Thinking
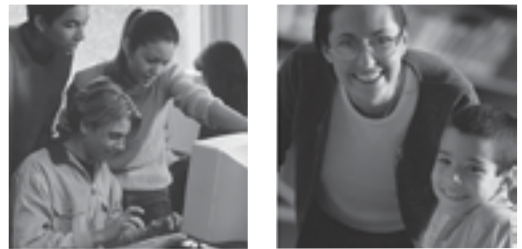# Strategies
for learners

A guide to PEBC's
professional development in
reading, writing, mathematics,
and information literacy

pe+bc
Minding our future.

**Public Education &
Business Coalition**

PEBC Mission

The Public Education & Business Coalition cultivates excellence in public schools so all students succeed in learning and in life.

A partnership of leaders from education, business and the community, the PEBC improves teaching to improve learning by working increasingly in low-performing K-12 schools and classrooms; by collaborating to improve Colorado's policy-making process; and by increasing the involvement of business in education.
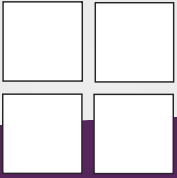
Thinking
Strategies
for learners

A guide to PEBC's
professional development in
reading, writing, mathematics,
and information literacy

pe+bc
Minding our future.

**Public Education &
Business Coalition**

Every river has its source – the same can be said for any body of work. For those of us at the Public Education & Business Coalition, our source streams from the early years when a handful of staff developers – Ellin Oliver Keene, Steph Harvey and Liz Stedem – walked into a few schools armed with loads of books and plenty of questions. The Public Education Coalition's Literacy League was born out of a fervent desire to support classroom teachers as they worked to help students become lifetime readers and writers.

For over 20 years, PEBC staff developers and lab classroom teachers have worked in classrooms to refine the content of our professional development model. They, along with countless teaching colleagues, school leaders and students, have broadened and deepened what it means to teach through a thinking lens. Our deepest thanks goes out to each and every one of them. Each has brought his or her own perspective, passion and sense of wonderment to this important work.

This platform was produced through the collaborative effort of many and represents our initial thinking, revised thinking, extended thinking. It is a work in progress – and a labor of love.

And so the river flows on ...

Lori L. Conrad
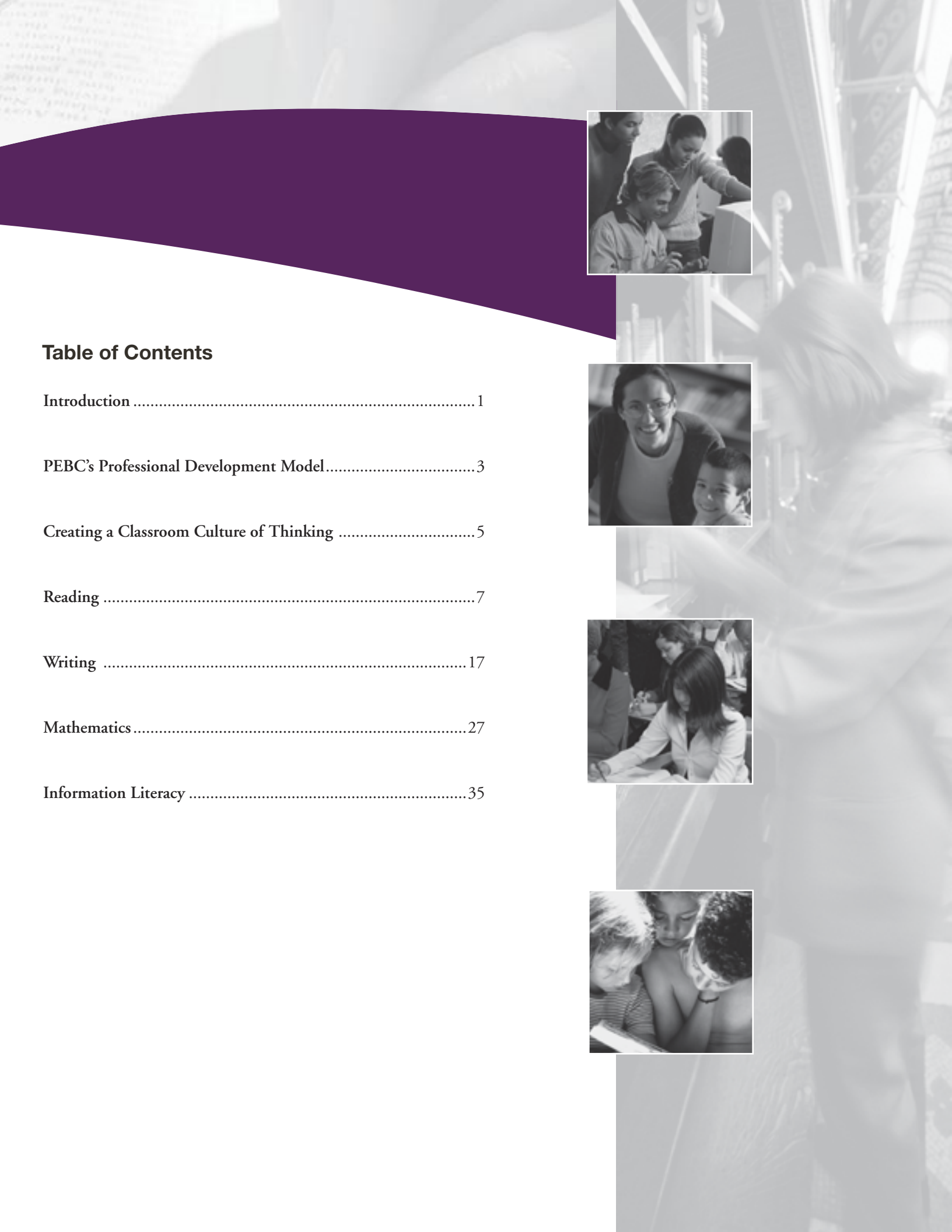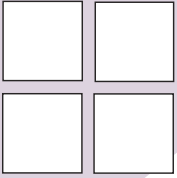
Director, Elementary Professional Development

Table of Contents

Introduction

In 1983, two staff developers were hired by the newly formed Public Education Coalition (PEC) to help elementary teachers put educational research into practice in Denver metro area schools. Twenty years later, the Public Education & Business Coalition (PEBC) has a different name and a dramatically different scope, with over 50 teachers and staff developers supporting K-12 teachers across the country. The goal of the PEBC remains the same, however, and staff developers continue to support teachers as they strive to incorporate research-based instructional practices into their classrooms.

In the late 1980's, PEBC staff developers began to investigate the research on reading comprehension, looking very closely at the work that identified the specific reading comprehension strategies used by proficient readers. This research, conducted and synthesized by P. David Pearson, Jan Dole, and others, provided the foundation for the PEBC's Reading Project, and PEBC staff developers once again sought to translate educational research into teacher practice.

After experimenting with reading comprehension strategy instruction with many teachers in many classrooms, Ellin Oliver Keene, former PEBC Associate Director, and Susan Zimmermann, former PEBC Executive Director, published *Mosaic of Thought: Teaching Comprehension in a Reader's Workshop*. Through this book, Keene and Zimmermann not only opened up the PEBC's rich classroom work in Denver to a national audience, but also clearly defined reading as thinking.

PEBC staff developers and lab classroom teachers have since published seven additional books — *Nonfiction Matters* by Stephanie Harvey, *Strategies That Work* by Stephanie Harvey and Anne Goudvis, *I Read It, But I Don't Get It* and *Do I Really Have To Teach Reading?*, both by Cris Tovani, *Reading With Meaning* by Debbie Miller, *7 Keys To Comprehension* by Susan Zimmerman and Chryse Hutchins, and *Writing Through The Tween Years* by Bruce Morgan — establishing the comprehension strategies as a critical element of literacy instruction at every grade level. Accompanying video series – *Thoughtful Reading and Comprehending Content,* both by Cris Tovani, *Strategy Instruction in Action, Think Nonfiction!*, and *Strategic Thinking* by Stephanie Harvey and Anne Goudvis, and *Happy Reading* by Debbie Miller – and numerous articles have added practical and specific images of the ways comprehension instruction looks in classrooms at all levels. PEBC staff developers have also published two books — *Learning Along the Way: Professional Development By and For Teachers* by Diane Sweeney, and *Pathways: Charting a Course for Professional Learning* by Marjorie Larner – describing ways to create effective professional development for classroom teachers and school leaders.

Coupled with these publications and articles, the outstanding work of teachers in PEBC classrooms has led the PEBC to become a national leader in reading comprehension strategy instruction and staff development, extending the application of the strategies far beyond the reader's workshop. As teachers and staff developers continue to work with these strategies, they have redefined them as cognitive *thinking* strategies that proficient *thinkers* use in every discipline and every academic endeavor.

PEBC offers this publication, *Thinking Strategies for Learners*, as a platform of its staff development work in reading, writing, mathematics and information literacy. The first section outlines

the professional development model PEBC staff developers employ when working with teachers and school staffs. This is followed by a description of the overarching classroom structures necessary for developing a culture of thinking for all students. The remaining sections describe this work embedded in the specific content areas. Each content area section is structured to help readers define the content, understand the ways thinking strategies fit with the content, see how the content is most effectively taught, and link the content with specific standards and assessment practices. There are also classroom vignettes scattered throughout the publication designed to offer a specific window into ways PEBC work looks inside the walls of real classrooms.

What is the PEBC's Professional Development Model?

Current educational research asserts that teacher quality is the single most important factor in student learning (Darling-Hammond and Berry, 1998), so PEBC professional development focuses on teachers and classroom instruction. PEBC staff developers work extensively in individual schools, supporting teachers as they implement research-based best practices in their classrooms.
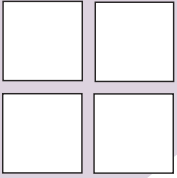
PEBC's professional development work is guided by the following principles:

- Professional development focuses on topics for which there is an abundance of high-quality research.
- Professional development evaluation focuses on in-depth teacher and student growth over a long period of time.
- Professional development is always voluntary and inquiry-based.
- Professional learning respects the integrity and decision-making rights and responsibilities of educators: no formulas or prescriptions for success are provided.

These principles are applied by PEBC staff developers in conjunction with the standards established by the National Staff Development Council (NSDC), suggesting that professional development be:

- results-driven and job-embedded.
- focused on helping teachers become deeply immersed in subject matter and teaching methods.
- curriculum-centered and standards-based.
- sustained, rigorous, and cumulative.
- directly linked to what teachers do in their classrooms.

Since professional development is most effective when it is directly linked to the practices of teachers in their own school settings, most of the PEBC's work takes place at the school and in the classroom. Schools typically contract with the PEBC for 20-45 days of staff development, for three to five years. This long-term, on-site work includes a planning phase, an implementation phase, and an institutionalization phase.

Phase 1: Planning

In the early excitement about implementing school reform or instructional change, there is a temptation to charge ahead without fully understanding the context in which the changes will occur and without building strong consensus to move forward with professional development. Steps toward understanding the context and building consensus should occur early in the process and deserve adequate time and thoughtful planning.

Context and Consensus
- Asset-mapping or another type of needs assessment
- Study groups to review the research and new instructional practices
- Support for the principal to build consensus to engage in professional development
- Staff developer classroom observations and feedback
- Formation of a leadership team

Once staff members reach a consensus about engaging in significant professional development, they need to articulate a vision of the classrooms and school they want to create. In order to create this vision, teachers need to observe best practices in action. These focused, purposeful observations lead to thoughtful conversations about possible implementation strategies.

Observation and Vision Building
- Lab classrooms hosted by exemplary teachers and facilitated by PEBC staff developers
- Guided visitations to other classrooms and schools
- Early demonstration teaching in study groups and classrooms
- Continued classroom observations
- Continued study groups
- Principal labs
- Principal study groups
- Quarterly leadership seminars for principals and teacher-leaders

Staff developers understand that teachers must make numerous attempts at a new practice before considering the practice part of a permanent repertoire.

Phase II: Implementation

Effective professional development encourages a cycle of continuous learning and improvement in practice. Deliberate, thoughtful, and based on well-corroborated research in teaching and learning, PEBC professional development encourages practitioners to experiment, revise, deliberate, and observe. Staff developers understand that teachers must make numerous attempts at a new practice before considering the practice part of a permanent repertoire.

Implementation
- Curriculum planning with teachers
- Instructional planning with teachers
- Demonstration teaching by the staff developer
- Debriefing demonstration lessons
- Co-teaching, observation, and feedback
- Analysis and discussion of student work
- Support for teacher research
- Collaboration around standards, curriculum, and assessment
- Continued study groups
- Intra-/Inter-district teacher, librarian and principal networks
- In-services with outside experts
- Participation in PEBC conferences and institutes
- Parent workshops

Phase III: Institutionalization and Continuous Renewal

In order to create lasting school reform, structures and attitudes both inside and outside the school must change. Teachers and administrators must think creatively and purposefully about how to continue to support the changes by re-allocating both time and resources. They must be willing to advocate strongly for policy changes at the building, district and state level that will support their new vision. They must also maintain a spirit of ongoing revision, knowing that the hard work of school reform is never truly done.

Structures that Sustain Learning
- Hosting internal labs
- Training school-based trainers
- Continued participation in PEBC conferences and institutes
- Continued study groups
- Continued participation in leadership activities
- Restructuring the school schedule to embed staff development in the school day
- Reallocating resources to support ongoing staff development
- Selecting and acting on policy issues relevant to program work
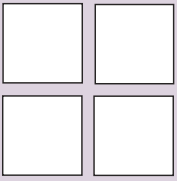
Creating a Classroom Culture of Thinking

Engaged, sophisticated thinking does not come about by chance. Long-lasting intellectual development occurs when necessary elements come together with artistry and craftsmanship, much like a well-staged performance, an elegant meal or an intricate jigsaw puzzle. In the classrooms and schools actively participating in PEBC professional development efforts, four essential "puzzle pieces" connect as teachers and school leaders work to support student learning. These elements constitute the common thread that ties PEBC classrooms and schools together.

Teachers know learning by:

- studying current research; and

- working to create a sense of integrity in their instruction.

Teachers come to know learners and the learning process by:

- developing trusting relationships with learners;

- assessing learners in both formative (ongoing) and summative (final point) ways;

- developing a rigorous and intimate environment in which learners' strengths and needs can be met;

- articulating the ways in which learners meet and have yet to meet agreed upon standards; and

- having a vision for the long-term goals of all teaching and learning: increased student independence, proficiency and passion for understanding.

Teachers embed instruction in authentic contexts by:

- employing materials, texts and tasks used outside the classroom when individuals "do thinking" in the world;

- making decisions based on the question "would I do this as an adult reader/writer/mathematician/researcher/thinker";

- creating differentiated, relevant work that is worthy, real, and applicable to learners' lives; and

- focusing instruction on a few concepts over long periods of time.

Teachers engage in ongoing, continual reflection by:

- being passionate about their own learning goals;

- pursuing professional growth independently and alongside colleagues;

- reading widely;

- collaborating with others; and

- seeking out evolution of ideas and beliefs.

Constructing an Environment in Which a Culture of Thinking Can Grow

  Teachers and school leaders who have actively participated in PEBC professional development efforts have come to know that the classroom environment itself is integral to growing thinking students. Like the rich soil in a well-tended garden, the classroom setting nurtures the seeds of thoughtfulness. In PEBC classrooms and schools, adults and students have constructed learning workshops that honor:

- the **time** it takes for deep, long-lasting understanding. They do this by structuring blocks of uninterrupted time for instruction, practice and reflection.

- learners taking **ownership** of their learning processes and products. In these classrooms, choice is an essential partner in learning. Students take responsibility for their own individual growth, as well as for the collective learning of the group.

- a learner's need for **response**. This feedback takes many forms, including one-on-one comments generated in a conference, small-group/whole-group sharing and individual reflection. Response can vary across oral, written and artistic formats.

- a **community** built around rigorous expectations, predictable rituals and routines, meaningful and well-orchestrated materials and experiences, and trusting and respectful relationships.

teachers know learning

teachers know learners

Classroom Culture of Thinking

teachers embed instruction in authentic contexts

teachers reflect continuously

Reading

Reading is Thinking

Simply stated, reading is thinking about text. Neurological research, as well as research conducted in the fields of education, linguistics, and psychology, clearly demonstrates that the human mind must process information from many different sources simultaneously in order to read the words on a page and to make meaning of those words. As the eye scans the page, the mind engages in a number of different cognitive processes.

Reading is Metacognitive

Proficient readers are metacognitive: they think about their own thinking while reading. Proficient readers know when they are comprehending and when they are not comprehending. They can identify their purposes for reading and the demands placed on them by a particular text. They can also identify when and why the meaning of the text is unclear to them, using a variety of strategies to solve comprehension problems or to deepen their understanding of the text (Duffy, 1987).

Reading is Complex

Making sense of print is no easy task. A reader has to weave together what is seen on the page (e.g., the letters, words, spaces, punctuation marks) with what is implied (e.g., the author's purpose, bias, writing goals). It is the resulting tapestry which ultimately allows a reader to understand the story, article, poem or essay. In order to accomplish this task, readers need explicit instruction on the ways letters and sounds connect to create words and ideas. They need time to practice in texts that are readable as well as meaningful. And they need access to and immersion in high-quality reading material in a variety of genres.

Reading is Comprehending Words and Ideas

While reading, the human mind receives information through six cueing systems. These cueing systems provide the reader with both surface structure information and deep structure information. Readers use surface structure systems to rapidly and accurately identify and pronounce words, as well as to recognize when the structure of words and sentences is comprehensible. Simultaneously, readers use deep structure systems to understand and remember what they have read, as well as to interpret and analyze text at both a literal and inferential level.

Which Reading Skills and Strategies Matter Most?

Many theorists believe that the six cueing systems operate in the mind simultaneously, providing the reader with an abundance of information from all six surface and deep structure systems at every moment. The reader relies on different sources of information at different times, depending upon the purpose and context for reading.

Surface Structure Systems

Surface structure systems provide the reader with visible and audible information about letters, sounds, words, and grammatical structure.

- **Grapho-Phonic System**
  Provides information about letters, features of letters, combinations of letters, and the sounds associated with them.

- **Lexical System**
  Provides information about words, including instantaneous recognition of words, but not necessarily including the meanings associated with the words.

- **Syntactic System**
  Provides information about the form and structure of the language. The reader notices the structure of words, sentences, and whole texts, including whether words and longer pieces of text "sound right" and are organized cohesively.

As readers work to identify new words and repair word-level confusions, they use their knowledge of the surface structure systems and the following skills/strategies to make sense of words in text:

- phonemic awareness – awareness of the sounds that make up spoken words

- alphabetic knowledge – knowing that the sounds of our language have a direct, but not necessarily one-to-one correspondence, to the letters of the alphabet

- word context – using the surrounding words in the sentence

- word recognition – developing a "bank" of words known automatically

- word analysis – using word parts (e.g., roots, prefixes, suffixes)

- rereading and reading ahead – using the flow of language and ideas

- sentence and text structure – understanding the ways words are put together

Deep Structure Systems

Deep structure systems provide information about the meanings of words and longer pieces of text, the purpose for reading, and prior knowledge related to the text.

- **Semantic System**
  Provides information about the meanings, concepts, and associations of words and longer pieces of text. It includes the reader's vocabulary and the degree to which the reader has a full conceptual knowledge of words that enable an understanding of subtle definitions and nuances.

- **Schematic System**
  Provides information from a reader's prior knowledge and personal associations with the text that permits the reader to understand and remember information from the text. It also governs the grouping and organization of new information in memory stores.

- **Pragmatic System**
  Provides information about the purposes and needs the reader has while reading, governing what the reader considers important and what the reader needs to understand for a particular purpose. It also includes "social construction of meaning," ways in which groups of readers discuss text to arrive at shared meaning and increasingly abstract interpretations of text.

As readers work to construct meaning from text, they use the following strategies at the deep structure level:

- monitor meaning

- activate, use and build background knowledge (schema)

- ask questions

- draw inferences

- determine what is important in text

- create sensory images

- synthesize information

- problem solve and repair meaning when meaning is interrupted

Thinking Strategies for Readers

Researchers who have studied the thinking processes of proficient readers conclude that if teachers taught the following strategies instead of much of the traditional skills-based reading curriculum, students who use the strategies would be better equipped to deal with a variety of texts independently (Keene and Zimmerman, 1997). These strategies are useful for composing meaning at both a text and word level.

Monitoring for Meaning

at a text level, readers . . .

- pause to reflect on their growing understandings
- recognize when they understand the text, and when they don't
- identify when and why the meaning of the text is unclear
- identify the ways in which a text becomes gradually more understandable by reading past an unclear portion and by rereading text
- decide if clarifying a particular confusion is critical to overall understanding
- explore a variety of means to remedy confusion
- consider, and sometimes adjust, their purpose for reading
- check, evaluate and make revisions to their evolving interpretation(s) of text

at a word level, readers . . .

- identify confusing words
- employ a range of options for reestablishing meaningful reading (e.g., rereading, reading on, using words around the unknown word, using letters and sounds, using a meaningful substitution)

Activating, Utilizing and Building Background Knowledge (Schema)

at a text level, readers . . .

- activate relevant, prior knowledge before, during and after reading
- build knowledge by deliberately assimilating new learning with their related prior knowledge
- clarify new learning by deleting inaccurate schema
- relate texts to their world knowledge, to other texts and to their personal experiences
- activate their knowledge of authors, genre, and text structure to enhance understanding
- recognize when prior knowledge is inadequate and take steps to build knowledge necessary to understand

at a word level, readers . . .

- apply what they know about sounds-letter relationships and word parts to make sense of unknown words

Asking Questions

at a text-level, readers . . .

- generate questions before, during and after reading about the text's content, structure and language
- ask questions for different purposes, including clarifying their own developing understandings, making predictions, and wondering about the choices the author made when composing
- realize that one question may lead to others
- pursue answers to questions
- consider rhetorical questions inspired by the text

- distinguish between questions that lead to essential/deeper understandings and "just curious" types of questions
- allow self-generated questions to propel them through text
- contemplate questions posed by others as inspiration for new questions

at a word level, readers . . .
- pose self-monitoring questions to help them understand unknown/unfamiliar words (e.g., "What would make good sense?", "What would sound like language?", "What would sound right and match the letters?", "Is this a word I want to use as a writer? If so, how am I going to remember it?")

Drawing Inferences
at a text level, readers . . .
- draw conclusions about their reading by connecting the text with their schema
- make, confirm, and/or revise reasonable predictions
- know when and how to infer answers to unanswered questions
- form unique interpretations to deepen and personalize reading experiences
- extend their comprehension beyond literal understandings of the printed page
- make judgments and create generalizations about what they read
- create a sense of expectation as they read

at the word level, readers . . .
- use context clues and their knowledge of language to predict the pronunciation and meaning of unknown/unfamiliar words

Determining Importance
at a text level, readers . . .
- identify key ideas, themes and elements as they read
- distinguish between important and unimportant information using their own purpose(s), as well as the text structures and word cues the author provides
- use text structures and text features to help decide what is essential and what is extraneous
- use their knowledge of important and relevant parts of text to prioritize what they commit to long-term memory and what they retell and/or summarize for others
- consider the author's bias/point of view
- use the filter of essential/other to clarify usefulness when applying other cognitive strategies to their reading

at a word level, readers . . .
- determine which words are essential to the meaning of the text
- know when choosing to skip words/phrases of text will or will not impact their overall understanding
- make decisions about when unknown/unclear words need clarification immediately and accurately, and when substitutions can be used to maintain meaning and fluency

"Eventually, the goal is for readers to use these strategies automatically and seamlessly."

Harvey and Goudvis,
Strategies That Work

"The workshop is both a metaphor and a model for turning classrooms into learning laboratories. In the ancient crafts workshop, the teacher was a master craftsperson who demonstrated a trade and coached apprentices in the context of making real products for the community. In contemporary classrooms, we borrow the workshop metaphor to create writing workshops, science workshops, math workshops, and other workshops across the curriculum. Students get large chunks of time to practice the trade of reading, investigating, or problem solving, while teachers take on the new roles of mentors, coaches, and models."

Harvey Daniels and Marilyn Bizar,
Methods that Matter: Six Structures for Best Practice Classrooms

Creating Sensory Images

at a text level, readers . . .
- immerse themselves in rich detail as they read
- create images connected to the senses of sight, hearing, taste, touch and smell to enhance and personalize understandings
- attend to "heart" images – feelings evoked while reading
- revise their images to incorporate new information and new ideas revealed in the text
- adapt their images in response to the images shared by other readers

at a word level, readers . . .
- use visual, auditory and kinesthetic modes when learning how words work
- use what they know about a word's appearance (e.g., length, spacing above and below the line) to understand unknown words
- ask themselves "Does that look right?" and "Does that sound right?" when cross-checking unknown words

Synthesizing Information

at a text level, readers . . .
- continually monitor overall meaning, important concepts and themes while reading
- recognize ways in which text elements fit together to create larger meaning
- create new and personal meaning
- develop holistic and/or thematic statements which encapsulate the overall meaning of the text
- capitalize on opportunities to share, recommend and criticize books
- attend to the evolution of their thoughts across time while reading a text, and while reading many texts

at a word level, readers . . .
- select specific vocabulary from the text(s) to include in their synthesis because they know that specific language is highly meaning-laden
- know when certain vocabulary is critical to the text's overall meaning, and therefore, must be understood if comprehension is to be achieved

Problem Solving

at a text level, readers . . .
- know that once meaning has broken down, that any of the other cognitive behaviors can be employed to repair understanding
- use information from the three deep surface structure systems to repair text meaning

at a word level, readers . . .
- use information from the three surface structure systems to solve word issues
- select from a wide range of word strategies (e.g., skip and read on, reread, use context clues, use the letters and sounds, speak to a peer reader) to help make sense of unknown words
- develop reading fluency

How Do We Teach Reading Effectively?

An abundance of research suggests that if teachers focus their instruction on a few cognitive strategies, over a long period of time, in a variety of different text genres, students will learn to use those strategies independently and flexibly. Successful teachers teach toward independent mastery by modeling their own use of the strategies and by gradually releasing responsibility to their students (Gallagher and Pearson, 1983).

The cognitive strategies are taught most effectively in a reading workshop. The reading workshop devotes a regular, uninterrupted, long block of time (45 to 90 minutes daily) to reading instruction. The workshop is comprised of three essential components that incorporate a gradual release of responsibility from the teacher to the students:

1. Crafting Lessons
2. Composing as Readers
3. Reflecting

Crafting Lessons

The reading workshop often begins with a crafting lesson to offer direct, explicit instruction and modeling for students. Teachers use this time to introduce and explain a new strategy or procedure. They also use this time to think aloud as they read, modeling their own use of that strategy for their students. As they think aloud, teachers carefully explain how they are applying the new strategy to the text.

Crafting lessons can explore both surface structure and deep structure systems. Since effective instruction focuses on a single strategy or skill over a long period of time, most crafting lessons fit together in a continuum in which students gradually increase their responsibility for understanding, while their teacher increases his/her expectations for successful implementation of the new learning.

Composing as Readers: Reading and Conferring

After the crafting lesson, students spend large amounts of time applying the content of the crafting lesson to their own reading experiences. During this time, students might meet in small, needs- or interest-based groups, or read independently. Teachers spend this independent composing time guiding small groups of students as they negotiate a common text or a common instructional need, or conferring with individuals as they work to make sense of their reading materials. Through these individual and small-group instructional gatherings, the teacher gains a sense of every student's progress, offering immediate, precise support and feedback. Brief, daily conferences also provide the teacher with a window into the progress of the class, helping to plan future lessons and assignments.

During independent reading, students read texts representing a wide variety of levels and genres. These texts are most often selected by the students, after careful demonstration from the teacher on effective strategies for selecting appropriate texts, but may also include teacher-assigned materials.

Reflecting

At the end of the reading workshop, students regularly share their new/developing insights about the content of their reading and their use of reading strategies. The format for this reflection can vary, depending on purpose. If the teacher wants every student to be heard on a particular day, students share their thinking with the full class in a *circle share*. If the teacher wants students to interact more with one another, students participate in a *pair share* instead. The teacher participates in the reflecting, offering observations and recording the individual and group needs generated by this process.

Assessment

PEBC staff developers work closely with classroom teachers and school leadership teams to develop assessment tools and strategies that effectively monitor and document students' growth toward reading proficiency.

Ongoing Classroom-Based Assessment

Because conferring with both individuals and small groups of readers is such an essential part of an effective readers' workshop, gathering the insights gained from these conferences is equally important. Anecdotal notes and classroom-based checklists act as the backbone for reading assessment, documenting the strategies readers use while constructing meaning, the on-the-spot instruction offered to further student success, and any overall classroom trends useful for planning further whole-group crafting lessons.

Written Response to Reading

Inviting students to reflect on their ongoing reading work is an important element in an overall plan for literacy assessment. These responses can include students' writing about their reading processes, writing about their goals and next steps, as well as their general understandings about the texts they are reading. The responses can take any number of forms, from double entry journals or short open-ended narratives, to jotted notes on a graphic organizer or sticky notes.

Use of Leveled Passages

Most classroom teachers employ some sort of individualized reading inventory as one way of measuring students' reading growth. These tools are useful for: 1) gathering comparative data across time and across readers, 2) gathering "benchmark" information for all readers. The data can be further analyzed to note students' use of the surface as well as deep structures as they work to make sense of new text.

Anchor Interviews

Teachers can record and analyze readers' developing understanding of thinking strategies using a common interview like the Major Point Interview for Readers (see www.cornerstoneliteracy.org for most current edition).

Standards for Reading

By focusing on the six cueing systems, the PEBC's professional development in reading is closely aligned with the Colorado Model Content Standards for Reading, and PEBC staff developers work alongside teachers to implement classroom practices that meet these standards. Because the scope of PEBC's literacy work extends nationally, it is also aligned with the standards established by the National Council for the Teaching of English (NCTE) in cooperation with the International Reading Association (IRA).

Students read and understand a variety of materials.
(Colorado Model Content Standard 1, NCTE/IRA Standards 1, 2)

PEBC staff developers encourage teachers to use a wide variety of texts from different media and genres to support literacy instruction. As students apply reading strategies and skills to different types of text, they gain much greater flexibility as readers.

Students apply thinking skills to their reading, writing, speaking, listening and viewing.
(Colorado Model Content Standard 4, NCTE/IRA Standards 3)

As teachers work with PEBC staff developers, they learn how to employ cognitive thinking strategies across grade levels and disciplines. Staff developers support teachers as they teach their students to think critically about material by questioning, inferring, synthesizing, and evoking sensory images.

Students read to locate, select, and make use of relevant information for a variety of media, reference, and technological sources.
(Colorado Model Content Standard 5, NCTE/IRA Standards 8,9)

PEBC staff developers support teachers and librarians as they teach research skills and as they instruct students to think critically about audience and purpose in the resources that they find.

References

Darling-Hammond, L. and B. Berry. "Investing in Teaching." *Education Week*, 27 May 1998, pp. 48, 34.

Daniels, H. and M. Bizar. 1998. *Methods that Matter*. Portland, ME: Stenhouse.

Duffy, G. G., et al. 1987. "Effects of Explaining the Reasoning Associated with Using Reading Strategies." *Reading Research Quarterly* 22: 347-368.

Gallagher, M. C. and P. D. Pearson. "The Instruction of Reading Comprehension." *Contemporary Educational Psychology 8* (1983): 317-344.

Keene, E. O., and S. Zimmerman. 1997. *Mosaic of Thought*. Portsmouth, NH: Heinemann.

Paris, S. G., D. R. Cross, and M. Y. Lipson. 1984. "Informed Strategies for Learning: A Program to Improve Children's Reading Awareness and Comprehension." *Journal of Educational Psychology* 76: 1239-1252.

Pearson, P. D., L. R. Roehler, J. A. Dole, and G. G. Duffy. 1992. "Developing Expertise in Reading Comprehension." In J. Samuels and A. Farstrup, eds., *What Research Has to Say About Reading Instruction*. Newark, DE: International Reading Association.

"If reading is about mind journeys, teaching reading is about outfitting the travelers, modeling how to use the map, demonstrating the key and the legend, supporting the travelers as they lose their way and take circuitous routes, until, ultimately, it's the child and the map together and they are off on their own."

Keene and Zimmerman, 1997

Further information on Best Practices in Reading

Allington, R. and P. Cunningham. 2002. *Schools that Work: Where All Children Read and Write*. Boston: Allyn and Bacon.

Bomer, R. 1995. *Time for Meaning: Crafting Literate Lives in Middle and High School*. Portsmouth, NH: Heinemann.

Booth, D. 2001. *Reading and Writing in the Middle Years*. Portland, ME: Stenhouse.

Calkins, L. 2001. *The Art of Teaching Reading*. New York: Addison-Wesley.

Clay, M. 1991. *Becoming Literate: The Construction of Inner Control*. Portsmouth, NH: Heinemann.

Cooper, J. D. 2000. *Literacy: Helping Children Construct Meaning*. Houghton Mifflin.

Farstrup, A. and Samuels, S. J. (2002). *What Research Has to Say About Reading Instruction.* Newark, DE: International Reading Association.

Gallagher, K. 2003. *Reading Reasons: Motivational Mini-Lessons for Middle and High School.* Portland, ME: Stenhouse.

Harste. J., V. Woodward and C. Burke. 1984. *Language Stories and Literacy Lessons.* Portsmouth, NH: Heinemann.

Johnston, P. H. 1997. *Knowing Literacy: Constructive Literacy Assessment.* Portland, ME: Stenhouse.

Pressley, M. 2002. *Reading Instruction that Works.* New York: Guildford Press.

"Put Reading First" – Publication of CIERA and National Institute of Literacy

Reading for Understanding: Towards an R & D Program in Reading Comprehension. RAND

Routman, R. (2003). *Reading Essentials: The Specifics You Need to Teach Reading Well.* Portsmouth, NH: Heinemann.

Rumelhart, D. (1976). *Toward an Interactive Model of Reading.*

Taberski, S. 2000. *On Solid Ground.* Portsmouth, NH: Heinemann.

Weaver, C. 2002. *Reading Process and Practice.* Portsmouth, NH: Heinemann

Wilhelm, J., T. Baker and J. Dube. 2001. *Strategic Reading: Guiding Students to Lifelong Literacy 6-12.* Portsmouth, NH: Heinemann.
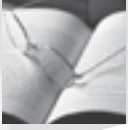
In The Field

Readers at Work in Patrick Allen's Class

The chalkboard ledge in Patrick Allen's third grade classroom is lined with books. Not just any books. These books are cherished artifacts. They represent the varied reading histories of the children who live in this classroom Monday through Friday. Today, Patrick shares a piece of his own reading history.

"I finally remembered to bring my book to share with you. I think this book came from a book order when I was in second or third grade. Do you see my signature inside? I must have been learning cursive – like you are now. The book smells a bit musty. It's been packed away for years. I'd love to read it to you." Patrick reads his tattered little copy of *The Teeny Tiny Woman*. He places the book on the chalkboard ledge alongside the others in the collection of favorites.

"Last night I thought a lot about our study of how readers monitor their own comprehension. I'm not so sure I understand the book I read last night before bed." Patrick pulls a book from his book bag. He opens the book to the place marked with a yellow sticky note. "I marked this page to share with you today because I really had to work at understanding it. I had to monitor my comprehension closely. There's one sentence on this page that stumps me. It's a long sentence. I had to read it three or four times before my confusion began to clear." The third graders watch and listen as Patrick reads and rereads the one tricky sentence. Patrick isn't staging a performance. He is demonstrating what truly happens as he reads. He stumbles as he tries to read the long, awkward sentence fluently.

"It sounds weird," Tyler says. "I think you should read it again." Patrick appreciates the suggestion and gives it another try.

"You guys know that sometimes readers understand what they read, and sometimes they don't. All readers struggle from time to time. Good readers recognize when they're struggling and when they're not. Let's take a look at our chart." Turning to the easel next to him, Patrick flips the dog-eared pages. He finds the class chart about monitoring comprehension. The chart wasn't purchased at a local teacher supply store. It's an original – constructed with and by the kids seated on the rug in front of Patrick's rocking chair.

After reviewing and adding to the comprehension codes on the class chart, the kids receive a copy of a nonfiction magazine article. Patrick has chosen this article carefully. He's sure it contains some tricky words and ideas. He'll watch as the kids demonstrate their knowledge of how readers monitor comprehension. He's hoping to see his students writing in the margins of the article, underlining words, and pausing to think. What the students do today will guide Patrick's teaching tomorrow.

Readers at Work in Cris Tovani's Class

It's 7:15 a.m. on a Monday morning and the students in Cris Tovani's high school English class need a couple of minutes to wake up. Class begins with informal conversations about the weekend. Cris then displays a magazine article on the chalkboard.

"I noticed this article in a magazine the other day. Anything about Iraq catches my eye right now because I'm continually trying to understand what's going on over there. When I looked at the article, I realized I was immediately drawn to certain features. I read the title of the article, but then the faces in the photographs caught my attention.

"When I read a novel, I start on page one and read page by page to the end. Reading articles like this one is different. I'm not always sure where to begin. It's a different kind of reading. What are you thinking? What about the article catches your eye?"

Matt chimes in. "The pictures. And then I'd want to read the captions to find out more."

Cris invites a few more students to share, and then each student receives a personal copy of the article.

"As the sticky notes come around take three or four. I'd like you to read the article. Notice your process. What catches your attention first? Then what do you do? And since we know reading is about making meaning, how will you keep track of your understanding?

"Use the sticky notes to record your thinking. Feel free to jot notes in the margins, too. The article is packed with information. You might consider jotting questions, especially when you notice your comprehension breaking down. Let's take about fifteen minutes to read and record thinking. Be ready to meet in small groups at 7:45."

Cris confers with Sharlene. "How's it going?"

"I'm not sure. I'm stuck in the second paragraph."

"What if you turn your confusion into a question? Remember how that's helped us in the past? It helps us to target just what we need to know."

"It's this word. In the context of this article, what does it mean?"

"There's your question. Jot it down on a sticky note. Maybe someone in your small group can share some insight."

High school English teacher Cris Tovani claims there's nothing magical about her teaching. She simply follows four guiding principals. She works hard to select quality text, she models her thinking, she sets a purpose for reading, and she provides options for students to hold their thinking. But ask her students and they may have a different opinion. They enter Cris' class well versed at playing the game of school, but thanks to such thoughtful teaching, they leave well prepared for playing the game of life.

Writing

Writing is Thinking

Writing is an active thinking process. Writers explore ideas, engage in reflective thought, and select and arrange language in a way that allows them to communicate effectively. In order to write well, writers attend to many factors simultaneously, including purpose, audience, organization, and voice.

Writing is Metacognitive

Proficient writers are metacognitive: they think about their own thinking while writing. They know when their writing makes sense, to themselves as well as to larger audiences. They can identify their purpose for writing and can identify the demands of different types of writing. Proficient writers recognize when their writing is unclear, and they use a variety of strategies to make their writing more accessible.

Writing is Complex

Writing is hard work. Although some people might suggest that writing can be as simple as matching colors to numbers in a paint-by-number drawing, anyone who has taken pen to paper knows that there are no color-encoded spaces to fill in with pre-determined words and phrases. With experience, however, writers become increasingly aware of the many strategies and skills that they can use to write well.

Writing is Process and Product

Writers honor both process and product. A piece of writing often evolves through a process of planning, drafting, revising, and editing. This process is recursive, allowing for considerable reflection, rereading, and revision at any point along the way. Writers begin the process with reflection, brainstorming possible topics, writing informally, and planning before they start to write an actual text. They then write a series of drafts, stopping often to reread and share their work. After rereading and receiving feedback, they revise their texts, clarifying and organizing their ideas. Before they complete their texts, writers edit them, polishing their writing and checking their use of the refining conventions.

Written products take many forms, from an informal note jotted on a napkin to a formal published essay. Written products are also generated for many different purposes. Ideally, writers write for themselves about topics inspired by their passions and interests. Realistically, they also write for specific audiences within defined parameters, responding to designated writing prompts or meeting the requirements of an assignment. No matter what the form or purpose, the end product is an attempt to fulfill both the writer's intent and the audience's expectations.

Which Writing Skills and Strategies Matter Most?

Because writing is a complex thinking process, students learn many different skills and strategies to become proficient writers. There is no hierarchy or preordained order for teaching these skills and strategies; rather, teachers choose to teach them in the most meaningful contexts, according to the individual needs of the student writers in their care.

Composing Strategies

Composing strategies guide what the writer is trying to say and how the writer says it. Proficient writers attend to myriad considerations.

- **Topic.** Writers must choose topics of great interest and importance to them. Good writing results when writers choose topics that matter to both them and their audiences, and about which they are genuinely curious.

- **Purpose and Audience.** When writers have a reason to write about something, they not only write more clearly, they also write more passionately. When writers know why they are writing a piece, they can also consider their audience more carefully, using the appropriate format, style, and tone.

- **Organization.** All writing has a beginning, middle and end, and it becomes the writers' task to organize their thinking in a way that allows the reader to follow the progression from beginning to end.

- **Voice.** Strong writing reveals the person behind the writing, a writer with a distinctive voice. The writer presents an original perspective, evident in the use of original language and in a clear point of view.

- **Specific Detail and Evidence.** Proficient writers strive for specificity, "showing" what they mean with their words rather than simply "telling." They know that their writing is most powerful when they can create vivid images or provide telling examples for their readers.

- **Clarity.** Effective writers write to be understood. They write simply and directly, eliminating unnecessary words and using language precisely and correctly.

- **Genre.** Skilled writers know the many forms available to them, and they choose the genre most appropriate to their purpose and audience.

Refining Conventions

When proficient writers write for a specific audience, they strive to adhere to standard conventions to make their writing more engaging and accessible to their readers. After writers have completed their initial drafts, they begin the final editing stage. At this point, writers check their punctuation, spelling, grammar and usage, capitalization, and paragraphing to ensure that their work is ready to present to an audience. For a final draft, writers often enlist peer editors, as well to check their writing for conventionality, ensuring a polished final draft.

"Writing is not only a little thing we do with black marks on the page, it is also a big thing we do with our whole lives."

Calkins, 1995

Thinking Strategies for Writers

The PEBC's approach to teaching writing is unique because composing strategies and refining conventions are paired with the thinking strategies most commonly used in reading comprehension instruction. These thinking strategies support student writers, helping them produce work that is rich in content and understandable to the reader. Additionally, by establishing a common instructional language, teachers are able to create cohesion across students' literacy learning.

Monitoring for Meaning

at a text level, writers . . .

- monitor their own writing during the composition process to ensure that it makes sense
- pay close attention to the needs of their intended audience
- pay close attention to their purpose, making word choices and style decisions based on that purpose
- read and reread their writing so they can listen for clarity, organization, voice, and impact
- share their work so others can help them check for clarity and impact
- make conscious decisions about when to turn a small piece into a larger project, when revisions are complete, or when to abandon a piece altogether
- see places for revision in their own texts as well as those they are reviewing for other writers

at a word level, writers . . .

- pay close attention to their writing's surface-level conventions (i.e., spelling, grammar, punctuation, capitalization) so their ideas can be clearly understood by their readers
- see places for editing in their own texts as well as those they are reviewing for other writers

Activating, Utilizing and Building Background Knowledge (Schema)

at a text level, writers . . .

- generate, select and narrow topics they care about
- plan their writing in a way that capitalizes on what they know and what they want to share
- take steps to build schema when what they know about a topic or text structure is inadequate for the writing they hope to do
- use their knowledge of their audience to make content and structure decisions
- use what they know about the content, genre, text format and conventions as they write

at a word level, writers . . .

- make word choices based on their understandings
- use their knowledge of sound/letter relationships and word patterns to spell unknown words
- make decisions about surface structures in light of what they know about how written language should look and sound

"Creating content standards can offer a high quality and conceptually rich curriculum, raise the bar for everyone, standardize what children learn, and align instruction with curriculum."

Dole, 1999

Asking Questions

at a text-level, writers . . .

- monitor their writing progress by asking themselves questions about the choices they are making in terms of content and structure

- compose in such a way that leads their readers to generate their own questions

- invite other writers to question their composition decisions in order to confirm their writing decisions and to find areas in need of revision

- wonder whether they are creating quality writing that has deep meaning, is well organized and meets their purpose and the needs of their readers

at a word level, writers . . .

- wonder if the words they select meet their purpose and the needs of their intended audience

- extend what they know about writing conventions by asking themselves questions like "If I can spell _____, what else can I spell?"

Drawing Inferences

at a text level, writers . . .

- compose text that allows, even encourages readers to make thoughtful inferences and draw meaningful conclusions

- consider their audience when making decisions about what to describe explicitly and what to leave to their readers' interpretation

- show what they mean in their writing instead of simply telling what they mean

- consider far more detail than they actually put in their writing so their readers can draw conclusions, make predictions and make connections of their own

at the word level, writers . . .

- provide enough print support and contextual structure so their readers can infer the meaning and importance of the words in their text

Determining Importance

at a text level, writers . . .

- pay attention to the world around them and record what they believe is significant

- decide what ideas and/or information to include in their writing based on their own purposes and the needs of their intended audience

- select the genre and text structure that best communicates their ideas and/or information

- provide only essential details necessary to reveal their intended meaning or to produce their desired effect

- study other authors' techniques for highlighting important points in their texts

at a word level, writers . . .

- select the specific words that most accurately convey their intended meaning given their purpose and audience

- understand the importance of surface-level conventions when communicating in writing

Creating Sensory Images
at a text level, writers . . .

- consciously create strong images in their writing using strategically placed detail
- attend to their own images while drafting text
- select words that create strong images for their readers
- create impact through their use of strong nouns and verbs
- match their illustrations and text format (e.g., spacing, font, paragraphing) with the "visual impression" they have in mind for their writing
- study the ways other authors use "image-evoking" language

at a word level, writers . . .
- use what they know about letter/sound relationships and spelling patterns to compose words that look and sound "right"

Synthesizing Information
at a text level, writers . . .
- compose in such a way that their readers can create new meaning from their writing
- use what they know about the authoring process, genre and text structures to compose meaningful, engaging texts
- include cues in their text to help readers determine essential themes and ideas that would need to be included in any synthesis statement
- study the work of other writers they find compelling in order to create vision for their own writing

at a word level, writers . . .
- combine what they know about surface conventions when composing to create meaningful, easy-to-read text

Problem Solving
at a text level, writers . . .
- revise their writing to make it clearer and more meaningful by adding details, eliminating unnecessary/unclear ideas or information, or rearranging text
- use what they know about writers' craft to enhance the meaning of their writing

at a word level, writers . . .
- edit the surface-level conventions of their writing to make it easier to read, easier to understand
- develop writing fluency

How Do We Teach Writing Effectively?

Teaching writing is teaching thinking. Writing teachers study the research, employ best teaching practices and pore over their students' writing to identify writing strengths and instructional needs. They fill their shelves with examples of well-loved authors and great writing so their students have many mentors for their own compositions. They consciously establish their classrooms as thoughtful communities of writers in which writing materials are easily accessible, writing is shared at every stage, and writers demonstrate a sense of choice and ownership in their work.

Students learn to write most effectively in a workshop atmosphere with uninterrupted, extended periods of time devoted to generating texts. The workshop acts as "both a metaphor and a model for turning classrooms into learning laboratories." (Daniels and Bizar, 1997). Within a writing workshop, there are three major components:

1. **Crafting Lessons**
2. **Composing as Writers**
3. **Reflecting**

Crafting Lessons

During the first part of a writing workshop, teachers offer explicit instruction in a specific skill or strategy, based directly on their students' needs. In the crafting lesson, teachers think aloud for their students, sharing their own writing processes and written products. They model specific writing strategies and techniques that their students can then emulate. Teachers also use texts written by their students and published authors to provide examples of effective writing. Rather than simply telling students to use rich language, teachers model their own process of choosing language and offer other powerful models of effective text to their students.

Composing as Writers: Writing and Conferring

After the crafting lesson, students work independently and in small, guided groups applying new ideas and understandings. During this time, they work on ongoing texts that are either self-selected or teacher-assigned, depending on the purpose. As they work, they confer with their peers and their teacher about these texts and their writing processes.

When the students are writing, the teacher spends a short amount of time writing as well. During this time, the teacher also confers with individuals and small groups, providing timely, personalized feedback.

Since the teacher is looking at the student's work while the student is engaged in the writing process, s/he can guide individual students to expand or revise their work as needed. The teacher can also provide immediate support if a student is struggling to apply the skill or strategy explored during the crafting lesson. Collectively, these individual assessments reveal the progress of the class, informing instruction for future crafting lessons and writing assignments.

Reflecting

Following writing and conferring, the teacher and students spend time reflecting on their ongoing writing growth. At times, the class shares texts, either finished or in-process, receiving feedback and support from their peers. Other times, the teacher and students work to answer the question, "What do we know about ourselves as writers today that we didn't know before?" The format for this portion of the workshop varies, depending on the teacher's purpose. In a *pair share*, students might ask each other questions and receive feedback on that day's work, while in a full-class *circle share*, students might listen to and celebrate one another's work. Teachers participate in the process, sharing their own work and recording both individual and group strengths and needs.

Assessment

In addition to aligning classroom practice with specific literacy content standards, PEBC staff developers work with classroom teachers to develop assessment tools to measure students' growth as writers.

Ongoing Classroom-Based Assessment

Since true assessment takes so many different forms, PEBC staff developers offer teachers guidance as they design a variety of ways to gather information about their students' growth as writers. Staff developers help teachers select the most appropriate assessments for their classrooms to measure writing progress. Staff developers also coach teachers as they implement forms of student self-assessment and peer evaluation.

Bodies of Evidence and Portfolios of Student Work

When teachers work with staff developers, they explore ways for students to create collections of their work to demonstrate their full range as writers. In addition, the staff developers offer management strategies to teachers, so they can modify classroom structures and practices in ways that support the collecting of writing samples, both finished and in-process.

Standardized Tests

Staff developers work with teachers to develop assessment strategies to help students write to various prompts, manage testing time constraints, and develop constructed responses. Staff developers also discuss and model ways students can modify their personal writing styles to meet the demands of test questions. Teachers can choose to focus on the standardized test as a genre of writing, with its own unique format, organization, and logistical demands.

Rubric Assessment

Since PEBC's work is based on current research and theory on writing instruction, it includes the content embedded in many rubric assessment structures, including that of the Northwest Regional Educational Laboratory's 6+1 TRAITS ™ model of writing assessment and its criteria defining the qualities of good writing at different levels of achievement. The PEBC and 6+1 TRAITS ™ both suggest that the traits of quality published writing can be named, defined, exemplified and taught to students. Both maintain that student writing can and should be assessed on a regular basis and that the assessment data should be used to inform classroom instruction. Both also assert that student writers can identify the traits of quality writing and can use this knowledge to set personal writing goals.

Standards for Writing

With the current demand for instructional accountability, educators across the nation are being asked to align their classroom practices with standards in various content areas. PEBC staff developers work alongside teachers to implement classroom practices that meet this demand. Because the scope of PEBC's literacy work is local and national, both levels of content standards are aligned to the PEBC's professional development opportunities.

Students write and speak for a variety of purposes and audiences.
(Colorado Content Standard 2, NCTE/IRA Content Standards 4 and 5)

Staff developers work with teachers to develop instructional strategies to help students construct text that meets a wide range of purposes for writing, their own as well as those prompted from outside sources. Staff developers also support teachers as they work with students to develop the fluency and flexibility needed to address the organizational and content demands of various writing forms and audiences. At the same time, staff developers assist teachers as they guide students to develop a strong voice and sense of ownership in their writing, no matter what the purpose or audience.

Students write and speak using conventional grammar, usage, sentence structure, punctuation, capitalization and spelling.
(Colorado Content Standard 3, NCTE/IRA Content Standard 6)

Staff developers assist teachers in developing instructional strategies that enable students to construct finished products that show all they know and are able to do as writers, an ability that encompasses the elements of an effective writing process as well as the requirements of a high quality finished product. As part of this process, staff developers demonstrate ways in which students can assess their own writing and set appropriate standards for themselves. Staff developers also offer strategies for the editing stage of the writing process, during which students offer and receive constructive feedback about their work.

Students apply thinking skills to their reading, writing, speaking, listening and viewing.
(Colorado Content Standard 4)

By introducing and focusing on the cognitive thinking strategies for writers, staff developers demonstrate and discuss a variety of ways in which teachers can help writers use prior knowledge, ask questions, determine what's important, draw inferences, create sensory images, and synthesize information in their own texts.

Students gather, evaluate, and synthesize information from a variety of sources to create and communicate knowledge.
(NCTE/IRA Content Standards 7 and 8)

Staff developers help teachers design ways in which their students can use writing as a tool for problem-solving in all disciplines. They also show teachers how to link writing skills to information literacy standards.

References

Calkins, L. M. 1995. *The Art of Teaching Writing*. 2nd ed. Portsmouth, NH: Heinemann.

Daniels, H. and M. Bizar. 1998. *Methods that Matter.* Portland, ME: Stenhouse.

Dole, J. 1999. Presentation to the Public Education & Business Coalition. Denver, Colorado.

Goldberg, N. 1986. *Writing Down the Bones: Freeing the Writer Within.* Boston: Shambhala Publications.

Further information on Best Practices in Writing

Anderson, C. 2000. *How's it Going? A Practical Guide to Conferring with Student Writers*. Portsmouth, NH: Heinemann.

Atwell, N. 1998. *In the Middle: New Understandings About Writing and Reading and Learning*, 2nd edition. Portsmouth, NH: Heinemann.

Fletcher, R. 1993. *What a Writer Needs.* Portsmouth, NH: Heinemann.

Fletcher, R. and J. Portalupi, J. 2001. *Writing Workshop: The Essential Guide.* Portsmouth, NH: Heinemann.

Graves, D. 1994. *A Fresh Look at Writing.* Portsmouth, NH: Heinemann.

Harwayne, S. 2001. *Writing Through Childhood: Rethinking Process and Product.* Portsmouth, NH: Heinemann.

Ray, K. W. 1999. Wondrous Words. Urbana, IL: NCTE.

Ray, K. W. and L. Laminack. 2001. *The Writing Workshop: Working through the Hard Parts (And They're All Hard Parts).* Urbana, IL: NCTE.

Reif, L. 1992. *Seeking Diversity: Language Arts with Adolescents.* Portsmouth, NH: Heinemann.

In The Field

Writers at Work in Leslie Blauman's Class

The walls teach in Leslie Blauman's fourth grade classroom — as do the flower bouquets, the cocoons, the gerbils, and the guinea pigs.

The fourth graders gather on couches, chairs, and the floor to begin the day's Writers' Workshop. Leslie holds a picture book in her hands. "The title of this book is *Twilight Comes Twice*. The author is Ralph Fletcher. Sound familiar to anyone?"

"He wrote *A Writer's Notebook*!" Erin answers.

"Right, Erin. Ralph Fletcher teaches us so much about writing. I think his books merit many readings.

The first time I read this book to you, I won't stop to share my thinking. Your job is to listen and enjoy. If you hear some striking words, and you would like to record them in your sketchbook, you sure may." Leslie begins to read. Most of the students look and listen, while a few jot down striking words. At the end of the book Leslie pauses, closing the cover gently.

"You know what? I think Ralph Fletcher used his careful observation skills to study the time of day called twilight. Then he used his remarkable language skills to put his observations into words. It's like our study of the similarities between scientists and poets." Leslie points to the wall on her right. "Remember our question?" The question 'How are poets and scientists alike?' spans the wall.

Surrounding the question are single words: wonder, question, connect, reflect, observe, linger. The students look at the wall, following Leslie's lead as they begin to integrate their learning of science and literacy.

"Here's what I'd like you to do today. Choose one thing in the classroom that you're interested in observing for an extended period of time. Use your writing time to sketch and write. What do I expect to see when our independent writing time comes to a close?" Leslie waits as students raise their hands. "Taylor?"

"You expect to see a sketch and some words."

"Thank you, Taylor. I do expect to see your sketch and words to describe it. Remember to linger; take your time. See something someone in a hurry wouldn't see. You will need your sketchbook and a pencil. Oh! I almost forgot." Leslie moves to a table scattered with microscopes. She adjusts a small container and a hi-tech camera. With the flip of a switch, an enlarged image of the container holding newly formed cocoons appears on the television screen. "Don't forget the cocoons, you guys. We need someone to observe them in order to document the changes. I'm really curious about the cobweb stuff at the bottom of the container."

"I'll do it!" says Mack. He quickly grabs his sketchbook and a pencil.

"Great. Okay everybody, go ahead and get settled." Leslie finds her own sketchbook. She sits near the cage of a large guinea pig. Seconds pass, and she notices a buzz near the gerbil cages. The gerbils are a new addition to the classroom, and many kids crowd around to get a good look. Leslie suggests they move the two cages to the center of the rug to provide a better view for all. It works, and the buzz fades to quiet.

After sketching and writing herself for a few minutes, Leslie leans over to the student seated next to her. "How's it going, Ariel?"

Ariel adds another detail to her sketch of the guinea pig. "I'm watching him eat," she says, and she writes the word "chew" next to her sketch.

"Hmmm. Any other words come to mind to describe the way he eats?" Leslie waits as Ariel thinks.

"I don't know," Ariel answers.

"Okay. I have a suggestion. Go to the shelf and get a thesaurus. Look up the word "chew" and see what you find." Leslie leaves to confer with another writer. Ariel heads straight for the shelf.

"What do you think?" Leslie sits next to Mack at the cocoon table.

"I think the cocoons are shivering. I thought it might be the kids shaking the table. But the more I watch, the more it seems it's the cocoons moving on their own." Mack lowers his head, observing the actual container. He then glances at the image on the television screen.

"Write the word 'shiver,' Mack. That's such an important observation. I wonder what it means."

"Here's what I think," adds Brandon. He shows his sketch to Leslie. He's sketched three drawings of a cocoon from three different angles. One is labeled "front," another "back," and a third "side."
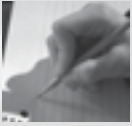
In The Field (continued)

"Wow! How do you know that's the front?" Leslie looks at Brandon. She obviously has no idea how he will respond. Her curiosity is contagious.

"I'm not sure. I just think it is the front."

"Keep thinking about that, Brandon. I can't wait to hear what you decide. And don't forget to record a few more words as you continue your work."

Leslie confers with three more students before asking everyone to take a couple of minutes to complete their sketches and record their words before coming to share. Ariel approaches Leslie, thesaurus in hand. "I found it, Mrs. Blauman. I wrote three new words next to my sketch." Leslie asks Ariel to share with the class. Ariel agrees to teach the first thesaurus lesson of the year.

The students gather again on couches, chairs, and the floor. Ariel begins the "share" session. She explains her use of the thesaurus, reading the words "chew," "nibble," "munch," and "grind" from her sketchbook. Students respond with pledges to try the thesaurus tomorrow. Two more students share before Leslie wraps up Writers' Workshop.

"Your observation skills and your ability to choose precise words to describe your sketches are improving. I'm impressed!" Leslie picks up the picture book she used in the mini-lesson. "Your work this morning reminds me of Ralph Fletcher. Tomorrow we will return to this book. I'd like to read it again, and I'll stop to share my thinking about the similarities between scientists and poets. Nice work today. Anybody hungry?"

The fourth graders hustle to their desks, exchanging sketchbooks for lunch boxes. Soon the room is empty, and all is quiet – all except a faint nibbling noise in a corner cage.

Writers at Work in Cheryl Zimmerman's Class

The students in Cheryl Zimmerman's first grade class know what's important to six and seven-year-olds: getting a swing at recess, showing off your pink glittery lip gloss, and expertly demonstrating how your toy monster truck transforms into a robot. So how does she help these first graders know that as writers they can determine importance, too? It is simple. Cheryl shares the work and wisdom of many mentor writers. She also shares her own process as a writer, taking a stab at using this strategy. Cheryl believes that strong teachers of writing "never ask their students to try something they aren't willing to try themselves."

As her first graders gather around on the floor, Cheryl pulls out her most current read, a copy of *Scuba* magazine. "Hey you guys, last night I read some of this magazine. Remember my passion topic is sea turtles, so I turned to the table of contents in this issue and sure enough, there was an article about sea turtles on page 23. This author chose to write an entire article on sea turtles. I love how writers of nonfiction help us to determine importance in so many ways." Her first graders listen carefully as Cheryl describes her noticings as a writer. Cheryl sees Adam's raised hand. "What are you thinking, Adam?"

"In my book about killer whales, I noticed a few bold words, and the words at the top of each page are really big." Adam's grin reveals two missing teeth. His sense of wonder is enlightened by Cheryl's explicit description of the text features in her ocean magazine.

"Why do you suppose the writer did that?"

"To catch my eye like we've been talking about. The bold words and the big words must be important."

"I think that makes sense, Adam." Cheryl returns to the magazine article she was sharing to capitalize on Adam's brilliance. "And I discovered a cool connection to what you're saying in my text. I found that not only did my author use bold print to show me which words were important, she also listed them in the glossary. So, I think the author determined which words were most important to remember and understand, then she made those words bold and she defined them in the glossary, all for me, so I'm better able to pick up on what's important. I know that's something good nonfiction writers might do to help their readers. I think it's going to be a challenge for us as writers to do the same."

Cheryl and her first grade class have studied nonfiction writing intensely for three weeks. Throughout their study, they've thought out loud about how boxed text, diagrams, bold print and captions caught their eyes as readers. Now, after researching a passion topic, they become anxious to be writers of nonfiction themselves. They are ready to continue designing their own nonfiction texts incorporating many of the features they had noticed in books

written by favorite authors. Cheryl's students "read like writers" and know the importance of using mentor texts to inform their own writing. They know about rigor. They know about stamina. They know writers employ a variety of skills and strategies as they compose meaningful texts. The evidence of their work together is charted and visible throughout the room.

"As you work on your nonfiction pieces today, think about how you're determining importance as writers. Remember, you can always refer to the chart we've been adding to each day. You've already narrowed your topics to a few important questions and answers. You might try to decide which words within those questions and answers are most important. You might also think about how a table of contents would help your readers find something they're specifically interested in reading." With this goal in mind, Cheryl's students settle into their writing projects. Clipboard in hand, Cheryl travels among writers, listening and watching.

"I think the word *enemies* is important, and the word *prey*." Sarah looks again at her nonfiction draft. "I could be sure to make those words bold on my book page, that way my reader will know to pay attention. It will give him the message that it's important."

"How did you choose those words, Sarah?" Cheryl pauses while Sarah considers the question.

"Well, it seems like some of the other words are pretty simple, like *does* and *have.* Even my little brother gets those words."

"I wonder if *enemies* and *prey* should be defined in your glossary?"

Sarah considers Cheryl's gentle nudge and continues working. Cheryl steps away and briefly records their conversation under Sarah's name on her clipboard.

And the hard work continues . . . after weeks of studying nonfiction, each learner in Cheryl's class proudly produces a nonfiction book. These young writers determined what was important – text boxes, colorful print, informative captions and carefully organized tables of contents filled

the nonfiction book pages. Each first grader's completed text brings to life the concept that young writers can use genre and text structure to communicate their ideas and information about a topic, a topic of passion.

So, alongside lip gloss and transforming toys, features of nonfiction made the first grade determining importance list.

Math

Mathematics Is Thinking

Mathematicians explore and investigate an often uncertain world and attempt to explain what they see. Sometimes a single explanation or answer works, but more often, patterns and relationships emerge that lead to several different conclusions. Logic helps mathematicians justify their methods and determine the validity of their solutions as they try to make sense of the unknown.

Mathematics Is Metacognitive

Proficient mathematicians are metacognitive: they think about their own thinking while they do mathematics. They know when their solutions make sense and when they do not. They can identify the demands placed on them by a particular problem and the methods they need to use to solve that problem. They can also identify when and why the demands of a problem are unclear to them, using a variety of strategies to understand what they need to do.

Mathematics Is Complex

Mathematics is a diverse domain that encompasses quantitative, spatial, and logical knowledge. The pattern and order found throughout mathematics unify these diverse concepts and help people to construct relationships between and among mathematical ideas. While there is great diversity in the types of skills and thinking necessary to do mathematics, pattern and order create a common thread to help individuals make sense of a complex world.

Mathematics Is Language

Mathematics is an abstract, universal language that provides a way for individuals to communicate their thinking. Sets of symbols and carefully defined terms allow them to describe relationships and to order the world. Visual aids, such as diagrams, graphs, and manipulatives enhance the ability to communicate and justify mathematical ideas to others.

Which Mathematics Skills and Strategies Matter Most?

As students learn and do mathematics, they use both conceptual and procedural knowledge to reason intelligently, to solve problems, and to communicate mathematical thinking in a clear and coherent manner. School mathematics should focus on the meaningful development of mathematical knowledge that emphasizes conceptual understanding and connects it to procedural knowledge.

Procedural Knowledge

Procedural knowledge, or surface syntactic knowledge, consists of a formal language or symbol system and the rules or procedures for manipulating those symbols (Heibert and Lefevre, 1986). Procedural knowledge includes:

- the formal vocabulary of geometry;
- the algorithms used for computing with whole numbers;
- the notation used to represent algebraic ideas.

Procedural knowledge diminishes if it is unused, so instruction must build on prior mathematical knowledge. For example, basic addition facts can be learned in a meaningful way if students first gain a conceptual understanding of the operation of addition and then construct the facts by using strate-

gies that build on their understanding of addition. Eventually, procedural knowledge will be accessed directly, and automaticity will be achieved.

Conceptual Knowledge

Conceptual knowledge, or deep semantic knowledge, is "characterized most clearly as knowledge that is rich in relationships . . . a connected web of knowledge, a network in which the linking relationships are as prominent as the discrete pieces of information." (Heibert and Lefevre, 1986).

Conceptual knowledge includes:

- a deep understanding of relationships among numbers;
- an understanding of various types of patterns and functional relationships;
- an understanding of the various meanings of the operations and how they

Thinking Strategies for Mathematicians

The PEBC has applied the cognitive thinking strategies to mathematics, adapting them to the problem-solving processes that mathematicians employ. As students use these strategies across content areas, they learn to use them much more readily and purposefully.

Monitoring for Meaning

mathematicians . . .
- check to make sure answers are reasonable
- use manipulatives/charts/diagrams to help them make sense of the problem
- understand that others will build meaning in different ways and solve problems with different problem-solving strategies
- write what makes sense to them
- check their work in many ways (e.g., working backwards, redoing problems)
- agree/disagree with solutions and ideas
- "think aloud" about what's going on in their head as they work through a problem
- are metacognitive, continually ask themselves if each step makes sense
- discuss problems with others and write about their problem-solving process to clarify their thinking and make problems clearer
- use accurate math vocabulary and show their work in clear, concise forms so others can follow their thinking without asking questions

Activating, Utilizing and Building Background Knowledge (Schema)

mathematicians . . .
- use current understandings as first steps in the problem-solving process
- use their number sense to understand a problem
- add to schema by trying more challenging problems and hearing from others about different problem-solving methods
- build understanding based on prior knowledge of math concepts
- develop purpose based on prior knowledge
- use their prior knowledge to generalize about similar problems and to choose problem-solving strategies
- develop their own problems

Math

Asking Questions
mathematicians . . .

- ask questions (e.g., Could it be this? What happens if? How else could I do this? Have I seen this problem before? What does this mean?) before, during, and after doing a math problem
- test theories/answers/their hypothesis by using different approaches to a problem
- question others to understand their own process and to clarify problems
- extend their own thinking by asking themselves questions for which they don't have answers

Drawing Inferences
mathematicians . . .

- predict, generalize and estimate
- make problem-solving decisions based on their conceptual understanding of math concepts
- compose (like writers) by drawing pictures, using charts, and creating equations
- solve problems in different ways and support their methods through proof, number sentences, pictures, charts and graphs
- use reasoning and make connections throughout the problem-solving process
- conjecture (i.e., infer based on evidence)
- use patterns (i.e., consistencies) and relationships to generalize and infer what comes next in the problem-solving process

Determining Importance
mathematicians . . .

- look for patterns and relationships
- identify and use key words to build an understanding of the problem
- gather text information from graphs, charts, and tables
- decide what information is relevant to a problem and what information is irrelevant

Creating Sensory Images
mathematicians . . .

- use mental pictures/models of shapes, numbers, and processes to build understanding of concepts and problems and to experiment with ideas
- use concrete models/manipulatives to build understanding and visualize problems
- visually represent thinking through drawings, pictures, graphs, and charts
- picture story problems like a movie in the mind to help understand the problem
- visualize concepts in their head (e.g., parallel lines, fractions)

Synthesizing Information
mathematicians . . .

- generalize from patterns they observe
- generalize in words, equations, charts, and graphs to retell or synthesize
- synthesize math concepts when they use them in real-life applications
- use deductive reasoning (e.g., reach conclusions based on known information)

Problem Solving

mathematicians . . .

- listen to others' strategies and adjust their own

- use estimation to determine if their answer is reasonable

- use trial and error to build thinking

- cross check by using more than one way to do a problem (e.g., check subtraction by adding)

- use tools (e.g., manipulatives, graphs, calculators) to enhance meaning

How Do We Teach Mathematics Effectively?

Educational research offers compelling evidence that students learn mathematics well only when they construct their own mathematical understanding (Ginsberg, 1989; Kamii, 1985; Kamii, 1989; Yackel, et al, 1990). To understand what they learn, they must be active learners who enact for themselves the verbs that permeate the mathematics curriculum. This happens most readily when students work in groups, engage in discussion, make presentations, and take charge of their own learning (Everybody Counts, 1989).

Problem solving, rather than being a distinct topic to be covered, becomes the context in which all concepts and procedures are learned. When they truly solve problems, students engage in authentic tasks that they do not know how to solve in advance. Engaged in problem solving, students construct understanding through the processes of assimilation and accommodation with prior knowledge.

Effective math instruction can vary greatly depending on the setting and grade level. However, there are four critical components to math instruction at all grade levels:

      1. Projects
      2. Math Tools
      3. Flexible Grouping
      4. Communication

Projects

Authentic projects integrate the students' conceptual knowledge with their procedural knowledge, allowing them to apply this combined knowledge to real-world problems. When students prepare for a class camping trip, they might make predictions about the cost of the items on their grocery list. After shopping, they would compare their estimations to the actual cost of the supplies. Using the grocery store receipts, they would be able to create an accurate budget for their next trip.

Math Tools

When students use tangible objects to construct the meaning of complex mathematical concepts, they develop a deeper understanding of the content that allows them to apply these concepts accurately in a variety of new settings. Too often, learners are simply taught math *facts*, without learning the tools to apply those facts. For instance, they learn the multiplication tables without being given the opportunity to really explore the meaning of multiplication. Math tools help students develop the conceptual understanding that is sometimes omitted from the curriculum. Hands-on materials do not lose their value in the upper grades. In fact, as concepts become more complex, these materials can help to accommodate the various learning styles of students so that they are more likely to internalize the concepts.

Flexible Grouping

Flexible grouping allows learners to work independently, with their peers, one-on-one with the teacher, or in small groups with the teacher. Rather than assigning mathematical problems solely on the basis of students' competency with a given concept, flexible groups allow students to articulate their own understanding of the content and to teach each other. Working with flexible groups also allows the teacher to provide individual feedback and direction. Working one-on-one or with a small group of students, the teacher can evaluate students' conceptual and procedural abilities. The teacher is able to provide timely, individualized instruction and direct students toward manipulatives and exercises that will help them build their skills. Through conferences, the teacher can also evaluate whether or not a student understands and can apply a given mathematical concept. If a student is struggling, the teacher is available to provide immediate support and reinforcement. These informal assessments provide a window into the progress of the entire class, shaping instruction for future lessons, activities, and projects.

Communication

Effective math instruction includes complex, open-ended problems in which multiple approaches to the problem, if not multiple answers, are possible. Teachers must ask complex questions to extend student thinking, and students must articulate their findings and the logic behind their processes. Small-group work and writing assignments give students this opportunity to clarify their own thinking and to synthesize what they have learned.

Creating a Math Workshop

The idea of creating a content-focused workshop environment is nothing new. Artists and craftspeople have been using a workshop frame for years. When students are able to learn about math in a carefully established workshop classroom, they are given the time, instruction and reflection needed to fully develop their math know-how. The three major components of a literacy workshop are also evident in a math workshop:

- **Crafting Session** – This is the time in the workshop where students and their teacher explore the question "What do successful mathematicians think and do?" A crafting session is the time for explicit, precise mathematical instruction in math procedures, concepts, strategies, skills.

- **Composing as Mathematicians** – During this portion of a math workshop, students put their new math learnings to work, building the stamina necessary to take on more challenging math thinking. To make this time operate effectively, students need to have access to "in the moment" math tasks (assigned as a direct result of the crafting session) and "ongoing" math work (long-term math projects). Support for students' learning can be offered through conferring and collaboration with others in small groups (teacher-guided as well as peer-guided).

- **Reflecting** – As is true of any classroom workshop, math time needs to end with students answering the question "what do we now know about math and about ourselves as mathematicians that we didn't know before?" This time needs to be more than simply sharing work. It should be a time for students to examine the many ways their thinking has evolved and become clearer. Math reflections can be done orally, as in a share circle or pair share, or in writing, as in an entry in a math notebook.

Assessment

PEBC staff development in math helps teachers develop assessment tools and strategies to monitor student learning and to increase student achievement. The PEBC bases its assessment strategies on the Assessment Standards for School Mathematics (NCTM, 1995).

Assessment should reflect the mathematics that all students need to know and be able to do.
With PEBC staff developers, teachers develop assessment strategies that allow students to display their developing math competencies and to document their progress towards meeting district and state standards.

Assessment should enhance mathematics learning.
Staff developers help teachers to develop multiple sources of assessment that strengthen student learning while providing information to guide the teachers' instruction. Such assessments include conferences, journals, discussions, and projects.

Assessment should promote equity.
Teachers work with staff developers to develop equitable practices and to accommodate students with special needs or talents.

Assessment should be an open process.
As they work with staff developers, teachers establish criteria, or rubrics, for assignments and communicate their expected standard of performance to their students.

Assessment should promote valid inferences about mathematics learning.
Staff developers help teachers gather adequate and relevant evidence from multiple sources and to make valid inferences about student learning.

Assessment should be a coherent process.
Teachers develop strategies with staff developers for planning assessment, gathering evidence, interpreting evidence, and using the results as an ongoing part of the math instruction.

Standards for Mathematics

Since the PEBC's professional development in mathematics focuses on authentic problem-solving and clear communication about mathematical thinking and process-

es, it is closely aligned with the Colorado Model Content Standards for Mathematics. Each of the six state standards includes the application of skills in problem-solving situations and the ability to communicate the reasoning used to solve these problems.

In addition to standards in the six areas delineated in the Colorado Model Content Standards, the PEBC's work in mathematics meets the NCTM's separate standards for both problem solving and communication.

Application of mathematical knowledge in problem-solving situations
(All Colorado Model Content Standards, NCTM Standard 6)

Staff developers demonstrate techniques that enhance student problem-solving ability. Teachers develop instructional strategies, such as teaching through problem solving and using a recursive framework, that help students become proficient problem solvers.

Communication of reasoning
(All Colorado Model Content Standards, NCTM Standard 8)

Staff developers assist teachers in developing questioning techniques that probe student thinking. Teachers learn instructional strategies that help students explain their thinking and justify their answers. Strategies for talking and writing about mathematics are also an integral part of the staff developers' work with teachers in their classrooms.

Development of meaningful mathematical knowledge
(All Colorado Model Content Standard, NCTM Standards 1-5)

Staff developers help teachers increase their own understanding of the math content of the standards — number sense, patterns and algebra, data analysis including statistics and probability, geometry, measurement, and computation. They model lessons that focus on conceptual understanding and the meaningful development of mathematical procedures. In addition, staff developers provide teachers with research and other information that will help them understand how they can help their students make sense of mathematics.

References

Ginsberg, H. P. 1989. *Children's Arithmetic: How They Learn It and How You Teach It*. 2nd ed. Austin, TX: Pro Ed.

Hensee, D. 2002. *Reworking the Workshop: Math and Science Reform in the Primary Grades.* Portsmouth, NH: Heinemann

Hiebert, J. and P. Lefevre. 1986. "Conceptual and Procedural Knowledge in Mathematics: An Introductory Analysis." in J. Heibert, ed. *Conceptual and Procedural Knowledge: The Case of Mathematics.* Old Tappan, NJ: Macmillan.

Kamii, C. 1985. *Young Children Reinvent Arithmetic: Implications of Piaget's Theory.* New York: Teachers College Press.

Kamii, C. 1989. *Young Children Continue to Reinvent Arithmetic, 2nd Grade.* New York: Teachers College Press.

National Research Council. 1989. *Everybody Counts: A Report to the Nation on the Future of Mathematics Education.* Washington, D.C.: National Academy Press.

Yackel, P. Cobb, T. Wood, G. H. Wheatley, and G. Merkel. 1990. "The Importance of Social Interaction in Children's Construction of Mathematical Knowledge." in T. J. Cooney, ed. *Teaching and Learning Mathematics in the 1990's.* Reston, VA: National Council of Teachers of Mathematics.
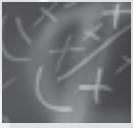
In The Field

Mathematicians at Work in Lorraine Gutierrez's Class

At the beginning of each school day, Lorraine greets her kindergartners with a smile and a song. Today, a rousing rendition of Freeze Dance leaves everyone ready to join the circle and turn their attention to math.

"Yesterday we talked about how mathematicians build sets. Do you remember what we did with the big bag of buttons?" Lorraine waits, allowing time for the children to reflect on yesterday's math lesson. She puts the bag of buttons in the middle of the circle.

Maria raises her hand and says, "We put the buttons into groups. I found four yellow buttons."

"Yes, Maria. We grouped the buttons. I remember your yellow set. The color yellow was the common attribute. Remember the word attribute? I've written the word here on our chart." Lorraine points to the word.

The children look at the word written in large letters on the chart paper. They know they will be invited to add their own thinking to the chart as their study of sets continues.

"Today we will continue our work with sets and attributes. And we will think about a strategy mathematicians use to help them understand math." Lorraine explains how mathematicians connect what they already know to new learning and new situations. She challenges the children to use what they learned when grouping the buttons in order to complete a new math task. All eyes watch as Lorraine pulls a bag from behind her chair. The clear bag reveals many interesting items: crayons, doll shoes, cups, and silk flowers. One by one, Lorraine places the items in the middle of the circle. "Hmmmm. What do you suppose we're going to do with these things?" she asks.

"Put them into sets! We can make little groups like we did with the buttons!" Nicole says as she bounces up and down in her place.

"Wow, Nicole! You are using the strategy I talked about a few minutes ago. You know that we put the buttons into sets, and you're using that knowledge in this new situation. We are going to put these items into sets. But I'm wondering how we'll do it. These items are different. They aren't all flowers or crayons or cups. What will we do?"

Volunteers move into the middle of the circle. Each builds a set using at least three items. When the new set is complete, the young mathematician must think aloud for the group, explaining how the items go together. "These are all purple," Austin announces after gathering a purple crayon, a purple cup, and a purple flower.

"Nice work, Austin. You know from yesterday that we can make a set based on a common color attribute. You did that with these new things just like you did with the buttons."

Eager volunteers build sets and explain their thinking. A set of crayons emerges, creating an opportunity for the class to consider attributes other than color. After the children create a variety of sets on the rug, they are given a new task.

"Okay, you guys. Now I'd like you to go out into our classroom. Collect at least three items that make a set. You can collect anything. Just be ready to explain your thinking. Be ready to tell us about the common attribute of your set. I can hardly wait to see how you use what you already know to build a brand new set!"

Lorraine observes the children as they go about their work. JD finds three magnets. Each is a different color, but they're all circle shapes. Daniel collects three pencils and tells Lorraine that the common attribute is "pointy." Lorraine marvels at the abilities of the children to use their new knowledge independently. She is already considering the possibilities for stretching and applying this knowledge after tomorrow's Freeze Dance.

Mathematicians at Work in Jamie Wisneski's Class

A small table in the corner of Jamie Wisneski's seventh grade math classroom no longer serves as a place to hold "in" and "out" baskets and extra text books. It now serves as a place to hold conversations . . . conversations about math and mathematical thinking.

While students work in groups to solve the problem of the day, Jamie and Kiara, one of her students, sit side-by-side at the table.

"So, Kiara, how's it going for you?"

"Fine." Kiara shifted a piece of blank paper in front of her.

"Okay, I'm curious about your strategy for finding all the factors of sixty (the focus of today's problem). What are you thinking?" Jamie smiled. Kiara's shoulder shrug prompted a new question. "Do you mind if I show you how I would begin to solve this problem?"

Kiara willingly accepted Jamie's offer. Jamie drew and labeled a number line in her notebook. "I'm thinking it makes sense to start by drawing a number line. I'll label the far left side of the line with the number one and the far right side with the number sixty. Does that make sense to you?"

"Yeah, because one times sixty is sixty. Then you could think about two as a factor, then three and then you could just keep going." Kiara's eyes widen with new understanding.

"That's what I was thinking. So what times two equals sixty?"

Jamie and Kiara's conversation continued for the next few minutes. Kiara drew her own number line and began marking factors of sixty on it. Jamie made a few notes about the teaching she'd provided as well as a plan for conferring with Kiara later in the week to see if the teaching had "stuck."

Kiara left the table with a new strategy for solving the problem of the day. She knew Jamie would check in with her when she'd completed the problem. Jaime left the table with new knowledge about Kiara's mathematical thinking – knowledge she hadn't gained from simply grading Kiara's finished work.

Conferring is one of a few critical elements that make up the math workshop in Jamie's room. Traditional desks in rows and lecture-style instruction conflicted with Jamie's evolving beliefs about teaching and learning. So desks in rows gave way to desks in clusters. Pacing to monitor assignment completion gave way to conferring with individuals and small groups to gain insight into students' thinking.

Information Literacy

Information Literacy is Thinking

Information literacy is driven by inquiry. Students are inquisitive by nature—they like to ask questions and look for answers. Pursuing information literacy encourages them to do both. It requires them to come up with questions based on their background knowledge or interest in a topic and then to thoughtfully gather, evaluate, analyze, and synthesize data. With information in hand, they craft something new and original instead of restating what they already know.

Information Literacy is Metacognitive

Skilled researchers are metacognitive: they think about their own thinking while they research. They begin with their own questions, distinguishing which ones can become meaningful, interesting research topics. They recognize when they can find answers to their questions and when they cannot. They can identify the demands of a given question and the ways that they can construct an answer to that question. They can also see how their questions lead to a deeper understanding of a topic and stimulate them to explore more resources to find relevant information.

Information Literacy is Complex

"Doing research" in school has traditionally meant finding and regurgitating information, with a final report sounding suspiciously like the encyclopedia. Information literacy now requires much more of student researchers. Since they are using resources to answer important, real-life questions, they must study a variety of sources, make conscious choices about the materials they use, and synthesize their findings.

Information Literacy is the Thoughtful Use of Technology

Students live in a rapidly changing, global community. Information literacy ensures that they have the skills necessary to take advantage of the multitude of human and technological resources available to them. Students also use information literacy strategies to think and to communicate flexibly about their own ideas and to make their knowledge available to others. When students are information-literate, they can use technology to learn new information and to communicate that knowledge.

Which Information Literacy Skills and Strategies Matter Most?

PEBC staff development in information literacy is based on the Colorado Information Literacy Guidelines, written by a collaborative of the Colorado Department of Education, State Library and Adult Education Office, and Colorado Educational Media Association. These guidelines outline expectations for students as they seek information, create a quality product from that information, engage as learners, both independently and within a group, and act as responsible information users (Colorado Department of Education).

Gathering Information and Constructing Meaning

Information-literate students are knowledge seekers, gathering information and constructing meaning from that information.

"The potential of computers for improving education is greater than that of any prior invention, including books and writing."

Institute for Research

■ **Gathering Information**
After discovering a passionate interest and selecting an authentic question, students assess their information needs based on the scope and purpose of their research project. They then develop a plan for finding that information, asking critical questions and identifying possible resources. At this point, students are ready to gather the information, from both print and electronic resources, focusing on the details and concepts that will answer their questions. As they acquire information from different sources, students decide which information they will use, considering authoritativeness, completeness, format, relevance, point of view, reliability and timeliness.

■ **Constructing Meaning**
Once students select the information they will use, they begin to construct meaning from it by organizing and processing it. They synthesize the information from the different sources, making inferences, building connections to prior knowledge, and drawing conclusions.

Creating Quality Products

After students construct meaning from the information that they have gathered, they are ready to create quality products derived from that information.

■ **Planning a Quality Product**
Using personal or classroom criteria for a quality product, students plan their projects. They first establish a clear purpose for the product, defining the content, format, and audience. They then identify the resources and the process they will use to meet their purpose.

■ **Creating a Quality Product**
In their final products, students strive to meet the established criteria, communicate clearly, in writing and/or in speaking, and present a polished finished product.

Learning Independently and Contributing to the Group

As they research, students must be able both to learn independently and to contribute to the larger group.

■ **Independent Learners**
As researchers, students must choose questions about which they are genuinely curious and maintain their interest in those questions throughout the research process. Students must also be able to establish goals for themselves, determine the process necessary to meet those goals, and monitor their progress towards those goals.

■ **Group Contributors**
When students work on a group research product, they participate effectively by fulfilling many of the same roles and responsibilities as

those in an independent project. They help the group determine its information needs, share responsibility for planning and producing a quality group product, and clearly communicate when presenting the group product. As members of a group, however, they also must collaborate, acknowledge and incorporate diverse ideas, and seek consensus.

Using Information Responsibly

Skilled student researchers know how to select and use information responsibly.

■ **Ethical Usage of Information and Information Technologies**
Students practice ethical usage of information and information technologies by applying copyright guidelines and citing references correctly. If students adhere to these practices, they avoid plagiarism and recognize copyright as protection for the copyright holder.

■ **Respect for the Principle of Intellectual Freedom**
When they enter the realm of research, students must not only understand the concept of intellectual freedom but also recognize the importance of this concept.

Thinking Strategies for Researchers

The cognitive thinking strategies are a critical component of the PEBC's approach to information literacy. These strategies align well with other research in the field, including *The Research Cycle Revisited*, by Jamie McKenzie, which delineates similar skills, such as questioning and synthesizing.

Monitoring for Meaning

researchers . . .

- recognize what they need to find and learn
- identify when they comprehend and take steps to repair comprehension when they do not
- pause to reflect and evaluate information
- choose effective ways of organizing information – notetaking, webbing, outlining, etc.
- use several sources to validate information and check for accuracy
- revise and edit for clarity, accuracy, and interest
- check sources for appropriate references and copyrights

Activating, Utilizing and Building Background Knowledge (Schema)

researchers . . .

- choose topics about which they know and care
- launch investigations and ask questions based on previous interests and experiences
- consider what they already know to decide what they need to find out

Asking Questions

researchers . . .

- narrow a search and find a topic
- clarify meaning and purpose
- evaluate their work by considering: What are the most effective resources, and how will I access them? Do I have enough information? Have I used a variety of sources? What more do I need? Does it make sense? Have I told enough? Is it interesting and original thinking? Does my writing have voice?

Drawing Inferences

researchers . . .

- think about the value and reliability of their sources
- consider what is important to a reader or audience

Determining Importance

researchers . . .

- evaluate and think critically about information
- sort and analyze information to understand it better
- make decisions about the quality and usefulness of information
- decide what is important to remember and what is not
- choose the most effective reporting format

Creating Sensory Images

researchers . . .

- create rich mental pictures to understand text better
- interweave written images with multisensory (auditory, visual, kinesthetic) components to enhance comprehension.
- use words, visual images, sounds and other sensory experiences to communicate understanding of a topic

Synthesizing Information

researchers . . .

- utilize information from a variety of resources
- construct meaning about a topic
- enhance their understanding of a topic by considering different perspectives, opinions and sources

Problem Solving

researchers . . .

- revise and edit for clarity and accuracy
- check sources for updated copyrights and reliability

How Do We Teach Information Literacy Effectively?

Current definitions of the research process have changed the way research happens in schools. Research has moved beyond passive projects that may or may not tie in with the curriculum to investigations that encourage students to think creatively and build new knowledge.

There are four critical elements to effective information literacy instruction:

1. **Environment**
2. **Research Cycle**
3. **Collaboration**
4. **Technology Integration**

Environment

Library media centers should be vibrant, active learning environments for the entire school, true learning centers where adults and learners gather, debate, read, write, construct, listen, seek information, and view the work of other learners. The school library should be a place in which students learn to sculpt knowledge of the world for themselves.

A library designed to support information literacy is an inviting, comfortable, and intellectually stimulating place for both students and teachers. Teachers and librarians create and build the library collection together, based on curricular needs and student interests. The library collection complements the textbook, and the library becomes an extension of the classroom.

Research Cycle

The goal of instruction is not a list of information literacy skills, but rather competency in carrying out research independently. Teachers and librarians should consider the following research cycle as they plan for student research. Eventually, students should be able to implement this process on their own:

- **Purpose.** Why are we doing this? What do we want students to learn? What do students want to learn?
- **Exploration.** What do we need to know to ask good questions and plan our project?
- **Resources and Search Strategies.** What are the best sources of information and materials, given the purpose of our research?

- **Reading for Understanding.** What comprehension strategies will help us understand this information?
- **Organization.** How will we gather, organize and evaluate the information we collect?
- **Writing and Presenting Information.** What is the most engaging way to present what we have learned? What information, ideas, and insights are we trying to communicate?
- **Assessment.** Did we achieve our purpose? What did we learn about the research process and ourselves as learners?
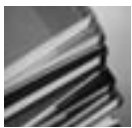
Information Literacy

Collaboration

School librarians no longer limit their work to checking out books, reading to young learners, and ensuring that the books are shelved in the right order. They now collaborate with teachers to design, implement, and assess instruction together in ongoing partnerships. They have become instructional leaders for the school, helping teachers plan, teach and assess student learning at the same time that they assist students with complex, in-depth investigations on a variety of subjects and topics.

As they strive to teach information literacy to their students, all staff members begin to view themselves as learners first, carrying out their own investigations and inquiry. In addition, teachers and librarians continually rethink and redesign instruction to meet information literacy standards and expectations more effectively.

Technology Integration

Technology is a means, not an end. The primary skills necessary to develop information literacy are still reading and writing. More than anything else, information literacy requires that students have the ability to read and synthesize material in order to present it in a logical, appropriate manner. With the use of technology, students simply have access to a more comprehensive collection of material to inform their research.

Teachers effectively integrate technology into the curriculum only when they decide that a certain technology supports the inquiry process and is the best tool to enhance student learning. As teachers decide whether or not to incorporate technology into the curriculum, they should consider the following:

- **Access.** How readily available are the technologies for teachers and students, and how are they organized?

- **Operability and Ease of Use.** What are the levels of understanding usability for teachers and students? Will the activity be successful, or will it be frustrating?

- **Engagement.** Will the use of technology provide challenging tasks, opportunities, and experiences for learning?

- **Functionality.** Will the skills learned be reapplied and facilitate access to and presentation of information?

Standards for Information Literacy

The PEBC is mindful of the pressures and expectations of teaching to standards and has carefully developed staff development in information literacy that supports teachers as they implement a standards-based approach. When teachers instruct students in information literacy, they address standards across content areas.

Students read and understand a variety of materials.
(Colorado Model Content Standards for Reading and Writing, Standard 1)
PEBC staff developers help teachers design and conduct research projects with their students. They support teachers as they show students how to pull information from multiple sources and media, to understand the differences and appropriate times to use one material over another.

Students read to locate, select, and make use of relevant information from a variety of media, reference, and technological sources.
(Colorado Model Content Standards for Reading and Writing, Standard 5)
PEBC staff developers offer demonstration lessons, modeling instructional and reading comprehension strategies for teachers. They show how they are metacognitive while they research their topics on the Web, how they monitor meaning while they take notes, how they ask questions, and how they determine importance throughout the inquiry process. Teachers debrief these demonstration lessons with the staff developers, deciding how they will incorporate these strategies into their own instruction.

Students understand the process of scientific investigation and design, conduct, communicate about, and evaluate such investigations.
(Colorado Model Content Standards for Science, Standard 1)
As PEBC staff developers help teachers to create a research process for their students, they also offer training in the scientific process. They show teachers how students can learn to ask questions to develop a hypothesis, map a topic to design a process, and explore resources to test a theory or find answers to a question.

Students know how to use the processes and resources of historical inquiry.
(Colorado Model Content Standards for History, Standard 2)
With the assistance of PEBC staff developers, teachers design history projects that require students to ask questions, activate background knowledge, gather data, and infer outcomes.

References

Colorado Department of Education. State Library and Adult Education Office. Colorado Media Association. Model Information Literacy Guidelines. September, 1994.

Institute for Research in Educational Finance and Governance. *Promise, Potential, and Pragmatism: Computers in High School.* 1984.

In The Field

Researchers at Work in Fran Jenner's Library and Beth Olsen's Class

Sticky notes abound in the library. Librarian Fran Jenner and second grade teacher Beth Olsen distribute stacks of books and sticky notes in preparation for their work with Beth's class.

"I hear you've asked some interesting questions about pioneer life. Who would like to share a question?" Fran waits as the students scan the questions they've recorded in their Writers' Notebooks. "Sarah, what have you got?"

"How did pioneers tell time?" Sarah reads.

"How did you arrive at that question, Sarah?" Beth asks.

"Well, Tamara asked if pioneers had clocks, and I started to think if they didn't have clocks, then how did they tell time?"

Fran smiles. Sarah has touched on an important point. "I've noticed that one question can lead to another question. You and Tamara just demonstrated how that works."

"We've noticed something else about our questions over the last few days, Mrs. Jenner." Beth points to a chart. She explains how the questions written in blue represent the questions the kids asked early in their study of pioneer life. As they uncovered answers and became more familiar with the content, the kids revised their early questions and recorded new, more specific questions in red.

"The more you know, the better your questions get," Chris says as Fran reads the class-created chart.

"How true! I'd like to share two of my own questions with you. I'd like to know what the pioneer kids did at recess. I'm also curious about before and after school activities." Fran takes a book from the shelf next to her. "Now I have a book and I have my questions. What's my next step? How should I go about finding the information I need?"

"Look in the table of contents," Ashley answers.

"Good thinking. We know that nonfiction texts contain features designed to help us locate information." Fran projects a copy of the table of contents onto a large screen. "Here's the table of contents. Now what?"

"Think about key words. What key word from Mrs. Jenner's first question might help us locate some information?" Beth looks intently at the screen.

"Recess!" Ashley points to the word on the transparency. Fran flips the pages of her book to the section about recess. She skims the text and tells the class it's likely she'll find the answer to her question in that section of the book.

Attention is turned to Fran's second question about before and after school activities. The second graders suggest many key words listed in the table of contents, but none of them reveal any answers. Fran then models how a researcher uses an index when looking for specific information. Still no answers. The dilemma offers Fran a chance to think aloud.

"I think I'll put my before and after school activities question aside for now. I just can't find the information I need. But guess what? As you helped me to search through my book, a new question formed in my head. It's almost as if my new question was hidden underneath my other question. Now I'm wondering what pioneer classrooms were like. I remember seeing two or three sections in my book that might help me answer this new question." Fran finds some information about pioneer classrooms. She thinks aloud as she reads the text, determining which words are most important and recording those words on a large sticky note. Confident that the students are ready to begin their own research, Beth and Fran invite them to move to the tables where they find stacks of pioneer books and sticky notes.

Over the next thirty minutes, the second graders pore over the books at their tables. Fran and Beth move from table to table, conferring with individual students. Fran helps Chris as he studies a diagram of a covered wagon. She stands tall, explaining the dimensions on the diagram in relation to her own height. Beth encourages Michael to find another resource after exhausting the possibilities for finding an answer to his question using the one book in his hands.

Lunchtime looming, Beth lures the kids away from the tables. Everyone gathers to share what happened during the independent work time. Kyle explains how he found information about the cost of supplies by looking in the table of contents under the section called "General Store." Ashley suggests that it's possible to get lots of information from pictures and captions. Chris demonstrates the size of a covered wagon, comparing the length to Mrs. Jenner's height. And in response to a unanimous chant for more, Fran and Beth promise the students more time tomorrow with their questions, the books, and the never-ending supply of sticky notes.
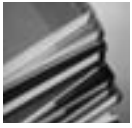
In The Field (continued)

Researchers at Work in Jeff Cazier's Class

"What do you want to know about the composition of the earth?" Seventh grade science teacher Jeff Cazier recorded his question at the top of a blank chart.

"What is inside the earth?" Carla asked.

"Will the inside of the earth ever run out?" Shawna wondered. "And how do we know what's in the earth if no one has ever been inside?"

Students wondered out loud before recording their questions on sticky notes and posting them on the chart.

"Right. I wonder if anyone can relate that to what happens with a volcano." Jeff stops to allow students time to think and respond. After hearing from a few students, Jeff continued. "Scientists observed lava coming out of a volcano and based on what they saw, they made a guess about what is inside the earth. As we progress through our study, we'll be doing lots of that – making educated guesses based on what we see. And as we go about confirming our thinking we'll collect important facts from our reading. Right now I thought we'd take a look at how we might do that with our science textbook."

Over the past few class periods Jeff observed students reading the science textbook, and just as scientists do, Jeff made instructional decisions based onwhat he saw. Jeff noticed that his students struggled when trying to mine a few important

facts from a dense textbook page. So, prior to the class demonstration, he challenged himself to dissect the ways in which he determined importance as a reader.

Jeff selected a newspaper article about an unfamiliar topic. As he read, he highlighted important facts. He jotted notes in the margins detailing his thinking. "The author repeated these words, so I'm thinking they're important. These were the last words in the article and they seemed to summarize the big idea. The bold print here is a signal of importance."

Having done his "homework," Jeff felt prepared to think aloud for his students. Jeff moved from the chart to the overhead projector. A single page from the textbook filled the large white screen.

"So how do readers collect important facts from their reading? I've been doing a lot of thinking about that. As I read this page from our textbook aloud, I'll stop here and there to share my thinking. Your job is to observe and listen. In a few minutes, I'll ask you what you noticed about my reading and my thinking. Here we go…"

And with that, Jeff blurred the lines between science teacher and reading teacher. After all, he and his students were on a quest… what is inside the earth?