What's The Big Idea?

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A Good Question Is Worth a Thousand Thoughts

"Good questioning requires skill and planning."
— EdThoughts, Aimee Kruger and John Sutton, 2001)

(Editor's note: For the past several years, the K-12 Alliance has used a theme approach to the lead articles. In keeping with this big idea -- and in celebration of its 20th year of existence -- this year's lead articles will focus on two elements that the K-12 Alliance has continued to emphasize: quality teaching and learning as well as advocacy.

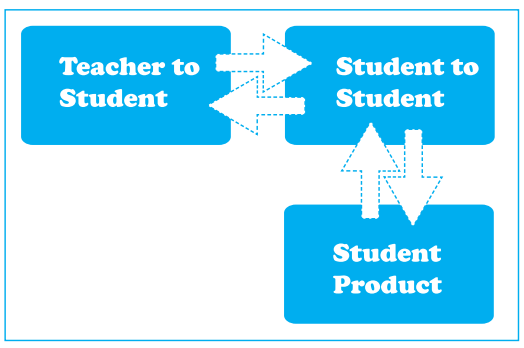
The former will be addressed in this issues and continued in the March and May issue. The latter will be addressed in the January issue as we preview the AIM process for selecting instructional materials so that districts can make informed adoption decisions.)

Quality teaching and learning includes the art and skill of questioning. "Huh?" you say, "Haven't we been here before? This is just old stuff."

On contraire! Questions are the basic blocks of good teaching and learning. Without them, nothing would be explored and we'd all be in the dark; with them, the world – and our classrooms -- are a more impressive and dynamic place.

We as teachers must recognize that when we improve the quality of our questions to students, we are not only prompting deeper thought, but we are encouraging student discourse.

Of course, both goals hold students accountable with products (e.g., notebook, whiteboards) that can clearly demonstrate their understanding.



In this article we examine the role of questioning between the teacher and the student. Teachers use a variety of questions within their day-to-day classroom activities including low-level yes/no questions, simple recall questions, rhetorical questions and leading questions (you know…when querying students for a word and giving the hint "starts with"…). These types of questions make minimal demands on student thinking.

Our goal is to decrease these interchanges and "get better" at asking and probing for student understanding. We have found that probing deeper for student understanding is a challenge for both novice and experienced teachers.

How does the teacher really know, based on a student response, when conceptual understanding is evident? When do student responses seem to show understanding but probing reveals misconceptions? Where and when does the teacher make a decision to ask follow-on probing questions? What type of question will be the most effective for the purpose?

Our classrooms need to be places where teacher questioning is purposeful and meaningful; this requires a shift in thinking as noted in Fig. 1

Google "questions" and you will find a plethora of articles that are overwhelming and daunting. Yet, there is a theme running through many of the articles: changes in teacher questioning practice are rare. For example, Walsh and Stattes (2005) indicate that research conducted for more than 100 years about teachers' use of questioning strategies show that very little has changed in classroom practice.

Yet, we know that questions promote student learning and that teachers should plan their questions before asking them to ensure that questions match the teacher's learning goals. These questions should require students to engaging in higher-level thinking. A few carefully prepared or selected questions are preferable to large number of questions. (Walsh & Stattes, 2005 p. 12).

Here are two strategies that we have found effective in increasing the quality of teacher questions and student understanding. The first addresses the level of question the teacher asks. The second has to do with the follow-on question to understand student thinking.

Question levels

Level of questions refers to the type of "brain engagement" the student does. An input question asking a simple fact (e.g., how many bones are there in the human body?) requires little engagement. The student either knows or does not know the answer.

A process question that asks student to compare and contrast (e.g., compare the pelvic structure of a bipedal and quadrapedal animal) engages the student's brain in seeking patterns between and among their facts/concepts.

An output question that asks students to apply their understanding in a new situation -- or to synthesize and evaluate their knowledge -- stretches their conceptual framework.

The key for teachers moving between and among input, process and output questions is linked to the questions' purpose in guiding student thinking. Input questions that focus students on attention to detail in an observation can provide the basis for linking a small fact to a larger concept.

Using all three levels of questions – input, process and output - support findings from How People Learn (Bransford et al., 1999) that describe an "expert" as one who:

(a) has a deep foundation of factual knowledge,
(b) understands facts and ideas in the context of a conceptual framework, and
(c) organizes knowledge in ways that facilitate retrieval and application.

Teachers should help students become familiar with the different levels of thinking and help them be aware of the kind of thinking required by the question (Walsh & Stattes, 2005 p. 13).

IN THIS ISSUE...

One way to accomplish this is to be overt about your questioning levels. The chart on page 4 (Chart 2) list verbs for questions that help categorize the level of question being asked. Many K-12 Alliance teachers have enlarged this chart and posted in their room as a reminder for them and their students of the level of thinking being asked for and used in the discussion.

Quality Teacher Questions	
Rapid fire teacher questions	Thoughtful questions that are linked to push student thinking
Questions directed to the whole class, with few students responding	Questions directed to student partners or small groups
Questions that ask students to state small pieces of knowledge unrelated to the larger context.	Questions that require connections between and among concepts
Questions that ask students to state small pieces of knowledge unrelated to the larger context.	Questions that ask how students know
Questions with quick answers	Questions with wait time for student thinking
Questions limited to current understanding	Questions that extend understanding to a new context
Plan activities in a lesson	Plan questions in the activities based on expected and unexpected student responses

Figure 1

Follow on questions

While you might think that asking a good question is the ticket to push student thinking, we know that student answers often reveal only partial understanding. Frequently the student reveals partial understanding and only shows the misconception on probing (see Fig.1) of a concept. Students often give responses that indicate an appearance of understanding, but on our reflection, we are left wondering, "How exactly are they thinking about the topic?"

The bottom line is that in order to understand student thinking, you have to ask more quality questions that continue with the student's line of reasoning, pushing and probing for underlying assumptions, alternate conceptions and partial understanding. We call these

A GOOD QUESTION... CONTINUED ON PAGE 2

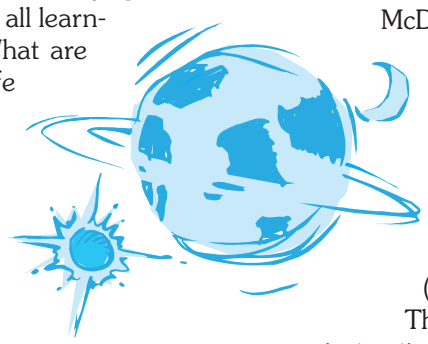
Thank Goodness the Earth is Round!

The Earth is round!

The lesson of that concept is that by staying the course you eventually get back to where you started.

For years, we have supported student-centered science programs. Twenty years ago, state policies aligned with this view, but then about ten years ago, those policies -- in its demand for rigor -- seemed to forget the center of education: the students.

Some necessary questions were being neglected. Questions like: What is developmentally appropriate? How do we engage all learners in meaningful content? What are the big ideas we want for life long learning? The problem was exacerbated in 2001 by the limited choices of instructional materials from which districts could select for their K-8 science programs.



Finally there is a crack, a shimmer of light in 2007. More than likely, districts will be able to select instructional materials aligned to the type of science program they deem best for their students.

Through hard work on the part of organizations like the K-12 Alliance and CSTA, that helped to alter criteria (remember the "at least 20-25 percent" hands-on issue?) and that monitored the adoption process (from selection of panel members to reviewing all the materials), things are finally changing.

At its September meeting, the Curriculum Commission approved the Instructional Materials Advisory Panel (IMAP) and the Content Review Panel (CRP) recommendations for instructional materials adoption. These recommendations will go to the State Board of Education in November and are expected to pass.

Districts will be able to select from the 11 programs noted below:

K-5/K-6:

Delta Education:
Full Option Science System (FOSS) (K-5)

Harcourt School Publishers:
California Science (K-6)

Houghton Mifflin:
Houghton Mifflin California Science 2007 (K-6)

Macmillan/McGraw-Hill:
Macmillan/McGraw-Hill California Science (K-6)

Pearson Scott Foresman:
Scott Foresman California Science (K-6)

6-8

CPO Science: Focus on Earth Science (6), Life Science (7), Physical Science (8)

Glencoe: Glencoe Science Focus On Series (6,7,8)

Holt, Rinehart & Winston:
Holt California Science: Earth Science (6), Life Science (7), Physical Science (8)

It's About Time: Investigating Earth Systems (6); Inter-Actions in Physical Science (8)

McDougal Littell:
McDougal Littell California Middle School Science Series: Focus on Earth Sciences (6), Life Sciences (7), Physical Sciences (8)

Pearson Prentice Hall:
Prentice Hall California Science Explorer: Focus on Earth Science (6), Life, Science (7), Physical Science (8)

These 11 programs offer a wide variety of instructional design. They range from those that use scientific inquiry as a foundational piece for student understanding, to those that include activities for student experiences, to those that depend on confirming activities for student learning. Districts can openly support the type of science learning they want to endorse.

So what should a district do? How can you help? There are several actions to take:

1. Volunteer to be on the district's selection committee.
2. Encourage your K-12 Alliance colleagues to volunteer also.
3. Insist that your district use a selection process that reveals the quality of the materials. Those recommended by the state met criteria, but they were not reviewed for how well they met the criteria!
4. Forget the glitz. Instead, look carefully at the work students will be doing. Is it conceptual? Does it address student thinking and misconceptions? Do activities build for student understanding? Do readings support understanding? Do experiences encourage student to student interaction?
5. Read the next issue of What's The Big Idea? for our preview of the AIM process for reviewing and selecting instructional materials.
6. Go slow to go fast. Whatever the district adopts will be with you for seven years! Select wisely.

For now, celebrate the round Earth. Celebrate returning to our roots. Celebrate the fact that groups of dedicated people can make a difference in the lives of their students and in the lives of students across our state. Celebrate your dedication to increasing student understanding!

K–12 ALLIANCE CONTACTS:

Kathy DiRanna—*Statewide Director*
(714) 438-3806 kdirann@wested.org
or your local Regional Director

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

REGIONAL DIRECTORS & SERVICE AREAS:
Jody Skidmore (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)

FAR NORTH HUB COORDINATORS
Michael Harris (530) 894-8225 mharris@cusd.chico.k12.ca.us
Kathy Jones (530) 891-6818 kjones@cusd.chico.k12.ca.us

Diane Carnahan (209) 468-9164 dcarnah@wested.org
North and South Bay (Lake, Marin, Mendocino, Monterey, Napa, San Benito, San Francisco, San Mateo, Santa Clara, Santa Cruz, Solano, Sonoma)
North Central Valley (Alameda, Amador, Calaveras, Contra Costa, San Joaquin, Stanislaus, Tuolumne

Rita Starnes (559) 332-2123 rstarne@wested.org
Central California (Fresno, Kern, Kings, Madera, Mariposa, Merced, San Luis Obispo, Santa Barbara, Tulare, Ventura)

Jo Topps (562) 597-8523 jtopps@wested.org
Greater Los Angeles (Los Angeles and Northern Orange)

Karen Cerwin (909) 337-9131 kcerwin@wested.org
RIMS (Inyo, Mono, Riverside, San Bernardino)

RIMS HUB COORDINATORS
Ann Pickett (909) 862-4210 iap12856@aol.com
Regina Van Wey (760) 251-1015 dreamingoffishing2@hotmail.com

Marisa Ramirez (619) 307-0024 mramire2@mail.sandi.net
Kathryn Schulz (619) 725-7325 kschulz1@mail.sandi.net
San Diego City Schools

A GOOD QUESTION... CONTINUED FROM PAGE 1

types of questions "follow on" because they follow the student's lead.

Follow on questions probe for student thinking. Probing can be used to help students:

- Clarify: to make something clearer by explaining it in greater detail; paraphrase, make more accurate
- Redirect: to focus attention on another aspect of the phenomena
- Summarize: to state the main ideas; synthesize to a bigger idea
- Extend: to apply to a new situation
- Reflect: to think about; active persistent and careful consideration

The teacher selects the question based on what needs to be "uncovered" in the students' thinking. For example, if the teacher is unclear about what a student is saying, clarification might be the best type of question to use; if the teacher wants to know how a student is in putting several ideas together, then summarizing might be the best type of question.

The following transcript shows the power of using follow-on questions to help students articulate their thinking and make powerful connection.

Dialogue With Quality Questioning

In a fourth grade classroom, students had been exploring with batteries, bulbs and wires and discussing how and why a complete circuit works. The teacher posed the question "Why did the light bulb light?" to pairs of students as he observed them working, The teacher wanted to see if the students had a conceptual understanding of what a complete circuit includes and how it enables a light bulb to light.

Teacher (T): Why did the light bulb light?

Student 1 (S1): Because it is a complete circuit.

T: (clarify) Explain what you mean by complete circuit.

S1: It is when electricity goes in a circle.

T: (reflect) Does it have to be a circle? Could it be another shape?

A GOOD QUESTION... CONTINUED ON PAGE 4

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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

Recollections From A Rambler

BY SCOTT HAYS

(Editor's note: Scott Hays and the then Helen Huey (now Helen Hays) were original members of the California Science Implementation Network (CSIN). Here, Scott reminisces on the strengths of the program for developing leadership.)

The new California Classroom Science just landed in our mailbox. After reading carefully what all the (particularly) new officers had to say in their columns (and thinking that, yes, things might still be OK), I opened up the inserts.

Ahhh…20 (!) years of CSIN/K-12.

My goodness.

AT THE BEGINNING– Helen and Scott Hays were original members of the California Science Implentation Network (CSIN). Scott is currently "retired" in Oregon but continues to work by by volunteering as an Art Literacy Coordinator at Hazeldale Elementary, his granddaughter's school.

The photographs stirred some deep memories (and not just the two at the top… though those were especially provocative) and inspired me to contact you. This is not an edited piece (but then, which bits of my work ever are?), but mostly a stream of consciousness. The first thing that came was a series of images:

Woofies, sidewalks around the apartments, Jim Knerl typing Footnotes and me drawing a lot of little "feat" around the margins …

… still in the apartments, and a little black and white border collie puppy that chewed up Deborah Miner's underwear every time she left them laying around. Helping Helen figure out how to deal with the problem -- the first of many problems I have been blessed to help Helen with …

Was it a Travel Lodge or Holiday Inn in Burlingame where we at up all night rejecting all the double-entendres for a name for ourselves? I can see the building and remember the walk to Kinkades, a place that we took the CSTA Board for dinner one night and where we still visit whenever we are near the airport.

The same place (and maybe the same meeting?) where we learned about "Thematic Instruction" and "Thematic Units" and – typical of the time – extended it to mean something much more connected than the cutesy-wutesy topics that it really represented:

… like doodling a possible set of thematic connections in the form of a Jeopardy TV screen;

… or taking the idea that all learning takes place in the form of stories, and trying to figure out how to create a storyline;

… singing homage to San Juan Batista with an ex-nun; … being married by science-teaching minister… and dumping the waste from a spittoon all over myself; skits… and jokes… and wine… and roller coasters… and lots of dorm rooms.

But mostly, I remember the commitment of staying up late every night with other deeply committed

RECOLECTIONS OF A RAMBLER CONTINUED ON PAGE 4

TEACHING & LEARNING

Hearing voices

BY DORIS WATERS.

February, 2006 was the beginning of the new spring semester at the local community college. I was scheduled to teach two evening classes -- office procedures and proofreading -- in the same classroom.

The first session went the way of most first classes– I greeted students and tried to take a mental picture of each and connect that picture to a name, laid out the class syllabus, and realized that for three-and-a-half hours, I was the only one who had talked.

I fretted and puzzled over that last thought for the entire next week, and just before I raced out of the K-12 Alliance office (10 minutes later than I should have in order to get to the school on time) I ran out to the warehouse and grabbed a stack of whiteboards, a few markers and four erasers. If the K-12 Alliance teachers used them with success, then so should I.

I had no clear idea however of what I was going to do with these items, but I was going to do something to get those students to open up! I didn't want to spend one more class session hearing only the sound of my own voice.

I stumbled into the classroom dragging behind me a rolling-cart full of books topped with an unstable stack of whiteboards. The students tried unsuccessfully to stifle giggles and hurriedly came to my rescue when the whiteboards were departing their precarious perch as the rolling-cart wheels caught on the step into the classroom.

Once attendance was taken, I asked the students to form groups of four then gave each group a whiteboard, markers and an eraser.

Five questions were presented (all having to do with what the students wanted and expected from the class) along with instructions to select someone to write each answer on the whiteboard (but only after each person in the group had contributed to the answer), and to choose someone to report the responses.

Nineteen pairs of eyes gave me a collective blank stare. Before I could offer any further instruction, someone yelled, "I got it!" Slowly, a conversation started in one group. Then the next group began a dialog. Soon, each group was *communicating with each other!*

Without any prodding from me, the *groups* began to interact. After 15 minutes, I asked if the groups were ready to report — they weren't. After an additional 15 minutes and a frenzy of writing, the din began to subside and the groups were ready to share the results of their discussions. I listened to each report, asking clarifying questions along the way, and complimented and thanked each group for their participation.

The whiteboarding session yielded the result I had hoped for — the students communicated with each other and with me — but it also achieved results that were neither immediately apparent nor envisioned.

As a result of this session, I completely revised my syllabus, discarding many of the pre-planned exercises, assignments and quizzes to include more discussions, whiteboarding, projects, group activities and outside reading based on students' suggestions.

The students responded to the new coursework with enthusiasm and shared ideas, often helping each other complete assignments. In addition, students who generally wouldn't speak in class (i.e., limited English speaking students) offered something in every class session.

These classes are offered only in the spring semester, and I discovered that in 2007 they are to be offered online for the first time. Hmmm…classroom communication via chat room and e-mail — that'll be a whole new challenge!

Doris Waters is the office manager for the K-12 Alliance. In her spare time, she teaches business classes at the local community college.

COLLABORATION

Finding the Spark

BY CHERYL WILHITE

(Editor note: The K-12 Alliance teamed up last year with Yreka School District and College of the Siskiyous in a Ca Math Science Partnership. Here is one teacher's point of view of how that partnership aims to increase teacher content knowledge and pedagogical skills..)

In order for you to understand just how much the Math and Science Partnership Project classes have helped me, you need to know a little about my background. First of all, I was never going to teach science, especially not junior high science. I mean you have to be crazy to teach junior high. Right? But when I got my credential, I had plenty of science classes to get a supplemental to teach physical science.

"Someday it might save your job or it might get you a job if you have that supplemental," I heard many times.

All right, I'll get it but of course that will never happen to me. If nothing else, that supplemental will look impressive.

A couple of years ago, however, that supplemental saved my job.

Through circumstances, I found myself teaching scary eight graders science and I hadn't done anything related to science in more than 20 years. I frantically started reading the science text and consulting teachers. I was still feeling rather lost, but I forged ahead and started the year out.

Nearly a third of the way through the year, I was diagnosed with cancer. There were many struggles, including the issue of trying to find things that I could leave for a substitute to do with the students that would be meaningful.

A few months later, I learned about science class that was being offered by the K-12 Alliance. It required a commitment of 5 days during the upcoming summer, 4 days during the following school year, and another 5 days of the next summer. Yeah, right, like I was going to give up that much time, I thought. I might not even be alive by then.

But a colleague encouraged me to consider it and I halfheartedly committed. I had just finished chemotherapy about a month before the first session, so I went to class tired and not expecting much because I've been to a lot of pretty boring, useless workshops. I figured that at least I would be sitting, not listening to my children fight, and enjoying some adult company.

Boy, was I in for surprise.

Well, I learned just how much I didn't know about magnetism and electrical circuits. I also learned about the 5 E's and some really excellent strategies for teaching science so the students discover the answers themselves and, hopefully, retain the answers. I learned about the use of lab books, which I now use and love.

Through these workshops, I got to know other teachers in Northern California who are teaching the same things and have wonderful ideas for teaching certain concepts. I met other teachers of older grades who are great resources for ideas and equipment. I found out when the younger grades teach the basic concepts, I have a better foundation to build upon later. I could go on and on, but you get the idea: the K-12 Alliance workshops were a life-changing experience.

Today, if you come into my classroom you will find that most everything I do is converted or being converted to what I have learned in these classes. After my first day of dreading going to class, I looked forward to and happily attended each of the subsequent sessions. I hope for more K-12 Alliance opportunities in the near future. I'll be the first to sign up.

Cheryl Wilhite is an eight grade teacher at Jackson Street School in Yreka.

Digging for Answers in Yreka

What better place to experience a week of Earth science, than out in the beauty of nature at the stunning Mount Shasta area in Northern California at summertime?

Here among the tall trees and impressive scenery, Siskiyou and Tehama County teachers met at the College of the Siskiyous in Weed for the Yreka MSP, Partner for Science Collaborative. They were lead by a cadre composed of Bill Hirt, Geology Instructor at the College of the Siskiyous and Mike Gilmore of Weed High School. Their goal: plate tectonics comprehension.

The week started out with a jigsaw activity looking at four data sets that define plate boundaries: elevation, rock age, earthquake and volcanic activity. After each teacher team learned their content, they would share in mixed teams thus reinforcing their understanding of convergent and divergent zones on the Earth's crust.

The teachers were treated to a welcomed surprise when Secretary of Education Alan Burson dropped by – he was in the region for meetings with Region 2 educational leaders. Retiring Siskiyou County Superintendent of Schools Barbara Dillmann escorted Burson and his aide to the college to meet staff and participants of the Yreka MSP.

Burson spoke briefly and acknowledged the model partnership between the pre-K-12 world and the community college. Participants enjoyed the opportunity to talk with someone from Sacramento about local and rural concerns.

Most of the time, however, participants were at the college using the state of the art Distance Learning Facility, a telecommuting classroom equipped with monitors, computers, smart boards etc. With the help of this technological magic, participants enjoyed guest speaker, Brian Grigsby from the Arizona State Mars Education Outreach Office.

A FRIENDLY LITTLE CHAT – Local educators got a chance to rub shoulders with Secretary of Education Alan Bersin at this year's Yreka institute. From Left to Right: Marian Murphy-Shaw; Siskiyou County Office of Education, Mike Read; hysics Instructor College of the Siskiyous, Alan Bersin, Dr. William Hirt, Geology Instructor, College of the Siskiyous, Mike Gilmore; Science Instructor, Weed High School

A former Redding educator, Grigsby was happy to give teachers the perspective of who uses Earth science in real world exploration. He shared how K-12 teachers can bring class projects about Mars into their schools that also address multiple content areas and skills.

Naturally, the institute featured plenty of field work, especially when participants visited the Shasta Valley volcanoes and caves to uncover the geological story of the region. They were astonished to find so many varying rock samples of basalt with full ranges of color from brown to deep red to almost black. Many samples were collected for classroom use.

The institute culminated with a trip to Shasta Caverns to learn about parts of California that were once under the ocean and are now buried deep within Shasta County. The group trekked back to Castle Craggs State Park -- a perfect example of volcanic intrusion -- for a final reflection and of course, taking their content post-test.

All in all, the institute was filled with good learning and good company – dosed heavily with plenty of good inspiration for the school year to come.

A GOOD QUESTION... CONTINUED FROM PAGE 2

S2 Yes, it is always a circle.

T: (clarify) Are their parts in your circle? What are the parts?

S1: A battery, a wire and a bulb.

T: (redirect) What would happen if we placed the parts in a square? Would it be possible for the bulb to light?

S2: Student hesitates…then says…yes, the bulb could light in a square.

T: (clarify) How do the parts help make the light bulb light?

S1: One wire needs- to touch the metal part on the bottom of the light bulb and one end of the battery, and one wire needs to touch the metal on the side of the light bulb and the other side of the battery

T: (summarize) How would you add this information to your idea of a complete circuit?

S1. So parts need to be connected in a complete circuit.

T (probe) Can you think of another shape for the complete circle in addition to a circle or a square?

S1: A triangle could also be the shape for the circuit.

T: (extend) What if you had two light bulbs? What would you need to do now to light both of them?

S2: We might need more batteries.

S1: Or more wires.

T: (reflect) Think about how you could test your idea.

S2: I think we should try to hook up both bulbs to two batteries. (students try and find they don't have enough wires)

T: (redirect) How might you do this with one battery? How many wires would you need?

S1: I see how we can connect the two bulbs with one wire and then each bulb to an end of the battery. We need three wires.

T1: (Summarize) How is this circuit like the first one you made?

S2: They both made the light bulbs light.

S1: The circuits were complete because the electricity went in a path when connecting the bulbs, wires and batteries the right way.

Levels of Questions				
Input	Complete List Observe Identify	Count Locate Recite	Define Match Select	Describe Name Tell
Process	Analyze Explain Sequence Compare Contrast Construct Analogy Summerize Estimate	Arrange Separate Combine Invent Relationship Distinguish Produce	Report Classify Infer Cause/ Effect Construct Plan Use	Arrange Show Organize Write Group Contrast Synthesize
Output	Evaluate Expand Extrapolate Project Discuss	Image Judge Predict Decide Hypothesize	Build Choose Create Generalize Apply	Model Speculate Forecast Recommend Principle

Figure 2

Like levels of questions, follow-on questions should be planned in advance of teaching based on student expected responses. Figure 3 is useful in pre-thinking questions. Place the first question in the center of the "wheel" and then list possible expected student responses in the first circle.

Decide what probes would be necessary in order to help students clarify, reflect, summarize, or extend their thinking. Write these questions, including ones that help redirect students, in the outer circle. Then when teaching, keep the wheel handy for planned questions based on student responses.

Using these two strategies—levels of questions and follow on questions, teachers can illuminate student thinking and instill habits of mind that build the foundation for a lifetime of learning.

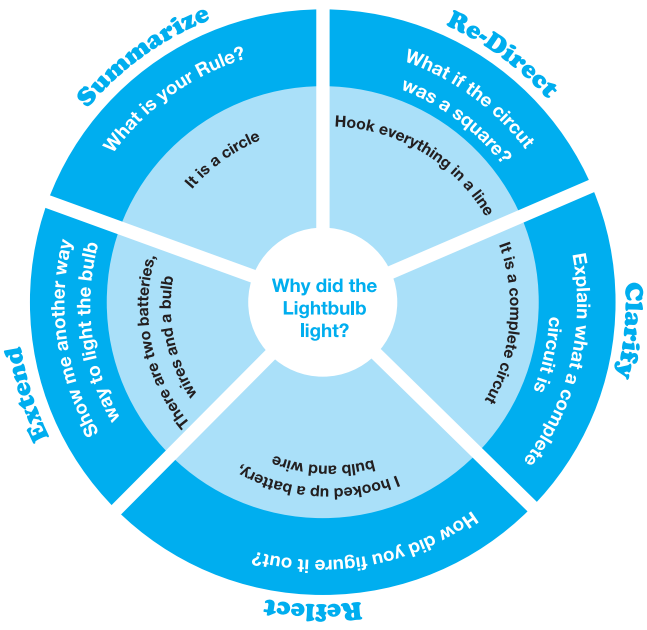

Figure 3

RECOLECTIONS OF A RAMBLER CONTINUED FROM PAGE 3

people, producing ream after ream of revisions or new drafts, telling jokes, sharing tragedy, laughing and crying together, and forging the bonds of a revolution.

Those bonds are strong… at least half the people in the pictures of the celebration are people I could sit down with tomorrow and have a friendly drink. We'd probably discuss this, that and the other until all hours of the night -- and then get up the next day and do something about it.

This adoption process (changing the subject slightly) seems to suggest that all is not lost. Some of the materials are better, a lot of the people who took part in the process (formal and shadow) are still committed to a powerful vision of how kids learn best. It looks like new people are still being drawn into that process.

Perhaps there is still hope that the revolution we began 20 years ago (even though we just thought that what we were doing was what was best for kids and their teachers) is still alive. It's just lying dormant these past few years -- is it almost ten? -- waiting to explode back on the surface once the bankruptcy of "Teach to Tell" is exposed.

Just a thought.

One last thought … we will be at CSTA. We would love to spend a little time with you and all of our dear friends that we have made through association with CSIN/K-12.

And the door is always open for you up here in Oregon City (and the light's on, too).

Scott Hayes recently retired to Oregon to be near grandchildren.