What's The Big Idea?

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IN THIS ISSUE...

Windows Into Student Thinking

Entries for Purpose Sense-Making Notebooks

(Editor's note: This article is second in a series on science and mathematics notebooks. In our first article, we discussed the importance of sense-making notebooks as a strategy to increase student understanding. Sense-making notebooks incorporate the three key findings from "How People Learn" (Bransford, 2000): accessing prior knowledge, building conceptual frameworks, and providing opportunities for metacognition. In this article, we discuss the role of the teacher in helping students construct sense making notebooks by addressing various types of student entries that scaffold thinking.)

Uncovering vs. Covering the Curriculum

As educators, we often have no knowledge of what students know until we administer a test, and by then, it can be too late to make a positive difference in learning. When we "tell" students the curriculum to stay on pacing guides and "get through" the information, we often miss student thinking. How can we uncover our students' prior knowledge, misconceptions or budding conceptions which, in turn, should guide us throughout our instruction?

Consider what a teacher might know about student thinking by uncovering the curriculum as seen in these three following examples:

- When third grade students were asked to describe what is in the day or night sky, they talked about celestial bodies like the sun, moon, stars, as well as clouds, birds and rain. Some mentioned planets and a few knew about the asteroid belt. When asked to describe what moves in the sky, they replied, "The sun; we on Earth stand still." Their "thinking" reflected their experiences – after all, the sun rises in the east, travels overhead and sets in the west.
- Seventh grade students were shown a pedigree of a rat family. Two black rats produced a black rat. Two white rats produced a white rat. These offspring were mated and produced a black rat. Students were then asked, "What types of offspring would a mating of these two black rats produce?" Answers included "Black because there are more of them;" "Black because it is stronger;" and "White because it was a different species."
- A group of fourth graders were investigating electromagnets. They experimented with the number of coils and the strength of the magnet. When asked to summarize their data, the typical response was: "It picked up more."

In each of these cases, teachers can effectively use sense-making notebooks to move students from their prior knowledge to a better understanding of the concepts – rotation and revolution; speciation and genetics; strength of an electromagnet. Notebooks could also help students learn how to make claims supported by evidence.

Overall, sense-making notebooks are windows into student thinking that enables teachers to design appropriate interventions. As Dave Hart, a participating fifth grade teacher in the *Palm Springs Math Opens Doors Project*, observed, "Teaching is about uncovering student thinking. Notebooks are vital in this process because the writing in the notebook reflect the student's thought process. Consequently, the teacher is able to adjust teaching based on the information in the notebook."

Selecting Entries Appropriate for Purpose

How does a teacher help students create sense-making notebooks? One vehicle for scaffolding student thinking is to recognize that different notebook entries require students to gather and interpret information in different ways. In a study funded by the National Science Foundation, Carolyn Landel and colleagues at Western Washington University analyzed samples of student work in science notebooks from all grade levels, demographic groups and geographic regions.

Eight distinct categories emerged, each with a distinct purpose. In Table 1, the eight entry types most frequently used by K-12 teachers are characterized in detail. The website (www.sciencenotebooks.org) illustrates each entry type with multiple samples of student work stored in a searchable online database.

In Table 1 you will see specific examples of these eight entry types; representative samples of student work are found on page 4. See how many of these entries strike a chord with you and your students.

NOTEBOOKS..., CONTINUED ON PAGE 2

Table 1: Science Notebook Entry Types (Landel, 2009)

Entry Type	Definition and Purpose
Drawings	**Definition** Student generated drawings of materials, scientific investigation set-up, observations or concepts. Three common types of drawings used in science notebooks include: 1. Sketches: Informal pictures of objects or concepts created with little detail. 2. Scientific Illustrations: Detailed, accurate, labeled drawings of observations or concepts. 3. Technical Drawings: A record of a product in such detail that someone could create the product from the drawings.
	Purpose Students use drawings to make their thinking and observations of concrete or abstract ideas visible. Drawings access diverse learning styles, allow entry to the writing process for special needs students and emergent writers and assist in vocabulary development (e.g. oral explanations, group discussions, labels).
Tables, Charts and Graphs	**Definition** Formats for recording and organizing data, results and observations.
	Purpose Students use tables and charts to organize information in a form that is easily read and understood. Recording data in these forms facilitates record keeping. Students use graphs to compare and analyze data, display patterns and trends, and synthesize information to communicate results.
Graphic Organizers	**Definition** Tools that illustrate connections among and between ideas, objects and information. Examples include, but are not limited to, Venn diagrams, "Box-and-T" charts and concept maps.
	Purpose Graphic organizers help students organize ideas to recognize and to communicate connections and relationships.
Notes and Practice Problems	**Definition** A record of ideas, observations or descriptions of information from multiple sources, including, but not limited to, direct instruction, hands-on experiences, videos, readings, research, demonstrations, solving equations, responding to guiding questions, and developing vocabulary.
	Purpose Students use notes and practice problems to construct meaning and practice skills for current use and future reference.
Reflective and Analytical Entries	**Definition** A record of a student's own thoughts and ideas, including, but not limited to, initial ideas, self-generated questions, reflections, data analysis, reactions, application of knowledge to new situations, and conclusions.
	Purpose Students use reflective and analytical entries to think about scientific content from their own perspective, make sense of data, ask questions about their ideas and learning processes, and clarify and revise their thinking.
Inserts	**Definition** Inserts are artifacts placed within a notebook, including, but not limited to, photographs, materials (e.g. flower petals, crystals, chromatography results) and supplemental readings (e.g. newspaper clippings).
	Purpose Students use inserts to document and to enrich their learning.
Investigation Formats	**Definition** Scaffolds to guide students through a controlled investigation, field investigation or design process. Examples include, but are not limited to, investigation planning sheets or science writing heuristics.
	Purpose Students use investigation formats to guide their thinking and writing while they design and conduct investigations. Students also use these formats to reflect on and discuss their findings and ideas.
Writing Frames	**Definition** Writing prompts used to focus a student's thinking. Examples include, but are not limited to, "I smelled…I felt…I observed…", "My results show…", "The variable I will change is…", or "I think that because…."
	Purpose Students use frames to organize their ideas, prompt their thinking, and structure their written response. Frames help students become more proficient in scientific writing and less reliant upon the prompts.

DIRECTOR'S COLUMN

Well, Duh!

BY KATHY DIRANNA

A new report from the Council of Chief State School Officers (CCSS0) funded by the National Science Foundation has documented what the K-12 Alliance has known and implemented for years: quality professional development positively impacts student learning.

The report, *Effects of Teacher Professional Development on Gains in Student Achievement: How Meta Analysis Provides Scientific Evidence Useful to Education Leaders*, cites three major factors in professional development (pd) that had positive impact in improving student achievement:

a. more time (average of 91 hours) spent in providing teachers with content-based teacher development
b. active methods of teacher learning
c. multiple follow-up activities over 6 months to a year conducted in the schools where the teachers work.

Active support from mentors and colleagues in the schools were also factors common to successful programs.

Well, no &#!^%$ Sherlock!

Our issues aren't about what makes quality science professional development. The K-12 Alliance has been a forerunner in offering premier pd for 24 years. We know what to do! No, our issue is a school/district's lack of time and focus to do it.

The CCSSO report comes at a time when English language arts and math are **still** the only focus in elementary schools; at a time when students who are below basic are pulled from science classes in middle and high school for extended time in ELA or math; at a time when our citizens are showing their scientific illiteracy in discussion about phenomena like global warning; and when the political leaders on both sides have problems making reasoned evidence-based decisions.

The call for quality professional development time also comes as schools struggle with budgets. Many districts chose furlough days rather than lose jobs. The first days to go? Yep, those pd days before school starts, a time when teachers should be reflecting on past practices and planning for new challenges. Instead, teachers are struggling with setting up classrooms for no pay.

We could just continue to accept this situation. Or we could stand united and say, "We're mad as hell and not going to take it any more."

While I appreciate the CCSSO report – we need all the citations we can get to support our work – I firmly believe that we – you and me – need to be stronger advocates for quality science professional development time.

We need to be vocal with our parents and help them understand what their children are missing when science is put aside. We need to be vocal with our colleagues and help them see how time for science is possible when it is integrated with reading, writing and ELD. We need to be vocal with our administrators so the few dollars we have for pd are spent in meaningful professional development which creates sustained learning communities for teachers and students.

I pledge to continue my advocacy. I hope you will join me. ■

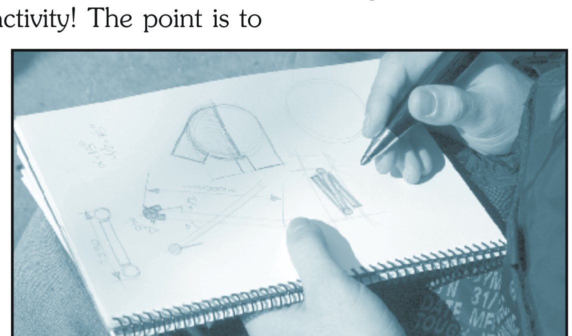
To review the CCSSO report, go to: www.ccsso.org/projects/improving_evaluation_of_professonal_development.

NOTEBOOKS..., CONTINUED FROM PAGE 1

Landel's work was with science notebooks, but a group of K-12 Alliance math staff developers who reviewed these science entries made alternative suggestions. For mathematic journals, they advised that Graphic Organizers, Inserts and Investigative Formats be replaced with Multiple Representations, Affective Mathematic Prompts and Proofs/Conjectures, respectively. Multiple representations are commonly used in mathematics in lieu of graphic organizers. Affective Mathematics Prompts are more appropriate in mathematics than Inserts and address student phobias about learning mathematics. Proofs/Conjectures are Mathematical Processes with conventions similar to investigative formats in science.

Selecting Entry Types: Getting Started

There are many questions that come to mind when considering which strategies are appropriate for learning. One good rule to follow: You don't need every type of entry in every activity! The point is to be selective.



Determine the learning goals for the experience. For example, if the goal is to build students' understanding of cause and effect, the use of charts, graphs and summary statements encourages students to make the cause and effect connections. If the goal is to increase the students' observation skills and focus on detail, then have them draw labeled illustrations, not sketches. If the goal is to have students generalize, then entry types should reflect the individual pieces that have to be "summed" for the concept.

In our beginning genetic scenario involving black and white rats, a teacher would work with many genetic crosses will help students "see" the law of segregation and understand the predictable patterns of dominant and recessive genes.

Reflective entries can be powerful because teachers can use students' thinking to determine the extent to which learning goals have been met and determine how best to intervene. The following list of writing frames will elicit responses about confidence and competence in mathematics and/or science:

- I am sure about ______________
- I am not sure about_____________
- Explain everything you know about__________
- What questions are still answered about_______
- I need more help understanding_____________
- What patterns do you notice in______________
- The most important part of solving a problem is_________
- I knew I was right when______________
- Tips I would give a friend to solve this problem are_____________
- What could you do differently to answer this question?

Another reflective strategy uses a signal light as a metaphor. Students draw a red, yellow or green circle next to their work: A red circle means, "I am confused and need help." A yellow circle indicates, "I may be correct, but need some help." Finally, a green circle communicates, "I am sure about my work.

It's time for you to reflect on your practice. Examine Table 1 carefully and check out the sample entries on page 4. Which entries do you use? When do you use them? How can you use them? How can you use them more effectively? Which new entries would you use? Why? ■

In our next article in the series, we address the analysis of student work in science notebooks and math journals.

K-12 Alliance
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K–12 ALLIANCE CONTACTS:

Kathy DiRanna—*Statewide Director*
(714) 438-3802 **kdirann@wested.org**
or your local Regional Director

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

REGIONAL DIRECTORS AND SERVICE AREAS:
Gloria Banuelos (650) 924-0709 gbanuel@wested.org
San Diego Area

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)

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)

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FOR FURTHER INFORMATION, CONTACT:
What's The Big Idea?/K-12 Alliance
2720 South Harbor Boulevard, #A
Santa Ana, CA 92704-5822
(714) 438-3802 or 3803 (telephone)
(714) 438-3808 (fax)

Editor: Brenda Rees
Layout: Wolfe Design Marketing

LEADERSHIP

Life Lessons – with Dancing, Too!

BY SHANNON MALONE

My career path has certainly taken some interesting twists and turns, starting at my early days as a math major at USC volunteering at a local high school, to six years teaching at schools in the Pasadena Unified School District (PUSD).

But it wasn't until I became the Curriculum Resource Teacher and Language Development Resource Teacher at Hamilton Elementary that I realized where my true passion was: coaching other teachers. I was very excited to work with the teachers, helping them set goals, following through and seeing them succeed.

When I was assigned in the fifth grade classrooms, my team teachers and I decided to departmentalize and I taught math for all fifth grade students. Then I had the opportunity to become a math coach. This was very intriguing!

This new Math Coach position – with the Pasadena Math Pipeline, funded by the California Mathematics and Science Partnership (CaMSP) – beckoned with two enticing reasons: teaching math and collaborating with my peers. While I was hesitant to leave the family atmosphere of Hamilton Elementary, I decided this would be a good chance to expand my leadership skills.

Being a math coach was a wonderful experience. Going to different schools really gave me larger perspective of education and I began to see the need for better professional development within our district. I enjoyed facilitating workshops, leading TLCs and working with students in various classrooms. I believe students receive some of the best lessons when we work together.

Collaboration, another need within our district, wasn't an easy sell to all teachers. But as they observed the increased level of student engagement within their classrooms, the teachers looked forward to the coaching sessions and TLCs.

At the institutes, we practiced being flexible, spontaneous, collaborative and caring all at the same time.

The institutes taught me how to be a good coach and I learn how to listen to people and work together to provide appropriate and relevant professional development. The K- 12 Alliance provides this awesomely safe place to take risks and discover new ways to contribute to the goal of providing better support to our teachers and, therefore, better instruction for our students.

Today, I continue to use the skills I learned with the K- 12 Alliance to good use. For example, this summer, I put together my own "Summer Institute" that focused on math (of course) and writing. Trainers worked on student engagement and differentiation strategies.

Remembering the element of fun from K-12 Alliance Summer Institutes, I scheduled a few opportunities for lunchtime workouts for the teachers. We did line dances like the Macarena (sound familiar?) and the Cha-Cha Slide. It was a great bonding experience that added a special touch to the institute. With the support of the math coaches and other district trainers, the teachers of PUSD participated in more 8,000 hours of professional development this past summer.

And this is just the beginning! Thank you K-12 Alliance for leading the way! Thanks for getting us up and dancing!

Shannon Malone is the Coordinator of Professional Development for the Pasadena Unified School District (PUSD).

TEACHING & LEARNING

Found Poem

BY MELISSA SMITH

Through the centuries, scientists have kept notebooks of their investigations to record their processes and how their ideas are developing over time. These ideas often came from experimentation as well as reading what other scientists were thinking about the subject. Scientists synthesize findings from various sources to make or confirm discoveries as well as conjecture about new ideas.

Our goal as teachers is to help students develop similar "habits of mind" that embrace analysis, synthesis and evaluation. One way to do that is to provide opportunities for students in their notebooks to make sense of information from an experiment as well as from a reading.

Rather than simply have your students record notes from a reading, try a strategy that makes the students interact with the text to build meaning. The "Found Poem" technique encourages readers to return to any text to perform a literary task. Teachers who use this method can add more illuminating literacy moments into their science classrooms.

Suggested Procedure:

1. Ask students to return to a specific text to select words and phrases that interest them and/or meet criteria provided by the teacher.
2. Readers scan a chapter/book looking for a paragraph or two that interests them.
3. Readers carefully re-read the interesting section and select the words or phrases that they think are important.
4. Readers put the words of phrases into a poem format and decide on a title which refers to the source.
5. Ask students to share their found poems in groups or with the whole class. Listeners give feedback and ask questions about the reasons for selecting the words or phrases in their poem.
6. The teacher can review the found poem by asking: Do the poems match the original meaning of the text? Do they add impact? Do the selected phrases show understanding or misunderstanding?
7. An extension of a found poem technique: the teacher reads one line of the poem at a time and the class writes a response to each line. Then, the student's original lines are inserted with the "real" lines from the poem. Share the end result.

Here's an example of text and a poem created from the given text:

***Earth in the Balance* by Al Gore**

But the most significant change thus far in the Earth's atmosphere is the one that began with the Industrial Revolution early in the last century and has picked up speed ever since. Industry meant coal, and later oil, and we began to burn lots of it – bringing rising level of carbon dioxide with is ability to trap more heat in the atmosphere and slowly warm the earth. Fewer than a hundred yards from the South Pole, upwind from the ski runway where the ski plan lands and keeps its engines running to prevent the metal parts from freeze-locking together, scientists monitor the air several times every day to chart the course of that inexorable change. During my visit, I watched one scientists draw the results of that day's measurements, pushing the end of a steep line still higher on the graph. He told me how easy it is – there at the end of the Earth – to see this enormous change in the global atmosphere is sill picking up seed.

FOUND POEM, CONTINUED ON PAGE 4

COLLABORATION

The Math and Science Connection

BY DAVID HARRIS

Thematic units were once a popular means of instruction in elementary and middle school. Teachers wove together topics from social studies, mathematics, science and language arts and wrapped them around an engaging "theme" for the month, semester or even year: the rain forest, the ocean, etc.

Then the standards movement arrived making us to think about a K-12 articulated continuum of content, pulling apart each content area into its own content strand and unraveling integrated content units.

The problem with dissolving integrated curriculum is that we present content as discrete, separate ideas when in reality ideas often overlap between subjects. Teaching ideas in isolation does a disservice to students. Concepts and strategies overlap classes and allow students to make connections that create bigger and broader understandings For example, science and math have an obvious overlap combination, since much of the study of science requires math (algebra/measurement/data analysis) to describe observed patterns and make further predictions.

Integration is not easy in any setting because it requires collaboration between teachers. This is especially true in middle and high school, where different teachers teach different subjects.

When I was in the classroom as a math teacher, I recall having discussions with science teachers who thought students should learn math concepts (i.e., graphing, manipulating equations, measurement, conversions, etc.) in math class. The science teachers who also taught graphing asked why students did not understand this concept from their math class.

Through many discussions the science and math teachers realized our overlapping subjects inherently go hand-in-hand. We then needed to decide how best to introduce certain concepts to the students; would it be in a math or science class?

We discovered that often concepts are best introduced in science first because it provides a real context for problems. Here is real data, real situations with concrete applications. Students don't have to ask (as they often do in math class), "When will we ever use this math concept?"

Working in this collaborative fashion, I see that when science lessons incorporate math concepts, students realize that applied mathematics is messy and often contains uncertainty, acceptable errors and different levels of precision. Pure mathematics is elegant in its solutions and certainty, but math is so very useful beyond the theoretical.

Math concepts help students explain and/or predict messier things in the world. Informed by data on a scatterplot, a line of best fit suggests a linear relationship or trend. A linear graph exactly depicts a functional relationship. Here is math at its finest.

Putting science and math together helps students see how an understanding of math can clarify the science; likewise, science shows how powerful math is as a descriptive tool. Students learn that math patterns can be recognized as scientific data.

In the end, we have our own content specific standards, our separate textbooks and our classes either called math or science, but students who visit both classes every day, discover different parts of the same story.

If you teach both subjects, start thinking about how integration can increase understanding in your class. If you teach only one subject, go down the hallway and knock on someone's door and start a conversation. You never know what part of YOUR story they are already teaching.

David Harris is a district math coach for Escondido Elementary School District and a K-12 Alliance Regional Director.

Fanning the Flames

BY BRENDA REES

A few weeks ago, my 10-year-old daughter Kate decided to build a seismometer using a cereal box, straws and string. It's quite a little marvel.

But this isn't the only science project: she loves to imagine fantastic human-powered machines, contraptions that glide through the air, on water, snow and sand. Through these drawings, she is playing with physical and mechanical concepts which come from her love of observing the natural world around her.

To this end, yes, I could credit both my husband and I for talking science with her freely. "They have found a new element!" we joyously told her when superheavy element 114 was recently recreated at Lawrence Berkeley National Laboratory. Kate stayed up with us at night to watch on TV as NASA's Deep Impact mission collided with a Comet Temple 1. She went on fossil hunting adventures with paleontologists from the Natural History Museum. She's profoundly keen on asking questions, thinking and musing over what she's discovered or read or seen.

FAMILY TIES — Families, like Brenda Rees (left) with daughter Katie and husband Jim, depend on the work of the K-12 Alliance.

But I know we aren't the end makers in her science education. To keep that fire going, I depend on her teachers to fan those flames. I count on her school to encourage thinking that is creative, open and challenging.

I've been editing this K-12 professional development newsletter for a whopping 10 years, a decade of taking a peek "behind the scenes" of what goes on for math and science teachers in our state. I knew teachers had tough jobs, but this newsletter experience has taught me that teachers give so much more than those seven hours they have with our kids in their classrooms.

I am happy to hear stories of so many teachers who are fanning the flames of learning for their students – but I'm equally thrilled to see that something else is keeping the spark alive for these teachers who often get caught in isolated ruts, doing the same motions, day-in and day-out.

That something else is the K-12 Alliance. It's you! All of you who participate, lead workshops, attend meetings, advocate for better systems, all of you who want to create energetic environments so that students and teachers can feel the excitement of discovery, each and every day.

I am honored to work with all of you, teachers, administrators and facilitators who truly want to do good with their job – good for their students, good for their own psyches. Teachers aren't automatons, blindly feeding dusty concepts to a conveyor belt string of pupils. They want to feel alive teaching their subjects; they want to recapture their own childhood joy about the workings of the world around them and pass their enthusiasm to their students.

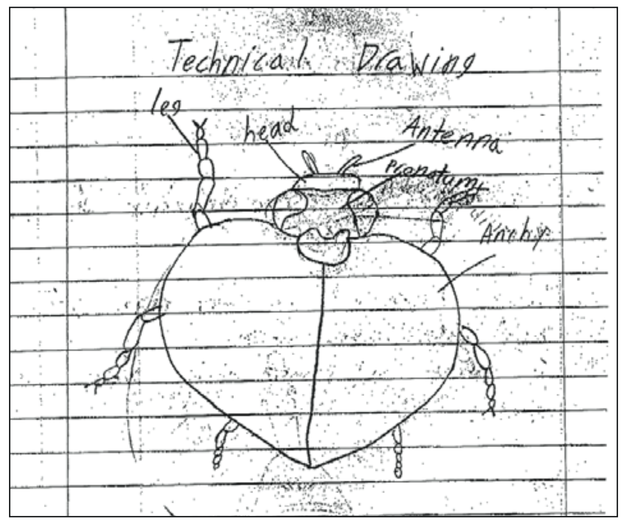
And when teachers have that much excitement bubbling up inside, it's just bound to spill onto everyone around them – and that's what we parents want and appreciate. Teachers full of life!

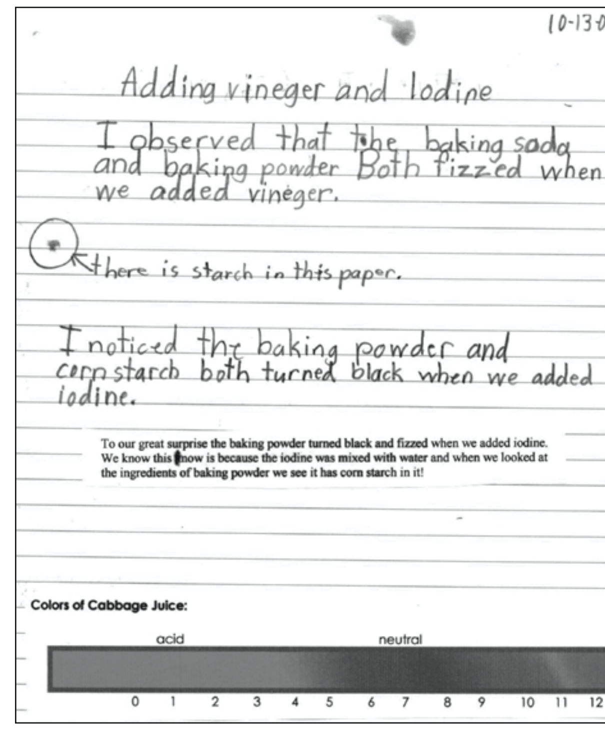
Thank you K-12 Alliance for keeping our teachers alive, making them feel worthy, competent, important and vital. Thank you for fighting for them, educating them and connecting them. You are a parents' best friend and we couldn't raise our kids without you!

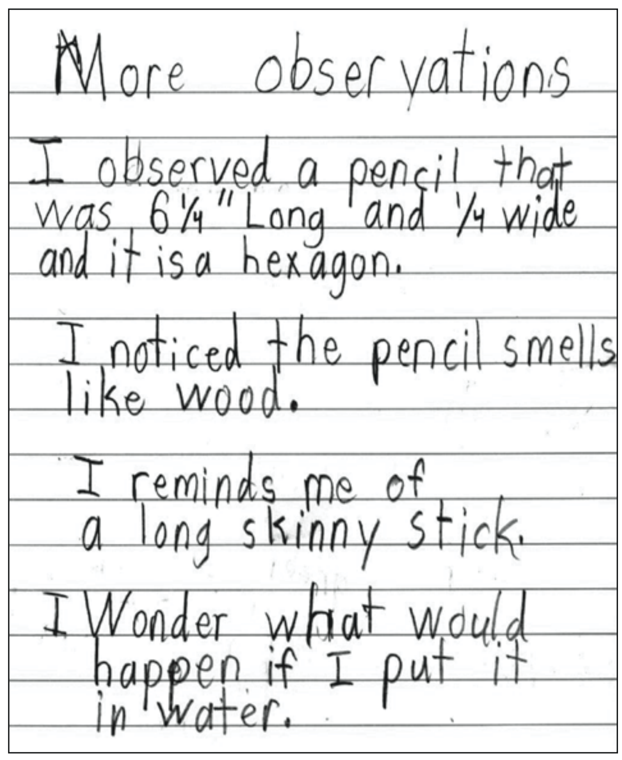
Brenda Rees is the editor of "What's the Big Idea?" and lives in Los Angeles.

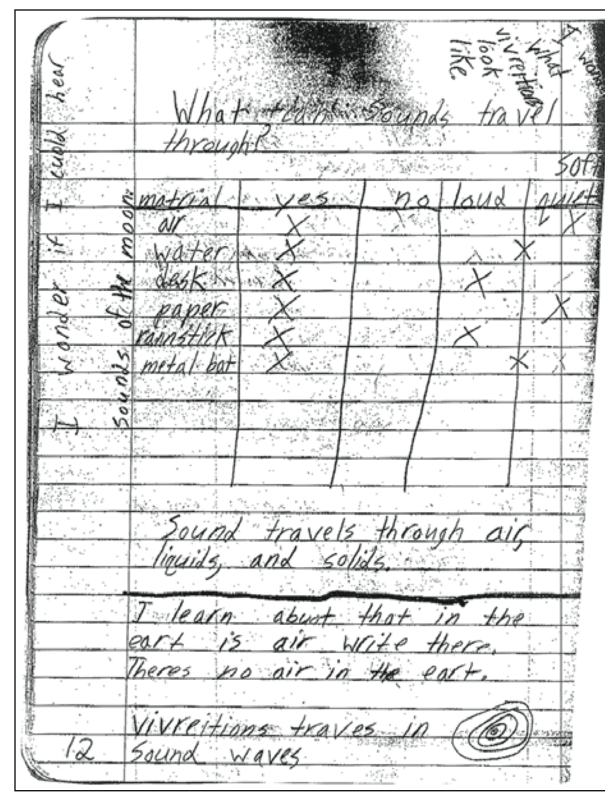
Being in K-12 Alliance is like running a marathon in the fog because the sideline crowds cheer you on, encouraging you to keep on going and going, and going...

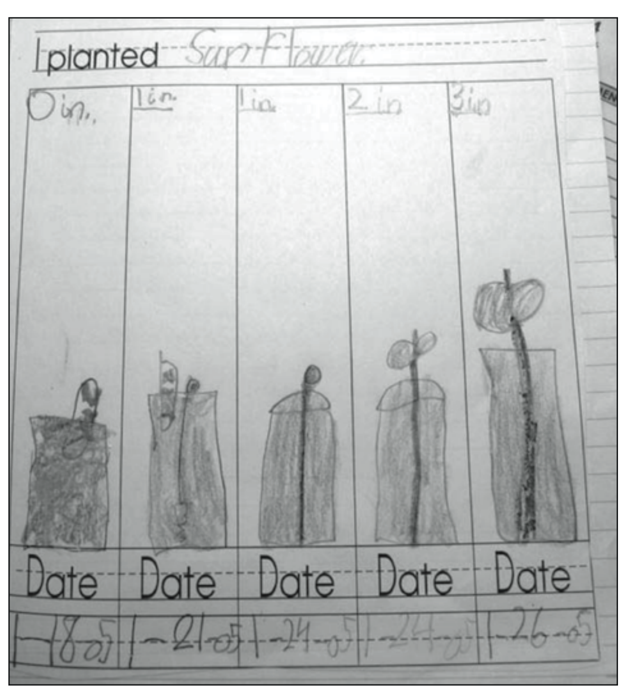
Student Notebook Entries

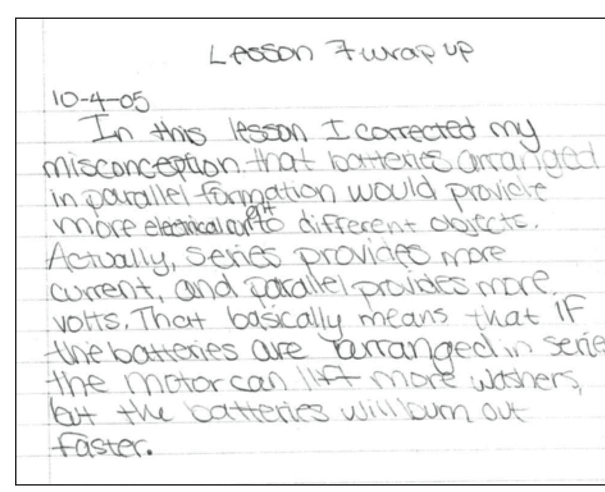












FOUND POEM, CONTINUED FROM PAGE 3

The resulting finished poem:

Global Warming
Began with the Industrial Revolution
Coal and later oil
We began to burn lots of it
Rising levels of carbon dioxide
Trap more heat
Slowly warm the earth
Scientists monitor the air
Draw the results of that day's measurements
Enormous change in the global atmosphere

Using the "Found Poem" strategy in notebooks, students have the opportunity to read content for deeper meaning; teachers can also chart how students are growing in their thinking.

"Found Poem" can effectively make science notebooks come alive.

Check it out!

The K-12 Alliance has just unveiled its new and improved website that includes information to the general public as well as a forum for Alliance members to share ideas, discuss topics and register for events.

Log on a www.k12alliance.org and see what you can learn today!