Hands On!

A publication for mathematics and science educators

Spring 2004 Volume 27, Number 1

TERC

Test Scores:

What Can They Tell Us?

By Diana Nunnaley

You have your end-of-year test data for grades 3, 6, and 10; you have sorted the data by poverty levels, race, ethnicity, disability, and limited English proficiency to determine whether you are leaving some students behind.

Now what do you do?

(continued on page 4)

Inside...

HOW MANY MORE TORNADOES DOES TEXAS HAVE THAN CALIFORNIA?

WHAT STATES BORDER ON IOWA?

TERC's newest math game, GeoQuest USA provides hours of challenging fun with five exciting facts-and-figures games about USA geography. The beautifully designed Satellite Map and deck of fact-filled State Cards will test players' knowledge of "stats and facts" about the fifty states. From borders to capitals, tornadoes to statehood, GeoQuest USA will sharpen players' math skills and power up their geographical knowledge.

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Editor's Note

The satisfaction, sense of achievement, and joy of solving a problem is often so apparent on the face of a young child who has just made a discovery. Children are eager to ask questions, investigate, and offer their own unique explanations for why things are the way they appear to be. It would seem that the desire to reason and make sense of the world is basic. The researchers and developers at TERC seek to build on that basic need and encourage students to reason and think mathematically and scientifically.

For TERC this might mean providing greater access to the science that is part of the exploration of Mars (page 16) or giving students tools to examine the mathematics of motion (page 12). It influences our math curriculum and professional development work, which seeks to foster a generation of students who view math as useful and doable (page 8). It also affects the way we reexamine the benefits of an "ancient cognitive tool," the journal (page 18).

Our cover article discusses new tools that are helping schools compile comparative data for analyzing what is being taught and how. It is an effort to go beyond just identifying the students who are not achieving and examining why.

No child should lose the desire to inquire and figure things out; rather, every child should be able to develop the mathematical and scientific skills to help him or her make sense of the world in meaningful ways.

—Kenneth Mayer, Editor

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As educators seek to raise student scores on annual assessments mandated by the No Child Left Behind (NCLB) Act of 2001, they have access to data on who is struggling, but they often lack data to help explain why. Under NCLB, states conduct annual reading and math assessments between grades 3–8, and at least one assessment between grades 10–12. The law requires that assessment results be disaggregated, that is, results are to be sorted and reported by poverty levels, race, ethnicity, disability, and limited English proficiency. The process aims to identify who is having trouble and what content areas are problematic but offers little insight into what causes low scores. In a search for answers, many schools and districts begin by examining their curriculum: Is it aligned with the standards? With the state test? Their search can only take them so far since important information is missing: data on what is actually being taught in the classroom.

Seeing what is taught through data

A new set of tools, the Surveys of Enacted Curriculum (SEC), is helping to fill this data gap by providing a way to identify and visually represent the content taught and the instructional approaches used in classrooms and across grade levels. The survey system and its reporting and analysis tools display these data and data gathered from state standards and assessments in a way that allows educators to compare what they are teaching with what they should be teaching, what is being tested, and how students perform on the tests.

The survey system allows educators to compare four areas of curriculum data: intended curriculum, enacted curriculum, learned curriculum, and assessed curriculum. (See Figure 1.) Intended curriculum encompasses what is to be taught as defined in state curriculum framework content standards. Enacted curriculum refers to the content actually presented in the classroom. Assessed curriculum is the content that is tested, and the learned curriculum is measured by the scores students receive on the tests.

Teachers provide the data for the enacted curriculum. They complete a survey (either online or with paper and pencil) that takes about an hour to complete. They provide input on the curriculum topics they teach, how much time is spent on each topic, and the variety of instructional approaches they use, such as time devoted to whole class instruction, hands-on activities, or small group work. They also identify what students are expected to do in a lesson. For example, to what extent does the lesson ask students to memorize, perform procedures, reason and analyze, communicate understandings, or solve problems.

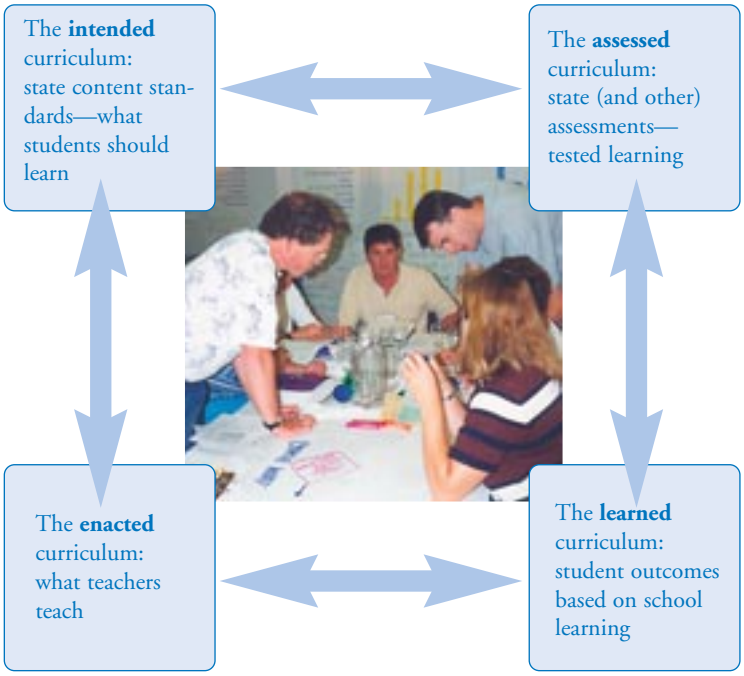

Figure 1: Surveys of Enacted Curriculum

The researchers who developed the tool code the teachers' data as well as data gathered from the content standards, assessment items, and assessment results for each grade in order to generate content and instructional maps. Figure 2 shows examples of content maps: three are generated from teacher data and one from content standards. The maps plot the amount of time spent on a subject area (listed on the vertical axis) and the amount of time the students are required to engage in specific cognitive activities (listed on the horizontal axis). The amount of time is indicated by color with red showing the highest percentage of classroom time and green, brown, beige, and white indicating decreasing amounts of time. With these maps, teachers and administrators get a snapshot of what is happening in the classroom and can compare their enacted curriculum maps with the intended, assessed, and learned maps and charts.

Content Maps

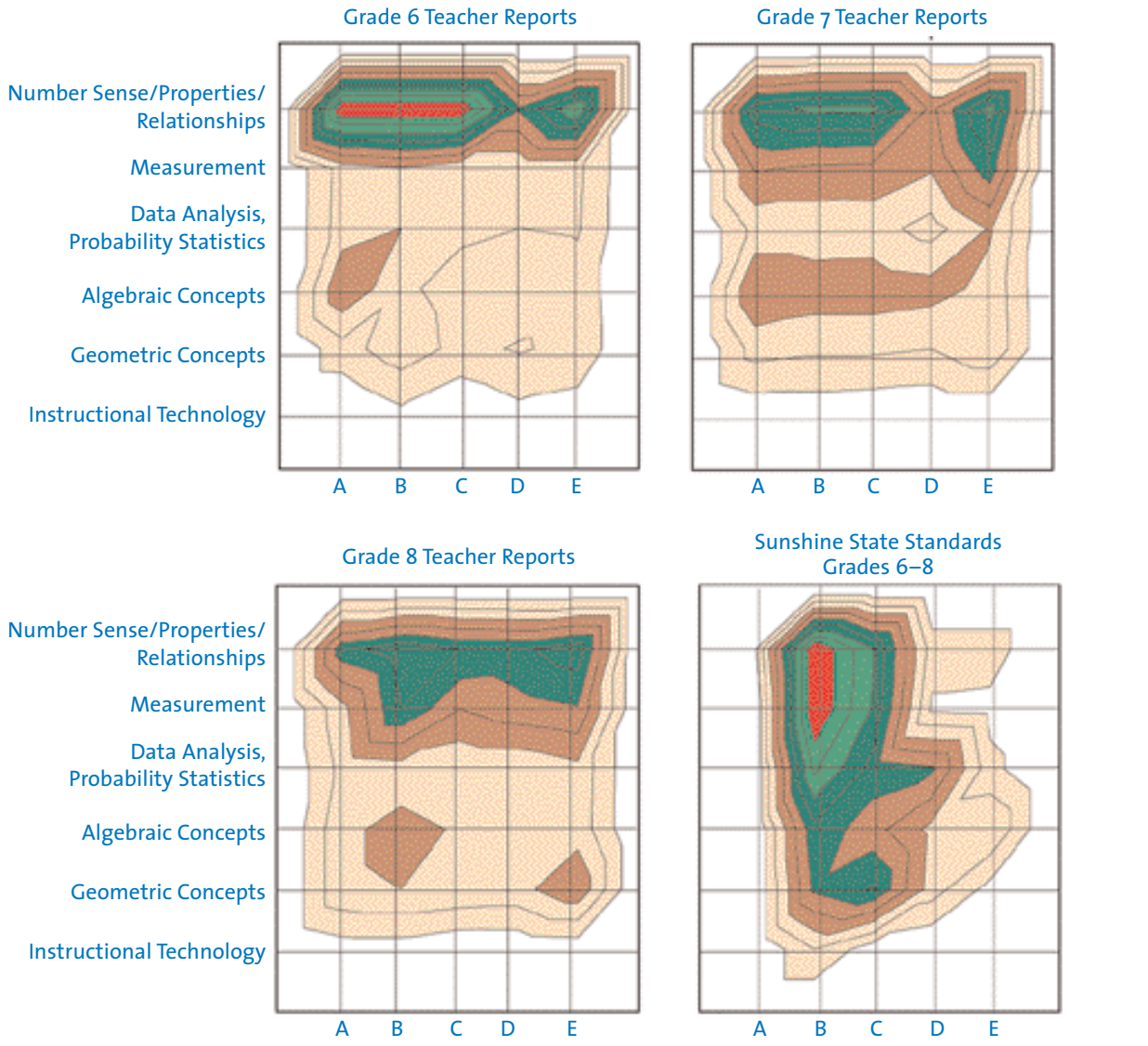

Figure 2:
These content maps were some of the first maps Homestead Middle School teachers in Florida viewed during their professional development sessions on using data. They eventually studied many more charts and graphs representing their survey data, including data on assessment practices, teacher preparation, use of technology and homework, and beliefs about student learning and professional collegiality.

Surveys of Enacted Curriculum

Tools for Aligning Instruction, Standards, and Assessments

The Surveys of Enacted Curriculum (SEC) offer a practical method for collecting, reporting, and using consistent data on instructional practices and subject content taught in classrooms. The survey instruments and reporting tools provide an objective approach for schools, districts, and states to analyze instruction in relation to content standards.

The surveys were developed by a collaborative of state education specialists and researchers led by Rolf Blank, director of education indicators at the Council of Chief State School Officers (CCSSO). The survey instruments and data reporting designs are based on research conducted by Andrew Porter of Vanderbilt University (former director of the Wisconsin Center for Education Research [WCER]) and John Smithson, senior associate at WCER.

Data on Enacted Curriculum Project

TERC and Learning Point Associates (formerly NCREL), working with CCSSO and WCER, have developed resources to help states, districts, and schools administer and interpret the survey. Forty schools from five urban areas are participating in a research program designed to help teachers and administrators use the SEC data to improve instruction. In the program, teachers learn how to collectively examine and analyze the data as a way to set a course of action to improve student learning. In the process, teachers and administrators discover the types of data they need to monitor progress and examine practice. The collaborative approach allows teachers to look reflectively at their own practices as well as share and learn from colleagues.

For more information see www.SECsurvey.org and www.ra.terc.edu/DEC.

Using data to improve teaching

Homestead Middle School in Florida is one of several schools using the SEC tools. Like many schools working to establish their systems for demonstrating adequate yearly progress under NCLB, Homestead uses annual test scores to determine which topics in the curriculum are most troubling for students and to identify which students are having the most difficulty. Unlike many schools that get stuck guessing at the root causes for low student achievement, Homestead is involved in a research program that is helping the teachers work together to analyze their SEC data, generate questions for further investigation, and take action to improve student learning based on their findings.

The maps in Figure 2 are some of the first maps that Homestead teachers viewed during their professional development sessions on using data. There were several observations the teachers made just from these maps. They saw that overall the sixth grade math teachers were devoting most of their time to teaching number sense, properties, and relationships, with the bulk of instruction calling for students to perform procedures. This emphasis seemed to repeat in grades 7 and 8. Looking at their learned curriculum maps (not shown) they saw that their students performed better than the state average for this strand, prompting the group to ask if there was a connection. They also could see from their learned curriculum maps that students were having the most difficulty with data analysis and probability. They asked if that was directly linked to instruction time. When the teachers compared the intended curriculum map with the enacted curriculum map they saw that the maps were not aligned. The teachers observed that most of the content strands in the enacted maps are sketched in wide bands of beige across all three grades. Some teachers wondered whether this was a visual representation of the "mile-wide, inch-deep phenomenon" in which teachers cover a wide range of topics in little depth.

Equally revealing and as provocative to the team as their content charts were the SEC data about instructional practices. Data charts highlighting the type and degree of instructional practices applied by all math teachers indicated wide variation in the approaches teachers were using. They also observed that more whole-class lecture occurred in classrooms with higher percentages of lower-achieving students. They began to question why this was occurring and whether they needed to change some of their practices, asking themselves whether they were making any assumptions about why standard-level classes should get more whole-class instruction.

Together, assessment results, content alignment maps, and instructional practices data shed new light on the teachers' root-cause analysis of student achievement. Working with their administrative support team—Homestead assistant principal Deborah Montilla, instructional specialist Cecelia Magrath, and science department chair Kelly Gibson—Homestead's teachers designed their professional development release days to dig further into their data to compare curriculum across the grade levels and to examine best practices in math instruction. Curriculum mapping activities determined that across the three grades, teachers were using almost identical materials. Their findings validated the SEC data. This was an important realization for the teachers, who had believed that they were following the curriculum and allowing students to build on previous knowledge.

During the summer break, following Homestead's initial foray into a collaborative inquiry process for using school data, grade-level teams gathered to identify critical unmet standards and strengthen curriculum content and teaching practices to meet these standards. After two years of basing changes in practice on their continued analysis of data, including monthly Saturday sessions where teachers visited one another's classrooms to examine materials and talk about teaching strategies, Homestead teachers are seeing results. Their students have made significant achievement gains, raising the school's standing on the state report card system.

Teachers at the Hanes Middle School in Winston-Salem, North Carolina, are also gathering to analyze their SEC data. In reviewing what the system calls "fine grain" maps which further divide content topics into smaller categories, they discovered their teaching of geometry was not very well aligned with their math standards and their end-of-year assessment. One math teacher said to his colleagues in the data analysis group, "I thought I knew what was in middle grades geometry. I'm not sure I believe that now. I want to take a closer look at the standards and see just what the content is." The collaborative process for examining the data created a safe environment for the math teacher to voice his doubts and concerns about his own teaching. At the high school in Winston-Salem, science teachers noted wide variations in what was being taught and how. No two biology classes were covering the same content in the same way. Specifically, honors courses covered a different scope of content than standard classes. The finding prompted a teacher to cover the same content with the standard-level class as he covered with honors-level students. The standard-level class went on to ace their quarterly assessments.

The teachers involved in using a collaborative inquiry process to examine the SEC data are moving beyond simplistic explanations for low student achievement. They begin with the data, looking for clues and generating questions to investigate. In the process, the teachers grapple with philosophical and pedagogical issues. They go beyond reviewing the lists of topics in their standards and ask what students are required to do to demonstrate their understanding of those topics. They seek additional data as a way to monitor their efforts to change instruction, including analyzing student work.

Many schools around the country are learning that gaining access to useful data is only one part of the challenge. How to use the data—how to engage an entire staff in the analysis of the data and how to act on the results of their analysis collectively—is more challenging and also more productive. The Surveys of Enacted Curriculum are somewhat like having infrared glasses to make things visible in the dark. Graphically displaying data about their enacted or taught curriculum and being able to compare that to standards and to the assessed curriculum offers teachers the ability to scrutinize their assumptions about how and what they are teaching. The process can allow teachers to collectively address inequities in their schools and to ensure that all students are getting what they need to achieve.

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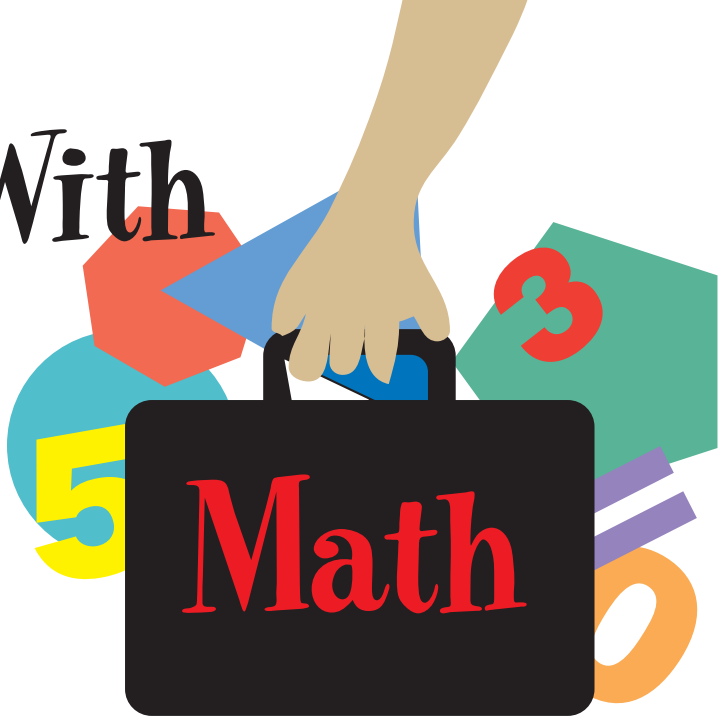
Photo page 4: Molly Singsen Richter

On the Road With



By **Myriam Steinback**

Each summer for the last seven years my colleagues and I have packed up boxes of *Investigations* curriculum units, samples of student work, snap cubes, pattern blocks, and hundreds of participant manuals and traveled across the United States to big cities and small remote towns. During this time we have met thousands of math teachers, who take time away from friends, families, and summer fun to reexamine the mathematics they know and teach. As workshop leaders and developers, we offer these teachers an intensive week of study designed to help them transform the way they think about and teach mathematics.

Investigations Workshops for Transforming Mathematics is a professional development program that began in 1997 with a five-day workshop to assist schools and districts implementing the *Investigations in Number, Data, and Space* elementary mathematics curriculum developed at TERC. Since then, our program has expanded to meet the needs of a growing number of schools seeking to improve their mathematics instruction with *Investigations*. In addition to our Level 1 workshop, we now offer Level 2 and Leadership workshops. While participants come for help with implementation, the long-range goal is to help them improve mathematics teaching and learning so that their students become mathematically proficient. To date, nearly 12,000 educators have participated, and we have been to 59 cities in 23 states.

Only one week?

We say the workshops are for transforming mathematics, but can we really do that in just one week? Our experience tells us that one week of professional development provides a foundation on which teachers within a school system can continue to build their content knowledge of mathematics and teaching.

When a school or district chooses *Investigations*, they are making a choice to transform the way teachers teach and children learn mathematics. They have chosen the curriculum because they want their students to become mathematically proficient. They want students to understand mathematical concepts, demonstrate skill in computation and procedures, reason and apply their understandings and skills to solving problems, and see math as useful and doable. It is reasonable to expect that any curriculum that aims to do that will require time and professional development. Transitioning to a curriculum like *Investigations* is not just a change to a new textbook. It is not a matter of learning a new sequence of topics or spending an extra week on fractions or division. Teaching for mathematical proficiency affects the role of the teacher and the classroom community she builds, in which mathematical discourse is central—students share and defend their strategies for solving problems and they challenge peers to explain theirs. For teachers to feel grounded in their own mathematical content knowledge and build a classroom environment that allows for learning mathematics in depth, they need ongoing support.

So what can we truly accomplish in just one week? We try to be explicit about what the workshops can do and what they cannot do. They are not a crash course in teaching the curriculum. Our Level 1 workshops offer a starting point, a place to experience the teaching strategies the curriculum requires and to examine math content in ways that may be unfamiliar. Level 2 workshops help teachers who have experience with the curriculum deepen their understanding of the development of number and computational fluency through the grades. Educators who are supporting the implementation of *Investigations* attend our Leadership workshops to consider implementation issues while becoming familiar with professional development materials they can use in their districts.

Because they happen during the summer, away from the immediate demands of the classroom, our workshops offer an opportunity for teachers to focus on just one part of their job as elementary school educators—teaching mathematics.

The workshops are a time for participants to examine their own mathematical learning and to experience and question the kind of environment and teaching that supports mathematics learning. As one district leader said, "We want all our teachers to have the opportunity to have the same experience, to learn together about the mathematics, the curriculum, and children's reasoning as they get started implementing *Investigations*."

What happens at the workshop?

The workshops model the teaching strategies used in the *Investigations* classroom. We want participants to see themselves as mathematical learners in the same way their students are learners. This begins with respecting the learner and that includes everything from listening carefully to understand others' thinking to paying attention to the physical classroom environment and providing all the necessary materials. We have learned that comfortable participants and aware leaders make for better learning. Comments like "Too much sitting" and "The room was hot" are taken very seriously. When we arrive in a new location on Sunday mornings, our first task is to get to know our school space and the people there who can help us make it the best environment for engaging with and learning mathematics.

Time to do mathematics is central to the week, as it should be for the elementary school mathematics classroom. Our workshops always begin with a mathematics problem. In Level 1 workshops the leader welcomes participants and then immediately poses a problem for them to think about and solve in their head. Participants are asked to share how they solved the problem and to identify the math they knew that helped them solve the problem. This process begins to model a way to talk about mathematics and underscores the importance of being able to communicate strategies and thinking.

Workshop Sites 1997–2003

Arizona
Phoenix
Tucson

Arkansas
Searcy

California
Riverside
Thousand Oaks
Ventura

Colorado
Boulder
Cherry Creek
Clifton
Loveland

Connecticut
Redding

Delaware
Lewes

Iowa
Cedar Rapids
Marshalltown

Maine
Farmington
Gardiner
Livermore
Scarborough

Massachusetts
Arlington
Attleboro
Boston
Berkshire
Cambridge
Dedham
Deerfield
Marshfield
Nantucket
Northampton

Michigan
Detroit
Dexter
Flint
Howell
Lansing

Minnesota
Shakopee

Missouri
St. Louis

Nebraska
Omaha

New Jersey
East Orange
Plainfield

New Mexico
Albuquerque
Las Cruces

New York
Fairport
New York City

North Carolina
Charlotte
Durham

Ohio
Cleveland
Columbus

Oklahoma
Stillwater

Pennsylvania
Perkasie
Philadelphia

Texas
Arlington
Elgin
Killeen
San Antonio
Uvalde

Utah
American Fork

Washington
Bellingham
Everett
Redmond
Sedro-Wooley

Following the discussion, participants are asked to remember their mathematical experiences in elementary school and to articulate what they want their students to experience in mathematics today. We believe this reflection is important because it respects the perspectives of each participant. We know that people come to the workshops for different reasons. Some teachers and administrators are very familiar with *Investigations* because they just went through a thorough curriculum selection process or have used it in their classrooms; they are eager for more experience. Others may have limited exposure to the curriculum and its goals. They have concerns about how it will affect their students and want a chance to question and test the curriculum's approach to teaching mathematics.

The workshop leaders expect this range of experience. Their aim is to inspire and educate. The single most important expectation is that participants actively engage with mathematics and think about their own mathematical learning process and how it informs what they want for their students.

Who are the leaders?

The leaders of the *Investigations* Workshops come from many states across the country. They have used *Investigations* in their classrooms for at least five years, have been involved in professional development activities both in and outside their schools, and have national recognition. Among our leaders are *Investigations* authors, staff developers, coaches, and six Presidential Awardees for Excellence in Mathematics and Science Teaching. We gather once a year for a retreat where we plan for summer workshops, learn mathematics together, and reflect on the work we do.

The leaders are focused on making sure all students (and workshop participants) have access to quality instruction and the opportunity to learn. We developed a set of guiding questions that we ask participants to reflect on throughout the workshop week. We know that when teachers are in their own classrooms they have goals for what they want their

students to learn and goals for the ways in which the learning is to occur. We believe these goals are informed by their experiences and by the ways in which the classroom environment and community impact learning. We present the following guiding questions so that the teachers can think about what is influencing the goals they set.

1. How is learning the mathematics in this way different from the way you learned mathematics in school? In what ways does this affect how you think about mathematics, teaching, and learning?
2. How do you participate? How does this affect the participation of others around you? What promotes or interferes with students' participation in the mathematics classroom?
3. What is it like for you to work with people who have different ideas, experiences, and learning styles than you do? What are the implications for working with students with different experiences and backgrounds (e.g., ethnicity, gender, socioeconomic class, language)?

Workshop leaders refer to these questions throughout the week to help participants consider the depth and complexity of learning new things in addition to the actual content they are teaching students. As the teachers work, they think about the times that they feel energized and excited, or confused and distracted. When do they want to think by themselves and when do they want to be thinking and working with others? By reflecting on their own learning, they can relate to their students' experiences and varying needs.

What is the experience like?

The structure of the workshops combines time for doing mathematics (e.g., multiplication and division, 2-D and 3-D geometry) and time for examining how topics and mathematical activities are developed in the curriculum. Morning sessions are spent in mixed grade-level groups where the focus is on the mathematical strands of number, data, and geometry. In the afternoons, participants move into grade level groups to focus on one unit.

Workshop leaders note that Mondays are like the first day of school, when everything is new. By Wednesday, people can feel overwhelmed, yet as participants move into Thursday, they regain their equilibrium and begin to think about how they will take what they have learned back to their classroom. By the end of the week, many participants have established intense bonds with their colleagues and have begun to think more deeply about facilitating mathematics learning.

The experience is of course different for each participant, which brings us back to the question: Can these workshops really transform how mathematics is taught? We know from the feedback we receive at the end of the workshops that many feel they have deepened their content knowledge and have come away with some new strategies for teaching math and for examining their own practice. One participant commented, "I learned that I enjoy math…it isn't laborious and boring." Many of the teachers' comments reflect what they experience as learners and how they connect that to what their students need. "I learned that I truly want to understand why. I realized how the children want to know the same thing. I think this will help me to guide my students in their learning." "I need some time to chew on an idea or problem before I am ready to talk about it. I need to allow my students to do that."

We often hear participants talk about their increased confidence and comfort with teaching certain topics after the workshop. "I learned most about feeling more confident about geometry and fractions. I felt I learned a new and more exciting way of understanding it better because each person shares their own way of doing it. I will have to do that with my kids."

We also know that for some districts the workshops lead to plans for more professional development and an ongoing relationship with those experienced in implementing the curriculum. Many participants return for Level 2 and Leadership workshops and districts seek additional assistance during the year. Some districts offer Level 1 workshops more than once, in an effort to get their newly hired teachers on board (e.g., Detroit, MI, and New York City, NY, six years; Scarborough, ME, seven years).

We have been fortunate to work with the Durham Public Schools in Durham, North Carolina, for the last four years. Durham serves a diverse population of 30,821 students in grades K–12 at 44 schools, 27 of them elementary schools. The student population is 56.3% African American, 29.2% white, 8.9% Hispanic, 2.4% Asian, 2.9% multiracial, and 0.3% Native American. The number of students has steadily increased over the last four years; but Hispanic enrollment has nearly doubled in the same period. Approximately 40% of the students qualify for free/reduced priced lunch, though at the elementary level the rate ranges from 11% at one school to 95% at another elementary school.

Percent of Durham Students Proficient on the North Carolina End-of-Grade Test in Mathematics

Grade	98-99	99–00	00–01	01–02	02–03	4 year change
Grade 3	61.3%	67.5%	69.4%	70.4%	83.2%	+21.9%
Grade 4	73.7%	75.1%	87.1%	86.1%	92.8%	+19.1%
Grade 5	77.0%	78.5%	81.9%	88.1%	92.0%	+15%

Figure 1: Durham, North Carolina, began using *Investigations* in 1999.

Durham, which began using the curriculum in 1999, has seen a substantial rise in its students' scores on the North Carolina end-of-grade test in mathematics, given in grades 3–5 (see Figure 1). Durham teachers and administrators have commented that their continued participation in our summer workshops has been a critical component of their strategy to raise achievement in mathematics for all students. In addition to the *Investigations* Workshops, Durham Public Schools offers one-day workshops, after-school study groups, and in-class coaching to assist teachers in implementing *Investigations*.

Clearly there has been a transformation in Durham. What has contributed to that change? What has been the role of the workshops? The ongoing professional development? The curriculum? These are questions we and others continue to research and study in the hope of improving mathematics learning in every district.

The workshops are most effective when they are part of a more comprehensive professional development program. As we look to meet the needs of districts implementing *Investigations*, we are exploring ways to connect with and support existing school-based professional development programs. On-site school year support, which we also provide, and face-to-face intensive sessions are two strategies. Technology offers us new opportunities, and we will investigate these avenues in order to provide greater access to professional development for all teachers and schools.

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For more about the workshops including registration information, see Get Involved page 22 or visit investigations-workshops.terc.edu

Photos: Lee Kilpatrick

STORY

TERC reached another milestone this past winter when the organization celebrated its first museum exhibition. TERC partnered with the Science Museum of Minnesota to create several interactive devices that allow visitors to explore kinesthetically certain math concepts and ideas that are fundamental to calculus. The devices are featured in exhibits at the Science Museum of Minnesota and the Charles River Museum of Industry in Waltham, Massachusetts.

The photos on the right feature one of the devices, the Storyline. The series of photos suggests some of the ways that visitors can go back and forth between carrying out a physical motion (moving the cars along the track) and seeing or creating a graphical representation of the movement (distance versus time graphs).

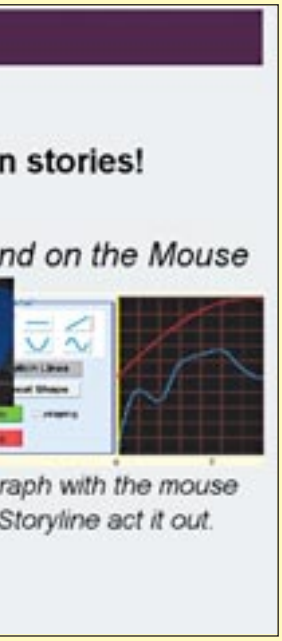
Below is an interview with two members of the exhibit development team from TERC: Ricardo Nemirovsky and Tracey Wright. The editor of *Hands On!* had the opportunity to sit down and talk with them at the opening of the Math in Motion exhibit at the Charles River Museum of Industry.

I just finished playing with the Storyline and wondered how you would describe this exhibit to someone who had never seen it.

TW: It is tricky to describe, especially since so much of the experience is about the connection you make when you actually go back and forth between moving the cars and seeing the graph of that movement, or drawing a graph and then watching the cars move according to how you drew the graph.

LINE

The Storyline exhibit invites visitors to explore motion in one dimension—a straight line path.



When you walk up to the Storyline, you see two ten-foot tracks, a red car and a blue car and some other colorful props—a train station, a farm, stores, and a post office.

Usually it is the bright red and blue cars that capture people's attention. As you move them back and forth along the track, you may begin to notice a graph changing on the projection screen. It is providing feedback in real time of the cars' actual positions on a distance versus time graph.

"I'm going to make it go back and forth really fast!"

RN: Yes, it is difficult to describe it briefly. There are many things you could say, but the one thing that occurs to me is that these exhibits present a certain, maybe an alternative, way of approaching a mathematical situation. We often see mathematics as distant or separate from us. It is not something we experience with our bodies or feelings the way we do with so many other things in our lives. The exhibits are trying to bridge that distance.

Are you trying to make mathematics and its symbols less abstract?

RN: I wouldn't say that. Mathematical symbols are abstract and there is a whole interplay of rules involved. We want to preserve that but change the relationship of how we work with and relate to the abstractions. You know, in a way chess is very abstract, but it makes a big difference that there are pieces that you move and touch.

TW: In our math of change research, we tend to talk a lot about fusion, combining the symbols or abstractions with the physical experience or phenomena. Right now I am thinking of the research paper by Elinor Ochs (1996), "When I come down I'm in the domain state." The title refers to a conversation scientists working in a high-energy physics laboratory are having about some pretty heady stuff around matter and magnetic properties. They are working with a graph showing magnetic-field strength as a function of temperature. The laboratory director points to the line on the graph and says, "When I come down…" as if somehow he was identifying with the substance and was inhabiting the graph. This kind of language, according to the researchers, was used when the scientists were trying to understand a new hypothesis. If you didn't know these were very bright people you might think that they were very confused or silly.

"What trip should we take?"

The computer remembers the movements or trip you just took with the cars. When you press *play*, the cars reenact the trip while the screen redraws the graph. This allows you to step back and see your trip from another point of view.

Racing the cars and creating stories on your own are favorite activities for many visitors. The Storyline also lets you and a friend enact one of four made-up stories: Post Office Demo, Picnic, Race, and Grandma's Farm.

If you are familiar with distance versus time graphs you may already be able say something about the relationship between the cars' motion and the shape of the graph. If not, the computer lets you add labels like "stop" or "going forward" to help you focus on the relationship.

The Storyline also allows you to choose from several predefined graphs or draw your own graph and watch how the cars respond.

We find children using similar phrases when they are working with devices like the Storyline, and this helps us understand how the children are building connections between the graph and their actions. We can see how their understanding of distance and time and speed are shaped by their physical engagement in the movement and by the way they enter the world of the graph.

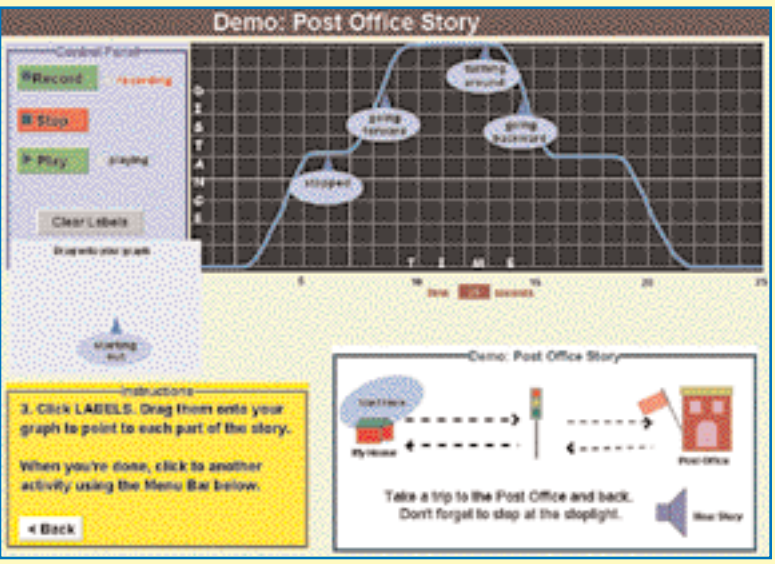
RN: Like the scientists, we find that children, when given the right tools, can have similar conversations about physical phenomena they are trying to understand, say acceleration. Unfortunately, people tend not to look at these conversations as very sophisticated.

TW: Sometimes in schools I think we ask students to talk formally in the way scientists talk when they are giving their final report. We ask them to do this before they have had a chance to really work with the symbols in a way that allows them to connect the symbols with the physical actions they are trying to understand.

What do children take away from these exhibits? What are they learning?

TW: Like almost everything else in life, what people take away is very much related to their prior experience. We have noticed particularly in Minnesota, where the exhibit has been open for a while, that people are spending a significant amount of time with the devices. This is true for children and adults. We are obviously pleased about this since a museum exhibit has to be compelling for visitors with very different backgrounds and experience. People may not come away with a formal definition of an integral, but that is not the goal of the exhibit. The aim is that people see that mathematics and graphs have meaning and are related to their everyday lives.

RN: Hopefully, by bridging the distance between these symbolic representations and actual physical events, we give children, really all visitors, a different way of approaching math, one that they can build on.



"Hey, the graph shows how fast it's going."

Whether moving the cars and reading a trip from the shape of the graph, or seeing the cars move in response to your drawing a graph, you can discover powerful connections between graphing and motion.

"I wonder if I can make it write my name?"

TW: Part of our aim is to see how these devices can support school learning through field trips or traveling exhibits to schools. The classroom conversations that result as students and teachers reflect on what they are doing and seeing while using something like the Storyline can help reveal what the students are really understanding about acceleration or rate of change. As researchers, we are interested in studying those conversations, examining how kinesthetic experiences contribute to students' understanding of the underlying mathematical concepts.

RN: The ongoing research will help us find appropriate applications of these devices in different environments, whether in a museum, a school, or as part of an after-school program.

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For more information about the mathematics of change research at TERC, contact ricardo_nemirovsky@terc.edu or tracey_wright@terc.edu; or visit www.terc.edu/mathofchange/CM/home.html.

The Handling Calculus exhibit at the Science Museum of Minnesota will run through the summer of 2004. Several devices in the exhibit will become part of the permanent collection. The Math in Motion exhibit at the Charles River Museum of Industry runs through the summer of 2004.

The Storyline development team includes Ricardo Nemirovsky and J. Newlin (co-principal investigators for the Handling Calculus project), Tracey Wright, Curt Newton, Matthew Peterson, and Philip Fitzsimons.

This work is funded by the Science Museum of Minnesota through a grant from the National Science Foundation #ESI0087912.

Photos: Ken Porter

MarsQuest Online

Creating Explorers in and out of Classrooms

The great adventure that is NASA's Mars exploration program has captivated many adults and children, including students at the Tesseract School in Paradise Valley, Arizona. Students there are embarking on their own remote exploration of Mars—proposing launch times, selecting landing sites, and exploring questions similar to those raised by adult scientists.

Guiding the students' explorations is MarsQuest Online, a collaboratively developed web site that broadcasts images from NASA's Jet Propulsion Laboratory within minutes of their arrival from Mars. The site also makes Mars images more accessible by placing them in a scientific context.

Jamie Larsen and Kim Boehne at Tesseract used MarsQuest Online as one way to make connections between school and everyday science like NASA's Mars exploration program. Explained Larsen, "I projected the MarsQuest site onto a smartboard [so that the entire class could view it]. I explained that the site contains the same images NASA scientists are getting and showed them the tools that allow users to navigate images." Larsen walked his students through a brief tour of the site and put to them the question of which features of the landing sites were most interesting.

"The students were able to identify places for exploration—an interesting looking rock, a place that looked like it may have contained water. Many students went home and came back to school with lots of questions we could use the site and other materials to answer."

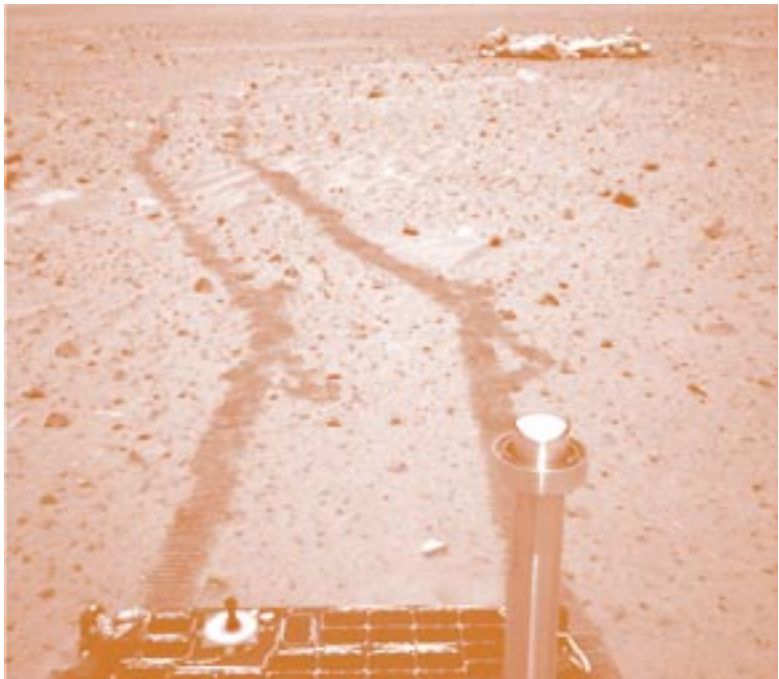
The ability of resources like MarsQuest Online to engage students is something Larsen's school relies upon in its integrated thematic approach to student learning. Said Larsen, "The school tries to break down barriers between disciplines as much as possible. Our fourth grade class has been doing work all year on rainforests and the importance of decomposition and microbes. This year, we looked at certain microbes responsible for many types of decomposition. We were able to tie that directly into a discussion about the types of life we might find on Mars."

Speaking about the benefits of working with the MarsQuest site, Larsen added "What resulted is an ongoing dialogue. Once kids learn the tool, they explore on their own, ask their own questions, seek their own answers, then share their discoveries with you. It's great as a teacher to have kids approach you and talk science with you without being asked. MarsQuest let me use science as a bridge to engage students on many levels beyond the confines of a class period."

Kim Boehne used the MarsQuest Online site with her seventh grade astronomy class at the Tesseract School to achieve slightly different objectives.

As part of an assignment on the history of space exploration throughout our solar system, Boehne asked her students to design a museum exhibit and present it to the class. Several of her students chose to do an exhibit about Mars.

The rover Spirit blazes a trail away from its landing site as it begins its exploration of the Martian surface.



www.marsquestonline.org

By David Shepard

One investigation on the MarsQuest Online site challenges users to successfully launch a spacecraft from Earth to Mars.

"That was when I discovered the site," Boehne said. She decided to use the site to highlight specific content about Mars that the students hadn't covered in their presentations. Said Boehne, "I realized that the site was so much fun that the kids would get too excited to do a lesson immediately. Once they had a chance to see and explore the site themselves, I began to develop some pointed questions that helped them realize some of the science content."

Boehne developed a worksheet containing questions about basic Mars facts the students should have been able to learn from the site. From there she directed students to the area of the site that challenges visitors to find launch windows and travel times to get a spacecraft to Mars.

The students had three chances for launch and had to record whether or not they landed. Once they were able to identify what launch times worked, they began to make guesses for shorter travel times based on the data the site was returning. Boehne then led her students in an exploration of the different geological features of the planet.

"I don't think students realized Mars had so many geological features. The kids were interested because [the investigations on the site] let them see all the different types of terrain. They saw that some of it resembled Arizona and started making connections between the geography of Mars and Arizona—their plains and large canyons.

"When I was using the site with my seventh graders, I really wanted to expose students to information that wasn't in the textbooks. Even brand new, the information in a textbook is already many months old. The timeliness and amount of new information returned as the rovers explore Mars made the site invaluable to me as an educator," Boehne said. "The kids were having a lot of fun, but at the same time they were learning."

That ability to entertain and edify educators and the general public alike lies at the heart of what the site's designers set out to accomplish. Explained Dan Barstow, director of the Center for Science Teaching and Learning at TERC and one of the TERC staff involved in the site's development, "MarsQuest Online enables students to *do* science, explore and discover and ask questions just as scientists do. This is an essential element of great science education. And with MarsQuest Online, every teacher can do this."

David Shepard is assistant editor of Hands On!. david_shepard@terc.edu

MarsQuest Online is funded by the National Science Foundation #ESI0104589

MarsQuest Online was developed through a partnership among the Space Science Institute, NASA's Jet Propulsion Laboratory, and TERC. www.marsquestonline.org

Photos: Courtesy NASA/JPL/Caltech

Darwin's Journals, and

What do educators stand to gain from keeping a journal? A journal has long been seen as a key tool for teachers (or anyone else) seeking to reflect upon their practice and direct and deepen their own learning. Because reflective writing in science is something that we increasingly value for students, it's important for educators to understand it from the inside out, by practicing it ourselves.

There are several reasons a journal is helpful: When you revisit something, or even when you copy it from a reference into your notebook, you are focusing attention on it, and each time you do so, you may notice different aspects than you did before. Second, when you paraphrase or reword something, you have to transform it, and therefore reexamine your understanding in light of other associations or thoughts triggered by the change from, and contrast between, the "original" and your new version. Third, keeping a journal may push you to try to better distill or outline a thought, or put it into pictorial, numerical, or graphical form. This is also a powerful way to test and strengthen your understanding of the point at hand. Finally, if you are working actively with some question, your cross-references to other entries, intermediate statements, and tentative formulations ("What I think is going on here is…") are a way to stimulate increasing depth and precision of your thinking, and also are opportunities to ask, "Do I really believe this? What's my evidence? What would really clinch it—or send me back to the drawing board?"

For some people, keeping such a notebook comes naturally, but others are put off by the idea. My own up-and-down experience with journal keeping suggests that sometimes the problem is that, like any new good habit, it's hard to fit journal keeping into your already full schedule. Perhaps you, like me, have found it difficult to figure out what to put in such a journal, and how it really helps deepen and broaden thinking. How can I move beyond pure introspection, or pure stenography, and really use this text as a thinking workshop? For starters, perhaps a good comparison to have in mind is not the kind of journal that is used for personal or spiritual growth, but rather a scientist's lab or sketch book.

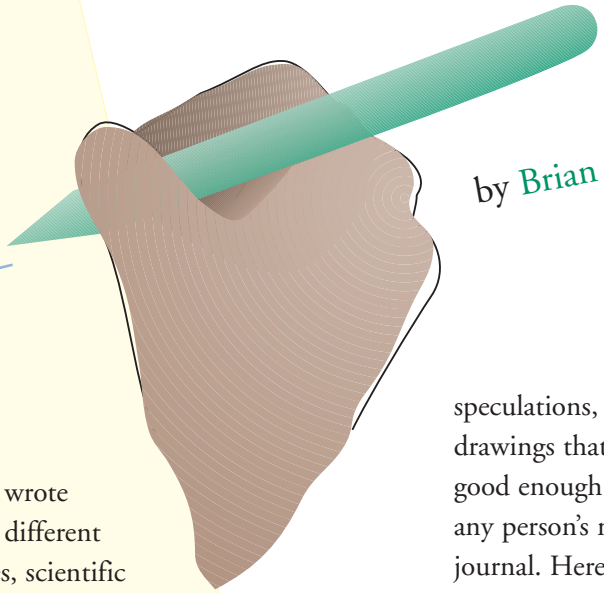
> Because reflective writing in science is something we increasingly value for students, it's important for educators to understand it from the inside out, by practicing it ourselves.

While pondering this some years ago, I found myself reading a lot about Charles Darwin and his creative process. In the midst of this Darwin hobby, my wife gave me an edition of Darwin's notebooks covering the years 1836–1844 (Barrett et al. 1989). From his notebooks I began to learn some lessons that helped me think more freely about how to use a journal as a tool for dialogue—not just with myself, but with my colleagues, my reading, and the subjects I was trying to understand—both in my work with science teachers, and in my scientific research in conservation biology.

Between 1836 and 1844, Darwin was reading, experimenting, and imagining ways to make sense of his field experiences; he was working from the very detailed notes of his investigations toward a theory that would encompass the development of all life, including *Homo sapiens* (Gruber 1981). In this grand endeavor, Darwin's notebooks played an essential role. In them, he entered his reading notes; observations of curious phenomena he saw in his walks or visits to the zoo; interesting comments from friends or correspondents; and reflections, daydreams, hypotheses, and many questions.

Three qualities of Darwin's notebooks have helped me imagine how to make my own notebooks more creative and supportive of reflection and learning. I have labeled these three qualities *diversity*, *freedom,* and *cultivation*.

Yours



by Brian Drayton

Diversity

Darwin took in and wrote down things from many different sources—learned treatises, scientific journals, word-of-mouth from cronies and colleagues, personal observations, his father's opinions, folk wisdom, etc. In this sense, his notebook serves as a kind of thematic memory, keeping the manifold strands of his scientific imagining and reasoning alive and available. A key feature of this memory is that it's a jumble, with lots of different kinds of facts, ideas, gossip, notes, reflections, jostling each other in no clear order, but just as they came over the course of the days. Here are a few examples [page numbers in brackets]:

> [468] Saw Humble [bumblebee] go from great Scarlet Poppy to Rhododendron—[…]. Humble alighted on base of filaments & reached nectar =again= between them, hence quite below stigma. & so avoided it. On certain days Humble seem to frequent certain flowers, to day early, the great scarlet Poppy—
>
> [551] Sept. 4th. Lyell in his Principles talks of it as wonderful that Elephants understand contracts.—but W. Fox's dog that shut the door evidently did, for it did with far more alacrity when something good was shown him, than when merely ordered to do it.—
>
> [463] Waterhouse showed me the component vertebrae of the head of Snake wonderful!! distinct!!—He would not allow such series showed passages—yet in talking, constantly said as the spinal marrow expands, so do the bones expand—instead of saying as the brain is created &c &c

Freedom

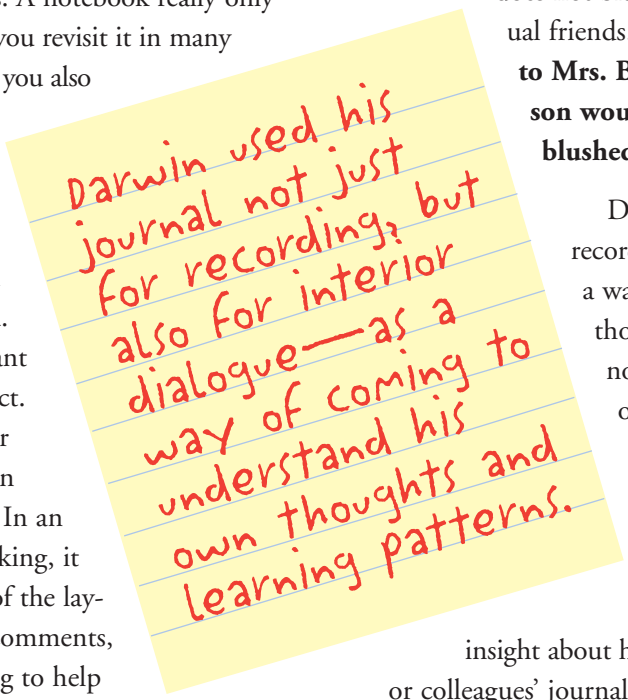
Don't think about what "ought" to be in a journal or notebook. Make it legible to yourself for future reference, but then include anything that helps you work on the ideas you have in mind. Darwin's notebooks contain solid facts, wild speculations, large and small questions, lists, dates, and crude drawings that convey little to any other reader, but were good enough for him. This is a reasonably good reflection of any person's mind at work, and is just right for the working journal. Here we find his ideas jammed together, feeding on each other, and co-existing for reasons that may or may not be apparent.

Very often, journal writers imagine someone reading over their shoulder and discovering just how confused and trite their thoughts really are. Darwin seems to have overcome that constraint pretty thoroughly! Your journal is yours, it is an extension of your own thinking in the same way a hammer extends the power of your hand. Write for yourself only.

> [466] My view of character being inherited at corresponding age & sex, opposed by cantering horses having colts which can canter—& DOGS trained to pursuit having PUPPIES with the same powers instinctive & doubtless not confined to sex.—Is not cantering a congenital peculiarity improved. Probably every such new quality becomes associated with some other, as pointing with smell.= **These qualities have been given to foetus from before sex developed—Double flowers & colours breaking only hereditary characters wh. come on in after life of Plants—also goodness of flavour in fruit—all affected by cultivation during life of individual.**
>
> [551] Plato (Erasmus) says in Phaedo that our *"necessary ideas"* arise from the preexistence of the soul, are not derivable from experience.—read monkeys for preexistence—
>
> [234] Thomas Carlyle, saw with his own eyes. new gate. Opening towards pig.—latch on other side.—Pigs put legs over, & then snout lift up latch & back.—

Cultivation

A journal requires cultivation, as with a garden—visit, weed, move, plant, churn, fuss. A notebook really only becomes a tool for thinking if you revisit it in many ways—if you write for yourself, you also need to be a reader of your writing. Here is where the diversity and freedom of the collection become most valuable—when you revisit it with questions or concerns in mind.



Furthermore, it is important not to treat entries as sacrosanct. Argue with yourself, add better wording, raise questions, put in cross-references to later pages. In an area where you're actively thinking, it helps to keep track somehow of the layers of thinking—dating later comments, or using different ink, anything to help keep track of the twists and turns of the inner conversation. Darwin reread his notes, added to them, corrected his own mistakes, added references and wisecracks, and later ripped out pages to use in other notebooks. In the examples below (and above), text in **boldface** was added at a later date, usually in a different pen or pencil.

> [466] Rhododendrum—nectary marked by orange freckles on a upper petal; bees & flies seen directed to it—The Humbles in crawling out brush over anther & pistil & one I SAW IMPREGNATE by pollen with which a bee was dusted over. [rude sketch of this] Stamens & pistils curve upwards, so that anthers & stigma lie *in fairway to nectary*.—Is not this so in Kidney Bean. How is it generally.—**In Azalea it is so.—In yellow day lily, the Bees visit base of upper petal, though not differently coloured—& stamens bend up a little.**
>
> [463] Bats are a great difficulty not only are no animals known with an intermediate structure, but it is not possible to imagine what *habits* an animal could have had with such structure. **Could anyone. have foreseen, sailing, climbing, & mud-walking fish?**
>
> [578] one carries on, by association, the question, "one [or what] will anyone, especially a women think of my face,"? to one [or one's] moral conduct.—either good or bad. either giving a beggar, & expecting admiration or an act of cowardice, or cheating.—one does not blush before utter stranger,—or habitual friends.—but half & half. **Miss F.A. said to Mrs. B.A. how nice it would be if your son would marry Miss. O.B.—Mrs, B.A. blushed. analyse this:—**

Darwin used his journal not just for recording, but also for interior dialogue—as a way of coming to understand his own thoughts and learning patterns. Darwin's notebooks are especially powerful, not only because of the quality of the mind displayed before us, but also because we know that for much of the time that Darwin struggled with his ideas, he could not confide in anyone else.

Darwin's journals are a great source of insight about how to manage one's learning—as friends' or colleagues' journals may be, too. Ask around about how people keep their journals. For a wider perspective about how people use journals in many fields, see Fulwiler (1987). For a fascinating story by a teacher-researcher, which gives some idea of how she uses her notes and journals to reflect on her students' learning, see Ballenger (1999).

I encourage you to return with your own current burning questions to your neglected journal with diversity, freedom, and cultivation in mind, and find your own way to make this ancient, simple, and reliable cognitive tool work for you.

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Brian Drayton is co-director of the Center for School Reform at TERC. brian_dayton@terc.edu

Excerpts from Darwin's journals from Charles Darwin's notebooks 1836–1844. *Reprinted courtesy of Cornell University Press.*

In Print

The following is a sampling of recently published research and academic works authored or co-authored by TERC staff.

Book Chapters

"How to Focus the Mathematics Curriculum on Solving Problems"
Susan Jo Russell (TERC), Rebeka Eston, Jan Rook, Malia Scott, and Liz Sweeney
in *Teaching Mathematics through Problem Solving, Prekindergarten–Grade 6*
Frank K. Lester Jr. and Randall I. Charles (Eds.)
National Council of Teachers of Mathematics, 2003

Journals and Periodicals

"Making Math Meaningful Outside of School"
Marlene Kliman (TERC)
ENC Focus, Vol. 12, No. 4, *Ideas!*, 2004

"Teacher Quality: From Policy to Practice"
Joyce Tugel (TERC)
Science and Children, Vol. 41, No. 5, pp. 22–25, 2004

New Projects

Communities of Practice for Teachers in Peru

The Communities of Practice for Teachers in Peru project will create a program for teacher professional development among teachers in rural areas of Peru. Teachers will videotape some of their own classes, and will use these videos to foster both online and face-to-face conversations about classroom practices and interactions among students. Funded by Concord Consortium through a grant from U.S. Agency for International Development.

Enhancing Math in Afterschool

TERC will produce a white paper focused on recommendations for the role of math in afterschool programs in Boston. The recommendations will be based on interviews with afterschool teachers and math educators who develop out-of-school programs, reviews of math curricula and staff development programs, and research on math out of school. The project will include a focus group with afterschool leaders and policy makers. Funded by Massachusetts 2020 Foundation and Boston Centers for Youth and Families.

Investigating Astronomy

TERC, in partnership with the National Optical Astronomy Observatory and the Astronomical Society of the Pacific, is developing Investigating Astronomy, a set of instructional materials for high school students studying astronomy. The six modules will include teacher guides, a teacher professional development web site, and family resources in both English and Spanish. Each module is built around a Challenge—an investigation that provides real-life, data-driven application to the astronomical and physical science content of the activities. Funded by the National Science Foundation.

NEW WEB SITES

EARTH EXPOSED
earthscienceart.org

Earth Exposed uses the beauty of our planet as seen from space to promote Earth systems science, geography, and art. The site contains compelling satellite images of Earth and asks visitors to consider them from the perspective of a scientist, geographer, and artist. In this integrated context, site visitors deepen their appreciation for Earth, increase their content knowledge, and develop technical and image interpretation skills. Site includes images, tools, and resources.

MISSION: ALGEBRA
neirtec.terc.edu/ma

Mission: Algebra provides guidance to district and school leaders in addressing the question, How can technology support teachers preparing middle school students for Algebra I? Based on standards and current research, the site is informed by the experiences of practitioners. Mission: Algebra addresses the topics of teacher professional development, the use of technology, and the new federal priority of preparing students for challenging mathematical content in high school.

Get Involved

Earth Exploration Toolbook

Participate in a two-hour distance-learning professional development seminar for science and technology teachers of grades 6–12. Participants will walk through one chapter of the Earth Exploration Toolbook (EET) and discuss ways to use Earth science data sets and tools with their students. EET is a collection in the National Science Digital Library and the Digital Library for Earth System Education. Requires use of the Internet and a phone at the same time. Attendees will receive a $60 stipend for completing the seminar and an online survey. For more information about EET, to see the current schedule, and to register, visit serc.carleton.edu/eet.

Investigations Workshops for Transforming Mathematics

Investigations Workshops for Transforming Mathematics offer support for teachers, math specialists, and administrators implementing the *Investigations in Number, Data, and Space* curriculum. Level 1 workshops engage educators in exploration of Investigations content and assessment while preparing them to use one unit. Level 2 workshops allow more experienced educators to focus on computation and number. Leadership Workshops assist educators in supporting implementation in their schools and districts. Workshops are offered throughout the U.S. Visit investigations-workshops.terc.edu, or phone 617.873.9785. See also article on page 8.

ISS EarthKAM

Middle School Students can take photos of Earth from Space! Through ISS EarthKAM, a NASA-sponsored education program, students control a camera mounted on the International Space Station and study the resulting images to enhance their learning of science, geography, mathematics, and technology. There are four or more missions each year, generally in January, April, July, and November. All images and educational materials are available on the Web. Register to join the program at www.earthkam.ucsd.edu.

Lesley/TERC Try Science

Register for online graduate-level courses designed by TERC and Lesley University for K–8 educators who would like to strengthen their science background, learn more about inquiry-based science, and align their classrooms with the National Science Education Standards. Try Science is the prerequisite course for the online master's degree program in science education at Lesley University. For information, contact Lesley University at www.lesley.edu/soe/science, email science@mail.lesley.edu, or call 800.999.1959 x8938.

Math Momentum in Science Centers

The Math Momentum in Science Centers project invites science center staff nationwide to a set of one-day workshops focused on data and measurement. The workshops provide science center staff an opportunity to learn and do math, exploring how to make the math in their exhibits and programming more explicit and accessible. For more information, including workshop dates, topics, and locations, contact bronwyn_low@terc.edu, or visit mathmomentum.terc.edu, available June 2004.

Regional Leaders Network

TERC is field-testing the Regional Leaders Network (RLN) in several western US states. RLN provides teachers, administrators, and parents professional development opportunities focused on effective teaching and learning in schools implementing the *Investigations in Number, Data, and Space* curriculum. Long-term partnership with the RLN builds leadership within the school and/or district. Learn more at investigations-rln.terc.edu.

Signing Science

Teachers of deaf or hard-of-hearing students in grades 3–8 are needed to field test signed versions of the web-based unit Is Our Tap Water Just Water? Visit signsci.terc.edu or email judy_vesel@terc.edu.

Relearning to Teach Arithmetic Leadership Workshop

The Relearning to Teach Arithmetic (RTA) Leadership Workshop will provide support for teachers and administrators planning to facilitate study groups using the RTA professional development curricula. Participants will examine video of students sharing their thinking as they solve arithmetic problems and the mathematical ideas central to understanding the four operations and number relations. TERC is seeking participants and a district sponsor in eastern Massachusetts for a field test in August. For more information, contact linda_gregg@terc.edu.

Science for Today and Tomorrow

Science for Today and Tomorrow is seeking field test teachers for two Life Science units for grade 6 or 7; one unit focuses on regulation of our internal environment; a second unit focuses on ecosystem interactions. Each unit encourages students to build ideas of science content and process through hands-on and web-enhanced investigation of a central focus question. In doing so, students develop understandings that serve as the basis for more molecular-based studies in high school and beyond. For more information and to apply, contact judy_vesel@terc.edu.

Tabletop

Bring the new *Tabletop* to your classroom. The Tabletop Project is seeking teachers to pilot test revisions of *Tabletop*, the popular software tool for graphing and organizing data. Participants will test the data tool and web-based curriculum in their grades 3–12 classrooms. Field test teachers may attend a training session, including brief lesson plans and extended projects. Participants will receive access to the software and web curriculum. For more information, email kate_kennedy@terc.edu.

NEWS

TERC to Deliver Online Courses Through eCollege (SM)

TERC and eClassroom(SM), the K–12 division of eCollege(SM), have entered into a partnership that will advance research efforts in K–12 online education and increase the flexibility, reach, and effectiveness of TERC's online programs. The partnership takes advantage of eCollege's expertise as one of the pioneers of eLearning to allow TERC to deliver applications that support the use of inquiry as a learning tool for the millions of distance learners in the U.S.

Collaboration efforts will focus on topics that enhance the online learning experience, such as student collection and analysis of real-world data, data visualization for exploratory data analysis, and greater course accessibility for students from every background. TERC is looking to deliver many of its existing and future online materials, as well as the master's program for middle school science teachers, through the eClassroom System.

"We look forward to working with eClassroom on several levels to continue to advance the online learning experience for teachers and students," said TERC President Dennis Bartels. "eClassroom is one of the pioneers of eLearning, with one of the most flexible platforms for advanced developers. eCollege's leadership position will further allow TERC to increase its reach and to explore more effective ways to deliver inquiry-based math, technology, and science education online."

Mary Jane Schmitt Honored for Work with Adult Learners

TERC researcher Mary Jane Schmitt received the prestigious Kenneth J. Mattran Award from the Commission on Adult Basic Education, which annually honors an individual with a distinguished record for achievement in adult literacy. Ms. Schmitt has made significant contributions to mathematics learning for adults and out-of-school youth during her thirty-year career in the field. She is currently Co-Director of the EMPower project (Extending Mathematical Power), a mathematics curriculum for adult learners.

TERC wins graphic design award

The TERC 2001 Annual Report has won an American Graphic Design Award. TERC won in the Annual Report category, competing against both corporate and nonprofit annual reports. Congratulations to designer Jane Sherrill.

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S'04

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Science Education Master's Program Growing

Photo: Gail Matthews-DeNatale

Science Online, the science education master's degree program developed by TERC and Lesley University, has expanded its reach. Through a new partnership with Walden University and Canter & Associates, the innovative program for K–8 teachers is now available at both Lesley University and Walden University. Science Online helps K–8 teachers strengthen their science knowledge, learn more about inquiry-based science, and align their classrooms with the National Science Education Standards.

Funded by the U.S. Department of Education and the National Science Foundation, Science Online combines a unique approach to online study with convenience of scheduling for the busy teacher. The first course in the program, Try Science, will be offered through Walden University in the fall starting on September 7. For more information, contact Victor Bruno, 800.733.1711, x 4841. For more information on Lesley University, see page 22.

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