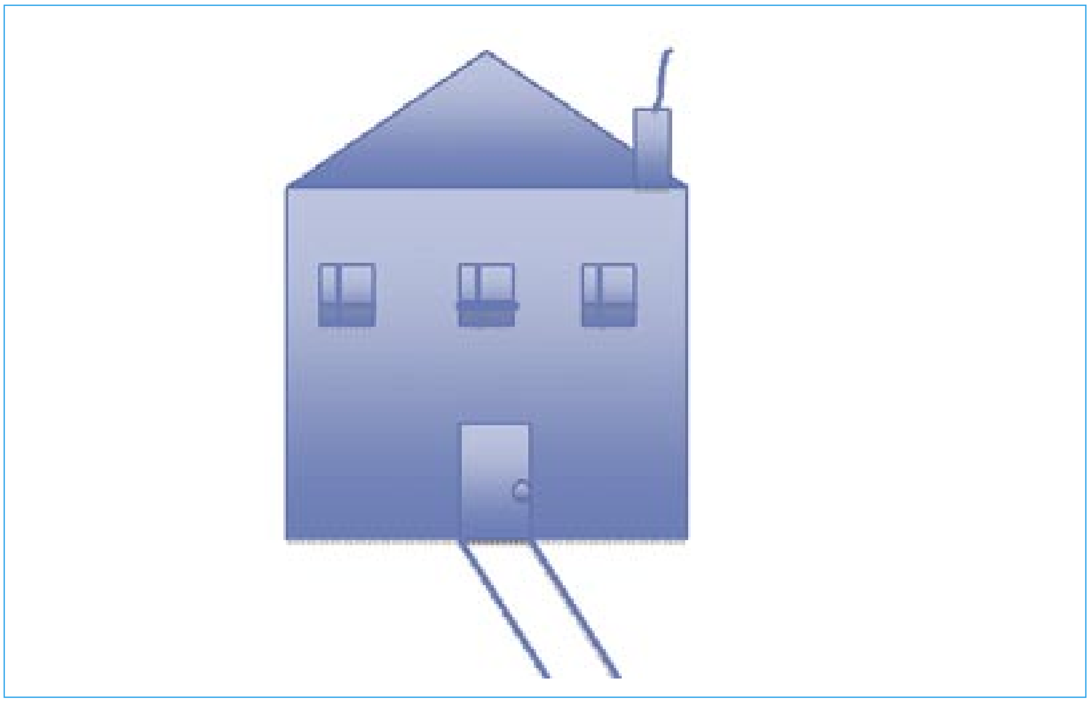
The edited directions were given to another class with the following results.

*SEE SCAFFOLDING, PAGE 11*

Wayne's initial class reviewed these student results and discussed which procedures where still confusing. They noted that the small rectangles, angled lines and the squiggly line were not positioned correctly. The following edits were added:

Edit 2: "Draw an equilateral triangle in the middle of the paper. Draw a large square underneath the triangle, connecting the ends of the square to each end of the triangle. Draw two diagonal lines from the bottom center of the square and angle the lines to the right. Draw three equal rectangles spaced evenly inside the top half of the square. Draw one larger rectangle at the center of the bottom line of the square so that bottom ends of the rectangle touch the two diagonal lines. Draw a rectangle on the side of the equilateral triangle. In the three equal rectangles draw two intersecting lines closer to the left side of the rectangle and the bottom side of the rectangle. On the right side inside the large rectangle draw a small circle. Draw a squiggly line connected to the top of the rectangle on the side of the equilateral triangle."

This time, the student work looked more like the original drawing:



Wayne decided this introduction to the challenges in procedural writing provided a way for students to talk about the need for clear directions that could be understood by the reader. In order for writing to be clear and precise, it needs to include: exact consistent language for naming items, words to show positions in relationship to shapes, and quantifying words that convey size and placement of objects.

Once students recognized the importance of procedural writing, Wayne wanted to move them toward independence in this skill. His next instructional step was to remove the teacher-directed scaffold by asking students, working in small groups or with partners, to write an original procedure. He challenged students to develop a procedure for an experiment to determine the "bouncibility" of balls. All students in the class were given the same challenge; this way, each group could effectively edit other groups' work.

First, students made preliminary observations using different balls and checking how they bounce. Then partners wrote a procedure on large whiteboards. Groups traded their white boards and new groups were asked to comment on the procedure by asking clarifying questions. Discussions about a "fair test" included how many trials might be needed, keeping measurements and maintaining a consistent height.

One group wrote the following procedure:

1. Select five balls.
2. Drop the balls at least three times.
3. Write the data on a chart.

SEE SCAFFOLDING, PAGE 12

***SCAFFOLDING (CONTINUED FROM PAGE 11)***

When another group edited the directions, the group added clarifying questions about the procedure:

1. Select five balls. Are they all different?
2. Drop the balls at least three times. What is the height of the drop? Are you dropping the balls next to a paper on the wall in order to record the exact height? Do you mean to repeat the procedure three times? Are you recording data each time?
3. Write the data on a chart. How will you record the data?

Partners got back their original boards, reviewed the clarifying questions and then edited their procedure. The revised procedure included the following:

Question: Which ball is the bounciest ball?

1. Select five different balls to test for bounciness.
2. Select an open area along a wall to test the bouncing distance.
3. Place a piece of tape on the wall showing the height to drop each ball.
4. Ask another student to stand where they can clearly see the bounce height to help record.
5. Drop a ball and record the height with a piece of tape on the wall. Repeat dropping the ball three times and place a piece of tape at the bouncing height.
6. Measure the three heights and record on the data table.
7. Average the three heights and record the average next to the other three recordings.
8. Continue dropping the rest of the balls using the same recording method.

A new group of students followed the procedure while the original group watched. The original group took notes on any problems in following the procedures. They noticed the ball bounced differently depending on who dropped the ball and how the ball was released. The group edited the procedure to include: using the same person to drop each ball; place the ball on a shelf and roll the ball off the shelf for each drop.

Happy with his students' progress toward student-directed procedural writing, Wayne wanted to "cement" the learning. He asked students to individually consider what worked and what didn't work in order to develop a set of criteria for writing effective procedures. He then conducted a discussion, which lead to a class criteria chart for quality procedural writing:

For high quality procedural writing make sure that:

1. Steps are in order
2. Materials are identified
3. Measuring tools are identified
4. Methods for "action" are clear
5. Recording methods, including number of trials are listed
6. Names of items/action are consistent

Wayne posted the criteria chart for students to use and suggested that edits to the chart could be made by student groups to continually clarify procedures.

Overall, Wayne gave his students one of the best lessons he could: he gave them the power to put their thinking to practical use, offering them the challenge of directing their own course of action instead of blindly following procedural steps in a book or from their teacher. Wayne's students left their classroom with a more profound appreciation for writing clear and precise procedures, a skill that they can – and will – use not just in their science studies, but throughout the many subjects they will encounter in their school days. And that is a lesson worth learning! ■