



**Inside...** Time to Enhance Math in After-School – 8

Bringing Data Literacy to Districts – 10 • The Story of Darrell – 14

I like cookie dough



I like  
butter pecan



I like  
chocolate  
swirl



I like mint  
chocolate chip



I like  
vanilla



**Vanilla is the most popular flavor of ice cream in your class.**

**How well can you predict the most popular flavor in your school?**

By Andee Rubin

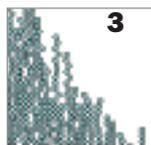
## Math That Matters

Our society is seriously conflicted about data. How often have you heard someone say: “If you torture data long enough, they’ll confess to anything,” or “There’s lies, damn lies, and statistics”? But we use data every day—to choose medications or health practices, to decide on a place to live, or to make judgments about education policy and practice. The newspapers and TV news are full of data about nutrition, side effects of popular drugs, and polls for current elections. Surely there is valuable information here, but how do you judge the reliability of what you read, see, or hear?

(CONTINUED ON PAGE 3)

# Contents

## features



### **Math That Matters**

*By Andee Rubin*

The case for establishing data literacy as a capstone course



### **Time to Enhance Math in After-School**

*By Jan Mokros, Marlene Kliman, and Hollee Freeman*

Report examines mathematics in after-school programs



### **Bringing Data Literacy to Districts**

*By Nancy Love*

A collaborative inquiry process for improving instruction



### **The Story of Darrell**

*By Judy Storeygard and Cornelia Tierney*

Case study illustrates successful strategies for teaching students with disabilities in mathematics

## departments

**18**    **New Projects**

**20**    **Get Involved**

### **Editor**

Kenneth Mayer

### **Associate Editors:**

Zoe Keller and David Shepard

### **Designer:**

Carol Maglitta, one[visual]mind

*Hands On!* is published by TERC, a not-for-profit education research and development organization dedicated to improving mathematics, science, and technology teaching and learning.

Copyright © 2005 by TERC. All rights reserved. No part of this publication may be reproduced without written permission. Contact Ken Mayer, TERC, 2067 Massachusetts Avenue, Cambridge, MA 02140, 617.547.0430, ken\_mayer@terc.edu. *Hands On!* is available at [www.terc.edu](http://www.terc.edu).

All opinions, findings, conclusions, and recommendations expressed herein are those of the authors and do not necessarily reflect the views of the funding agencies.

Photo credits: (cover and p.3) ©Photos.com/Jupiter Images; ©Royalty-Free/Corbis; (p.4) ©David Butow/Corbis SABA; (back cover) ©ISS EarthKAM/NASA

ISSN 0743-0221

# Math That Matters

By Andee Rubin

**Taking a certain medication decreases the risk of having a heart attack by 23%.**

**Would every person's risk decrease by that amount?**

This is no trivial skill—and we are not preparing students to make these critical and subtle distinctions. As they go through school, students need to build an appreciation for both the power and the limitations of data, but they seldom have the opportunity to learn enough about data to be skilled consumers of the information that bombards them daily. “Numerical literacy” is woefully incomplete without “data literacy,” yet we shortchange most students by leaving these topics out of the common series of math courses.

The standard—almost universal—math track in K-12 education moves students from basic computation skills (although many current elementary curricula present a more multifaceted view of mathematics) through algebra, geometry, and precalculus. For students who plan to go on to college, the capstone course is usually calculus. For others, something like Algebra II is their final taste of mathematics. If students encounter data analysis at all, it is usually in the form of learning about measures of center (mean, median, and mode) and, perhaps, measures of spread (range and standard deviation). The curriculum also often includes the creation and interpretation of simple graphs such as histograms and scatterplots. Many

students encounter these same topics again and again in elementary and middle school; there is no curricular progression of skills that culminates in data literacy.

For most students—even those who are college-bound but not planning to major in mathematics, science, or engineering—knowing how to critically analyze data is a more useful skill than understanding delta-epsilon proofs. Even some biology and chemistry students are likely to spend more time evaluating the results of experiments than computing limits. Certainly those who will rely primarily on their high-school math need skills in data-based decision-making more than the ability to solve sets of simultaneous linear equations.

In 1997, the College Board emphasized the importance of data analysis by creating the AP Statistics Test. But in most states, the standardized math tests taken by all students generally test skills from the traditional algebra/geometry track, with barely a hint of data analysis—and so, for the most part, it isn't taught. It's time to change this situation. Data literacy is not just for the elite. How can we design a curriculum that supports all students in developing solid statistical-reasoning skills?



**The leading candidates are 2 percentage points apart in the polls.**

**If the polls have a margin of error of  $\pm 3\%$ , how well can you predict who will win?**

## What is Data Literacy?

Definitions of data literacy always include descriptions of the process of posing and answering data-based questions, similar to the scientific method. Some elementary and middle-school curricula give students opportunities to practice this process: students create a survey question (a common one is “What’s your favorite flavor of ice cream?”), collect data from their classmates, and graph the results. They might use these data to answer the question, “Which flavor is most popular?” or, if the data relate to the length of students’ feet, they might find the mean and median foot size.

It is critical that young students learn to ask and answer the “context” questions about a set of data, to evaluate the legitimacy of data values, and to collect and organize data to answer particular questions. However, this kind of data activity misses the core of statistics, that is, the task of understanding the world from incomplete or imperfect data. Most of the questions and answers reported in the media use incomplete data to make statements that extend beyond the actual objects counted or measured. Going beyond the data requires special techniques: statistical techniques.

What is the difference between the classroom survey and a parallel statistical question? Let’s go back to the ice cream survey data. If we used that information to make a statement about a larger group of people (e.g., all the second-graders in the school or in the city), we would be asking and answering a statistical question. If we were to use the

foot-length data to make a general statement about the relationship between boys’ and girls’ foot lengths (e.g., boys’ feet are in general three inches longer than girls’ feet), we would be analyzing the data from a statistical perspective. And it’s statistical questions like these that we are most likely to encounter in our daily lives.

Such questions and answers that go beyond the immediate data are, in fact, most of the ones we really care about—understanding the math behind them should be a skill possessed by all citizens and consumers. The risk of a new drug has to be estimated from the fate of people who have already taken the drug; the data are incomplete because they don’t include the people who haven’t yet taken the drug. The effectiveness of Head Start can only be based on the people who have been in the program; we assume, but can’t be sure, that another group of people going through the program would have a similar experience. We can examine the relationship between unemployment and environmental factors by analyzing current data, but using these data as a prediction for the future is a chancier proposition.

The density of data rises dramatically near national elections. We are bombarded with the results of polls and predictions for turnout, the closeness of the race, the designation of swing states, and so on. All of these reports go beyond the actual data collected, as they are all based on a relatively small fraction of the country’s voters. And the exit polls have several sources of uncertainty in them: again there is the sampling issue (especially a concern if polling

is done at a particular time of day during which only non-working people vote), but there is also the question of how honest people are in their responses. The big questions in all statistical analyses are: how much can we go beyond the data, and how sure are we of what we then say?

## Where's the Math?

Statistical reasoning requires a wide variety of mathematical skills. Some are concepts students already encounter in other parts of their math education, such as proportional reasoning. Reasoning in drug studies about the relative proportion of people who had heart problems to those who did not is a classic example of thinking about ratios. For example, students need to be able to compare the ratios 20 out of 200 and 40 out of 300. Which is larger? By how much? In fact, one of the benefits of teaching data analysis is that students need to use such basic concepts and operations in a new context.

Other traditional mathematics concepts that may be effectively—perhaps even more effectively—taught and practiced through data analysis include constructing and interpreting the scale and units on graphs; understanding the meaning of slope as a relationship between two variables; comparing inequalities; and basic arithmetic operations. Even the notion of “variable” has a potentially more intuitive meaning in the context of data.

However, there is a whole other set of skills that students need in order to think statistically that are not part of the current curriculum. These skills are tools for going beyond the data in a principled, mathematically defensible way. They include, among other things, language for describing how confident one is about one's prediction and graphical conventions for indicating lack of certainty. If data analysis should become a standard part of the high-school curriculum, we need to prepare students in middle school for these new mathematical structures. Rather than repeatedly practicing how to calculate the mean and median, students should be learning how to use these measures in talking about generalization, prediction, and confidence.

As always, adding something to the curriculum displaces other content. If a group of students pursues courses in data analysis, they may not take Algebra II or trigonometry. If statistics were the capstone course for many students, calculus classes would shrink. Teachers who have

spent many years offering the same classes might need to take on a challenging new mathematical topic with which they have had no experience.

What if there were significantly fewer students taking calculus or trigonometry? This change could actually have a beneficial effect on high school students. Students in calculus or trigonometry classes would be those for whom these courses were clearly important in their future plans. Other students, freed from a mathematical path they find irrelevant, might actually take more mathematics—or, at least, be more productively engaged in the math classes they take. In fact, it is possible that as the importance of data analysis in the curriculum grows, it may be the students in the calculus track who are missing a crucial part of their math education.

**For most students—even those who are college-bound but not planning to major in mathematics, science, or engineering—knowing how to critically analyze data is a more useful skill than understanding delta-epsilon proofs.**

Teaching data analysis is defined as a K-12 priority in the National Council of Teachers of Mathematics (NCTM) standards and, as such, its inclusion in standardized tests is likely to increase. But there needs to be significant work done to ensure that the NCTM standards are interpreted and implemented appropriately. At present, data analysis is taught and assessed without a longitudinal plan for supporting students' statistical-reasoning process as they get older.

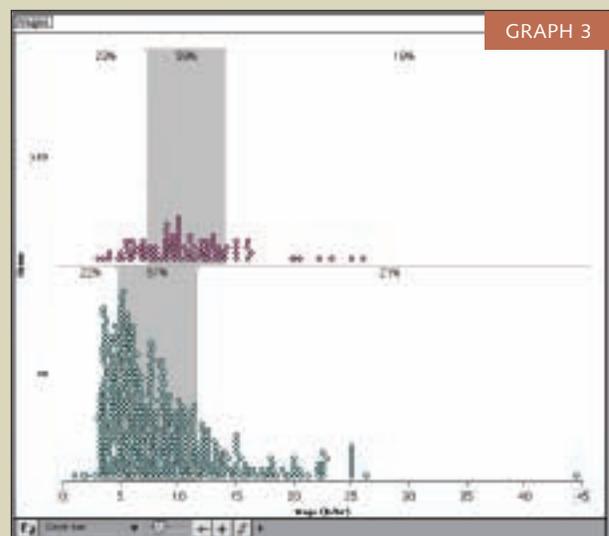
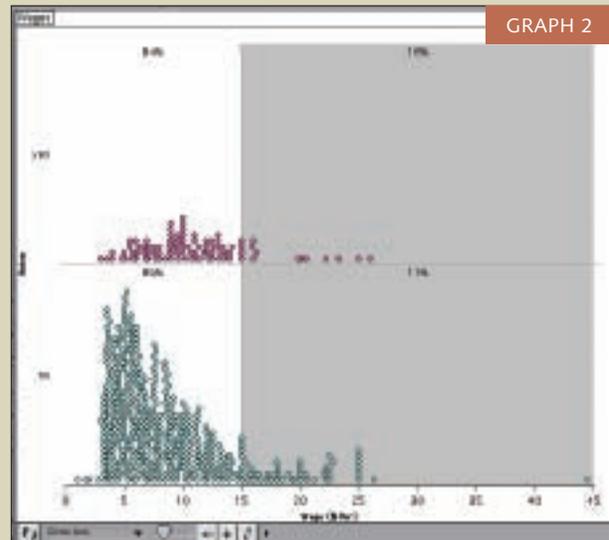
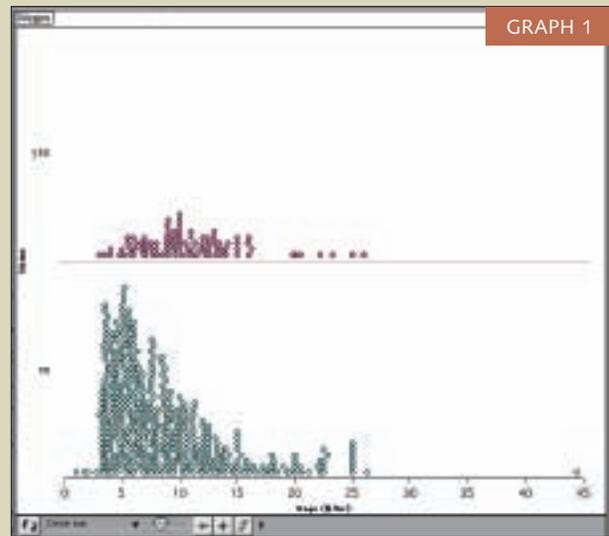
### Working with Data

Technology is a critical support for learning data analysis, even in middle school. Choosing the right software tools is particularly important. Many schools use Excel for data analysis, but its structure is much better suited to the “what’s the most popular ice cream” kind of question than it is to generalizing and predicting. There are only a few pieces of software that allow students to manipulate statistical graphs flexibly, and most schools view them as too single-purpose to be economical. However, there are several examples of software that do a good job analyzing statistical data and can also solve problems in other areas of mathematics; one of these would be a smart purchase for a school. Fathom is one such program, for use primarily with high-school and college students. In addition to supporting the display, manipulation, and analysis of statistical data, Fathom includes the ability to graph complicated functions, calculate derived values with a powerful formula editor, and read data in many formats from a variety of locations, including the Web.

An example of data-visualization software more appropriate for younger students is TinkerPlots. Here’s a short example of statistical reasoning about relatively simple data that demonstrates the power of technology in supporting statistical reasoning—not just to calculate measures, but to generate visualizations that can reveal the structure of data. We will look at a data set of wages for a sample of 534 people, about one-third of whom belong to a union. For each person, we know hourly wage, union status (yes or no), gender, and age.

The question we have to answer is: do union workers make more than nonunion workers? If so, by about how much? And we could add: how sure are you about your answer? Notice that these questions are about workers in general, not just about the people we have data for. It will require us to go beyond the data at hand.

With these data, there are many ways to answer these questions, and different graphs may actually provide slightly different answers. Using a variety of tools in TinkerPlots, we can create graphs that depict individual workers, arranged on the X-axis by wage, and group the data by union and nonunion workers. Because there are more nonunion workers in our data set, it may appear that more nonunion workers make over \$15 per hour than union workers. (See graph 1.)



To test this hypothesis in TinkerPlots, you can divide the graphs into those making less than \$15 and those making more—and quickly see that, while there are more nonunion workers making over \$15 per hour, there is a greater percentage of union workers making more than \$15 per hour. So this graph supports the argument that union workers make more. (See graph 2.)

As a final test, you can move the dividers to group the middle 55 percent of wage earners in each category. In this graph, you would see that the main clump of nonunion workers makes between \$5 and \$11 per hour, while the middle 55 percent of union workers makes between \$7 and \$14 per hour. Again, the data show that the union workers make more, and from this graph, we can see how much more—about \$2 to \$3 per hour. (See graph 3.)

It's certainly not true that every union worker makes more than every nonunion worker; the graphs show that you can't make an absolute statement because union workers vary in the wages they receive—and so do nonunion workers. You need a different language to describe the relationship, one that describes the pattern you see, the variations within the pattern, and how confident you are that you've found the important pattern.

These are statistical judgments. While the topic here is wages, the reasoning process is the same as that used to decide whether a new drug is effective or dangerous. Data on which major decisions are based always vary and, thus, require an approach that helps us deal with uncertainty.

## Where Do We Go From Here?

Helping students learn how to go beyond the data to express degrees of uncertainty in their conclusions and to make principled inferences from data is not yet a well-understood science. It is clear, however, that students must have experience with notions of uncertainty in data analysis as early as middle school and continue to enhance their skills in statistical reasoning through high school. For many students, in fact, data analysis is an appropriate capstone course, the culmination of their high-school mathematics experience.

No matter what mathematical path students eventually follow, we know this for sure: if they don't have the opportunity to develop statistical reasoning, they will not be equipped to use data to make important decisions in their everyday lives.

## How can we increase the probability that students will acquire the data expertise they need?

- Establish data analysis as a capstone course for students who are not planning a career that will require them to know calculus.
- Combine the teaching of probability and data analysis—which are now taught separately—in middle school so that students begin to learn how to deal with uncertainty in the context of data.
- Integrate data-analysis perspectives in other high school math classes. For example, connect teaching about algebraic functions with their parallel role in statistics as trends around which other data points vary.
- Require courses in data analysis for teachers preparing to teach secondary mathematics.
- Provide professional development for teachers of data analysis courses, not just for teachers of AP statistics.

## RESOURCES

*Data Analysis and Probability Standard. Principles and Standards for School Mathematics.* National Council of Teachers of Mathematics, 2000-2004. [standards.nctm.org/document/appendix/data.htm](http://standards.nctm.org/document/appendix/data.htm)

Fathom Dynamic Data Software. Key Curriculum Press. [www.keypress.com/catalog/products/software/Prod\\_Fathom.html](http://www.keypress.com/catalog/products/software/Prod_Fathom.html)

Kilpatrick, Jeremy, W. Gary Martin, and Deborah Schifter, eds. *A Research Companion to Principles and Standards for School Mathematics.* National Council of Teachers of Mathematics, 2003. [my.nctm.org/store/ECat/product.asp?ID=12341](http://my.nctm.org/store/ECat/product.asp?ID=12341)

Lajoie, Susanne P., ed. *Reflections on Statistics: Learning, Teaching and Assessment in Grades K-12.* Lawrence Erlbaum Associates, 1998.

Lehrer, Richard and Leona Schauble, eds. *Investigating Real Data in the Classroom: Expanding Children's Understanding of Math and Science.* Teachers' College Press, 2002.

Moore, David S. *Statistics: Concepts and Controversies.* W.H. Freeman, 1985.

TinkerPlots. Key Curriculum Press. [www.keypress.com/catalog/products/software/Prod\\_TinkerPlots.html](http://www.keypress.com/catalog/products/software/Prod_TinkerPlots.html)

*Reprinted courtesy of Threshold: Exploring the Future of Education, Spring 2005. Online at [www.ciconline.org/threshold](http://www.ciconline.org/threshold).*

*The Visualizing Statistical Relationships project is funded by the National Science Foundation #REC-0106654.*



# Time to Enhance Math in After-School

By Jan Mokros, Marlene Kliman, and Hollee Freeman

An excerpt from a report developed for Massachusetts 2020 and the Boston Centers for Youth and Families

## Scope of Work

As parents, educators, and policymakers debate causes and possible interventions to improve students' mathematical performance, many assume after-school programs can provide part or all of the solution. The aims of this report are to examine ways in which mathematics is addressed in Boston after-school programs, and to identify the potential for after-school programs to support elementary and middle school children's mathematical learning. Improving mathematical understanding is a complex and ever-changing endeavor within schools themselves, and the role of after-school programs in supporting this work is both ill-defined and potentially powerful. The questions addressed include:

- What does it mean to improve mathematical understanding?
- What pieces of this problem are Boston after-school programs currently addressing?
- What are the challenges associated with this work?
- What are important next steps in building upon this work?

To answer these questions, several sources of data were studied, including examination of recent MCAS scores and curriculum frameworks, interviews with educators and leaders from after-school programs and from the Boston Public Schools (BPS), reviews of mathematics curricula in use in the BPS, reviews of math-related materials appropriate for after-school programs, and research reviews.

## Findings

Two main findings emerged:

- Effective mathematics programming in after-school settings necessitates specifying programmatic goals (i.e., improving test scores, supporting an understanding of math curriculum by providers, helping students with homework, or improving students' attitudes toward and engagement in mathematics). In many instances, programs did not have the supports needed in order to specify clear, attainable goals.
- Effective mathematics programming in after-school settings depends on staff development or development of a strong tutoring cadre. In many instances, staff development was not available to the entire after-school staff, but rather, was used for at least one staff member or tutor who coordinated efforts with the other after-school providers.

## Recommendations

### 1 DEVELOP AND DISSEMINATE A MATH RESOURCE GUIDE

The Boston area contains a very wide range of after-school programs, with varied goals, needs, populations, staffing, and schedules. After-school providers need to choose the math-related programs and resources that fit best with their capacity and requirements. Thus, we recommend as a vital first step the development of a Math Resource Guide for Boston after-school programs. The Guide should be available in both print and online format, and should provide the following major components:

- A self-assessment tool to enable providers to identify logical places to begin building math capacity. This would involve reflection on issues such as: short-term and long-term goals regarding math; mathematical

attitudes and knowledge among staff and volunteers; existing resources such as curriculum materials and manipulative tools; availability of dedicated program and storage space; time and opportunities for staff development; and financial resources that could be committed to building math capacity.

- An annotated list of math programs and resources available to after-school programs in the Boston area and nationally, including information on location, eligibility/age requirements, costs associated with materials and staff development, and mathematical focus, including alignment with BPS curriculum.

---

## **2 DEVELOP AND IMPLEMENT WORKSHOPS FOR MATH CONTACTS, TUTORS, AND OTHERS**

Each after-school site should identify a Math Contact person (preferably someone likely to continue in the role) who will champion math in after-school and to incorporate math into her own site programming in appropriate ways. This person would be responsible for reading the Math Resource Guide, implementing the self-assessment, selecting math materials for her site, attending several workshops over the course of a year, and informing staff at their site about math activities and resources.

---

## **3 DISSEMINATE BPS CURRICULAR SUPPORT MATERIALS**

Boston Public Schools have developed detailed guidelines for helping K-5 children with their math work in after-school settings. These should be made available to all after-school providers.

---

## **4 PROVIDE SUPPORT FOR HOMEWORK HELP**

There is an excellent resource on math homework that should be given to all after-school programs: Annette Raphael's book, *Math Homework That Counts* (2000), which discusses four different purposes of math homework and provides concrete suggestions on how to help fourth through sixth grade children with homework in reform math programs. This book should be used in conjunction with a workshop session on math homework. (The workshop session would extend the book's ideas to younger children.) We further recommend that the book and workshop session be required for all tutors, including college students. Tutors need specific and grounded advice about

how to handle math work that may not look familiar. The book and two-hour workshop will provide them with the basics of how to help with reform mathematics.

---

## **5 INCORPORATE MATH INTO THE EVERYDAY ROUTINES OF AFTER-SCHOOL PROGRAMS**

Many routines and activities that are a regular part of comprehensive after-school programming that can form a basis for math. For instance, many after-school programs incorporate reading or story time as part of their regular daily schedule. Whenever possible, link math with the literacy initiative in after-schools by reading counting books, books containing mathematical puzzles, and other math-related stories. A related but more ambitious task is to integrate after-school math with other "everyday" after-school activities, such as sports, snack time, and clean-up time. Real-life mathematical problem solving is one of the fundamental components of mathematical understanding. Many contexts in which adults use math in their everyday lives play a natural role in after-school programs, including estimating and determining time, cooking, sharing food fairly, and collecting and spending money.

---

## **6 CONDUCT EVALUATION RESEARCH**

As new forms of mathematics support are added into Boston after-school programs, there should be ways of documenting and evaluating their use and effectiveness. In evaluating the success of new initiatives, it is essential to link outcome measures with indicators of what was actually implemented. It is reasonable to expect larger impacts among children who are continuously and intensively involved with a math initiative. On the other hand, it is unreasonable to expect children who are involved in math for one hour every few weeks to show changes in their mathematical understanding.

Furthermore, it is important to choose measures of impact that are closely linked to the goals of the new after-school components. For example, if the focus of a program is on supporting the math curricula through homework help, the impact measure should directly relate to children's improvement on their homework.

**For a copy of the full report see [www.terc.edu/mathafterschool](http://www.terc.edu/mathafterschool)**

*A Using Data Workshop participant posts charts on the "data wall."*



**feature**

# Bringing Data Literacy to Districts

*By Nancy Love*

**There's a ton of data being collected. The trick is to know how to use it effectively.**

**W**hen educators in one Texas high school saw African-American students' performance drop slightly below 50% on their state mathematics test, putting the school on the state's list of low-performing schools, they reacted quickly. Decision makers immediately suggested that all African-American students, whether or not they failed the test, be assigned peer tutors (Olsen, 2003).

Based on one piece of data and one way of looking at that data, these decision makers made assumptions and leapt to action before fully understanding the issue or verifying their assumptions with other data sources.

They ignored past trends, which indicated that African-American students' scores were on an upward trajectory. They failed to consider that the decline was so small that it could better be explained by chance or measuring error than by their instructional program. They considered only the percent failing without digging deeper into the data to consider what students needed. Finally, their proposed intervention targeted only African-American students, while overlooking Hispanic and white students who also failed the test.

The Using Data Project, a collaboration between TERC and WestEd, helps mathematics and science educators develop data literacy—the ability to examine multiple measures and multiple levels of data, to consider the research, and to draw sound inferences. Funded by the National Science Foundation, the Using Data Project gets teachers involved in rigorous data analysis and reflective dialogue to improve how math and science are taught and learned and to close achievement gaps. Through the project, teachers and administrators become data facilitators, leading school data teams to dig deeply into several data sources. And they learn, as the Texas example illustrates, that superficial data analysis can be worse than none.

The project partners with several mathematics and science education improvement projects nationally that reflect a mix of urban and rural schools, most of which are high-poverty. After just two years, schools participating in the project are starting to see significant gains in student achievement. For example, all four participating middle schools in Canton City, Ohio, part of the Stark County Mathematics and Science Partnership, increased the percentage of students who scored proficient or above in mathematics on the Ohio Proficiency Test from 2002-2003 to 2003-2004. Two of these schools doubled that

percentage. These and other Using Data sites are showing steady improvement on state assessments as well as other measures such as local and common grade-level and course assessments in both mathematics and science.

## Using data differently

Having data available does not mean the data are used to guide instructional improvement. Many schools lack the process to connect the data they have with the results they must produce. The Using Data Project focuses on developing professional developers, administrators, and teachers who can lead a collaborative inquiry process. The aim is to influence school culture to be one in which educators work together to use data continuously and effectively to improve teaching and learning mathematics and science.

In the Using Data approach, data teams investigate not scientific phenomena or mathematics problems, but how to improve teaching and learning. They raise questions, examine student learning and other data, test their hypotheses, and share findings with their colleagues.

Typically, one or two teachers, one administrator, and one National Science Foundation (NSF) project staff member become data facilitators for a school. They then convene school-based data teams to focus on improving mathematics and science. Sometimes team members are from the mathematics or science department or are existing grade-level teams. Other times, the team is school-wide.

## Creating Data Facilitators

Data facilitators learn to facilitate teams and to use data in a 12-day workshop series over 1½ to two years, with on-site follow-up and coaching several times a year for three years.

The professional learning program includes five segments: laying the foundation (committing to core values, establishing data teams, and working effectively in the school's context); identifying the student learning problem; verifying causes; generating and monitoring solutions; and achieving student learning goals. In each segment, data facilitators conduct a sequence of activities and data experiences with their data teams, master relevant data concepts and tools, practice facilitation, and plan for implementation.

They then carry out those activities with their data teams with support from NSF project staff at the site and coaching from Using Data Project staff. They reconvene for the next segment of the workshop, reflect on their experiences, and learn how to implement the next segment of the program.

For example, in the segment on identifying a student learning problem, data facilitators practice analyzing multiple levels of student learning data. They start with aggregate data trends, such as the percent of students proficient in state assessments in mathematics or science, then examine disaggregated data to understand how subgroups, such as African-American or Hispanic students, are performing relative to white students. They dig into the content strands, such as geometry, measurement, number sense, and problem solving, and analyze how students performed on individual test items. Finally, they collect and examine student work on items and strands of greatest concern to understand student thinking.

If data facilitators have only one source of data on student learning, they collect additional data such as local assessments or common grade-level and course assessments for the next data facilitator session. The process emphasizes triangulating data, using three different sources of student learning data before identifying the student learning problem. By triangulating, data facilitators guide data teams to test hunches with other data instead of drawing conclusions from a single measure.

As they implement the Using Data approach and collect data, facilitators also learn to interpret data—how to determine what differences in year-to-year or group-to-group test scores are meaningful statistically and educationally (Carr & Altman, 2002).

## Data Shifts

### LESS EMPHASIS

External accountability

Premature data-driven decision making

Data use as specialty of a few

Data as carrot and stick improvement

Data in isolation

Data to sort

### MORE EMPHASIS

Internal and collective responsibility

Ongoing data-driven dialogue

Widespread data use and literacy

Data as feedback for continuous improvement

Data through collaborative inquiry

Data to serve

## Data Shifts

After analyzing data in their workshop sessions, the facilitators return to their schools and lead their data teams through the same kind of data analysis experiences they have had. Their job is not to analyze the data for everyone else, but to foster collaboration, build data teams, and facilitate powerful conversations about data—conversations that lead to improved teaching and learning.

To help bring about these cultural shifts, data facilitators learn a variety of tools and processes to make working with data a positive and collaborative learning experience for the data team. One tool is data-driven dialogue, a structured process for making sense of data (Wellman & Lipton, 2004). First, team members predict what they think they will see in the data. Predicting activates prior knowledge, surfaces assumptions and questions, and prepares and motivates the data team to learn from the data. For example, a team member might say, “I predict that physical science will be our weakest content strand on our 4th-grade state test results.” Next, data team members make factual observations only, such as, “25% of our 4th-grade students were proficient in physical science in the state test in 2003.” This phase extends the opportunity to explore and discover the data before jumping to explanations or conclusions. Finally, data team members interpret the data. For instance, a team member might say, “I think our results in physical science are because our teachers do not feel comfortable with the physical science content they are supposed to teach.” Participants test their interpretations by collecting additional evidence to support them.

In their data facilitator workshops, data facilitators use the “go visual” principle, first developed by nonverbal communications expert Michael Grinder (1997). Grinder revealed the power of large, visually vibrant and color-coded displays of data in fostering group ownership and engagement. Data facilitators work with the team on one data report at a time to avoid overload and confusion. For each report, they create a colorful newsprint-sized graph displaying the results and post it on their “data wall.” Then they record their observations and inferences on additional pieces of newsprint that they post under their chart. As they work with additional data, they add more graphs and more observations and inferences to their data wall.

Stoplight highlighting is another “go visual” tool for color-coding that data facilitators learn to use with their teams (Sargeant, 2004). Based on No Child Left Behind Act



Nancy Love (standing) helps Using Data workshop participants “dig into” the data.

requirements and/or state and district goals, data teams set criteria for high performance, performance below expectations, and performance that is urgent and in need of immediate improvement. They then color code each graph using green (high performance), yellow (below expectations), and red (urgent) markers. With stoplight highlighting, urgent areas pop out across the multiple data sources on the data wall.

All this takes place before the team makes any decisions. Data-driven dialogue creates a more thoughtful decision-making process by bringing out multiple perspectives. Teachers embrace solutions because they own the student learning problems that emerge from their own data analysis.

Data facilitators learn how to facilitate data-driven dialogue through repeated practice, feedback from Using Data Project staff, and self-reflection both in workshop sessions and on site with their data teams.

## Root Cause Analysis

“Once you find out what your weak points are, you can begin to decide what is causing them and intervene in those areas,” explained Stark County Data Facilitator JoMarie Kutscher. Data facilitators learn that to uncover root causes of students’ poor performance, they collect and analyze other kinds of data, such as disaggregated course enrollment data, interviews with students, classroom observations, and survey data.

In the TASEL-M Project, for example, mathematics teachers from four Orange County, California, high schools and their feeder middle schools cross-tabulated disaggregated student achievement data with disaggregated course enrollments. They discovered that subgroups performing poorly in mathematics often were those trapped in low-level mathematics courses. The data teams used the information as a catalyst and guide to expand opportunities to offer rigorous mathematics instruction to more students.

While local data can uncover achievement gaps and specific student learning problems, those data are not sufficient. To understand possible causes and solutions, teams consider relevant research on mathematics and science achievement. The message in the research is that quick fixes like teaching to the test or tutoring a few students are unlikely to produce sustained improvement in student learning.

Unlike action plans generated from the top down, teachers are invested in the solutions they generate from their own collaborative inquiry. As Richard Dinko, former co-principal investigator of Stark County (Ohio) Mathematics and Science Partnership, said, “Until teachers started talking deeply about the data, they would create plans that never got implemented. The best thing about the Using Data Project is that it engages teachers in deep discussion of data.

“Using data used to mean rubbing teachers’ noses in poor performance,” he said. “But that didn’t get us anywhere. Now we have a process that gives teachers a voice and a lens for looking at data. With teachers as the change agents, we are starting to see real movement.”

## REFERENCES

- Carr, J. & Altman, E. (2002). *The bottom-up simple approach to school accountability and improvement*. Norwood, MA: Christopher-Gordon Publishers.
- Grinder, M. (1997). *The science of nonverbal communication*. Battle Ground, WA: Michael Grinder & Associates.
- Love, N. (2002). *Using Data/Getting Results: A practical guide for school improvement in mathematics and science*. Norwood, MA: Christopher-Gordon Publishers.
- Olsen, L. (2003, May 21). Study relates cautionary tale of misusing data. *Education Week*, 22(37), 12.
- Sargeant, J.L. (2004). *The toolbelt: A collection of data-driven decision-making tools for educators*. Naperville, IL: Learning Points Associates.
- Wellman, B. & Lipton, L. (2004). *Data-driven dialogue: A facilitator’s guide to collaborative inquiry*. Sherman, CT: MiraVia.

## PROJECT PARTNERS

- Arizona Rural Systemic Initiative in the American Indian Programs, Arizona State University East, Mesa, Ariz.
- Mathematic and Science Enhancements (MASE) K-5 Using Technology, a local systemic change project in Clark County (Las Vegas), Nev.
- Stark County Mathematics and Science Partnership (MSP) in Canton, Ohio
- TASEL-M partnership between the Orange County Department of Education and California State University, Fullerton
- Education Development Center’s K-12 Science Curriculum Dissemination Center in Newton, Massachusetts
- WestEd, a nonprofit research, development, and service agency headquartered in San Francisco, California

Adapted with permission from an article that originally appeared in the Journal of Staff Development, Fall 2004 (Vol. 25, No. 4). Copyright, National Staff Development Council, 2004. All rights reserved. Online at [www.nsd.org](http://www.nsd.org).

The Using Data project is funded by the National Science Foundation #ESI-0221415.

## feature

# The Story of By Judy Storeygard and Cornelia Tierney DARRELL

**Darrell is a lively, intelligent boy. Even as a young child, he was skilled in using his body, excelling at gross motor activities. He enjoyed playing outdoors, especially delighting in building structures, climbing trees, and making pulley systems to raise objects into trees.**

**D**arrell is also a child with learning disabilities, one who has struggled with math. Despite his family's ready access to materials and their own experience as educators, Darrell was not offered a mathematics education equal to his peers for most of his elementary school years. Because his family and teachers recognized and drew on his strengths, Darrell is today an eighth grader who has completed standards-based math curricula in the fifth, sixth and seventh grades. This story illustrates the limitations placed on students with disabilities and what is possible when educators develop inclusive mathematics communities in which all students are expected to learn with understanding. The Accessible Mathematics project at TERC believes that all students, given proper support, can learn math in a way that makes sense to them. Following is a true story of Darrell, a child with learning disabilities, told from the point of view of Darrell and his parents.

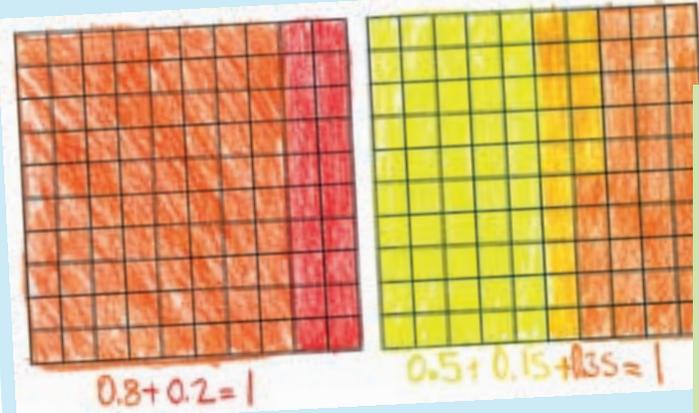
### **A Foreign Language**

While Darrell was able to learn snowboarding, swimming, and rock climbing by watching, imitating, and persistent practice, this way of learning was not helping him understand numbers. His parents encouraged his interests and did not pressure him to do small muscle activities that he did not choose on his own such as jigsaw puzzles or writing numbers and letters. Starting in the first grade, Darrell described math as "a foreign language from another uni-

verse." In the first through third grades, math instruction was not well organized, and Darrell participated without understanding what was being taught. His mother remembers that when she visited his second grade classroom, the class was marching in a circle and doing the 7s table in a large group. "They would do 7, 14, 21, 28...I remember watching him mouthing the numbers." Darrell's family supported him at home through board games and hands-on math activities. At first his parents were patient. "We gave him time. He was unfolding slowly. We trusted that we would get to the place of things clicking."

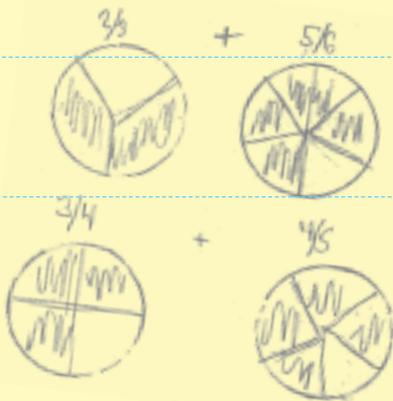
However, when his parents didn't see progress by the end of second grade, they hired a private special education tutor. The tutor noticed that Darrell was not able to maintain recall of number facts and vocabulary, and she recommended an evaluation. The local public school district, as required by law, was in charge of the evaluation process. When his parents received the report at the end of December of his third grade year, the subsequent meeting with school staff devastated the family. The school psychologist focused exclusively on Darrell's weaknesses, learning facts and procedures, without acknowledging the spatial strengths that his parents knew he had.

A few weeks into the third grade, seeing Darrell was making little progress in school but exhibiting some good understanding at home, his parents took him out of school



### Successful strategies for teaching students with disabilities in mathematics

- Encourage students to be specific about what they know and what is difficult for them.
- Use visual representations such as arrays, number lines, and 100 charts.
- Write out directions and other math work, as well as presenting it orally.
- Group students flexibly. Depending on the activity, students may need time alone first, they may need to be in groups with similar needs and strengths, or they may need to be in a group with a range of abilities.



for an intensive tutoring program that emphasized visualization in both language and mathematics. For the first time outside of the family, Darrell felt safe enough to reveal his thinking and to present his questions and confusions. He confessed that he was “faking” during math time in school. Using kinesthetic and visual strategies provided by the tutor, such as walking along various segments of a floor-length number line, Darrell began to understand the sequence and patterns of the tens and ones in the number system. After six weeks, the family did not have the financial resources to continue paying for full-time private tutoring, so Darrell returned to his school. His parents continued to pay for two tutoring sessions a week, and his mother learned the activities so she could practice with him at home.

The next year, Darrell repeated the third grade. Instead of attending the general math class, Darrell and a student with developmental disabilities were pulled out for math. Darrell’s mother continued working with him at home, using some of the same models that were part of the private tutoring sessions the previous year.

### Building Understanding

The fourth grade turned out to be a wonderful school year for Darrell, a year in which he began to learn and truly understand mathematics. The special education teacher and classroom teacher were both experienced and worked as a team. When the special education teacher told Darrell’s parents, “Kids like Darrell are my specialty,” it was music to their ears. In addition, the classroom teacher had prior special education experience. They did not see him only as a student who had academic weaknesses; instead they identified and capitalized on his strengths. Because the special education group was small and the teacher was experienced and confident in her own mathematical understanding, Darrell was comfortable telling the teacher what he didn’t know. Both teachers reported that he was becoming more familiar with addition facts and that he was developing strategies for solving computation problems. By the middle of the year, Darrell would sometimes ask the special education teacher if he could participate in math in the general education classroom, adding, “If I need you I’ll come ask you.”

In the general education class, the teacher developed projects with multiple entry points and used several strategies to explain concepts. Darrell found success when he had a special education teacher and a classroom teacher who were knowledgeable in how to teach math for understanding, who provided multiple entry points and carefully

## the story of darrell continued from page 16

sequenced lessons, who worked together as a team, encouraged inclusion, and valued each student's contributions. Where he was previously cut off from learning experiences, suddenly new doors were opening for Darrell. This supportive experience would follow him, even as he encountered further obstacles.

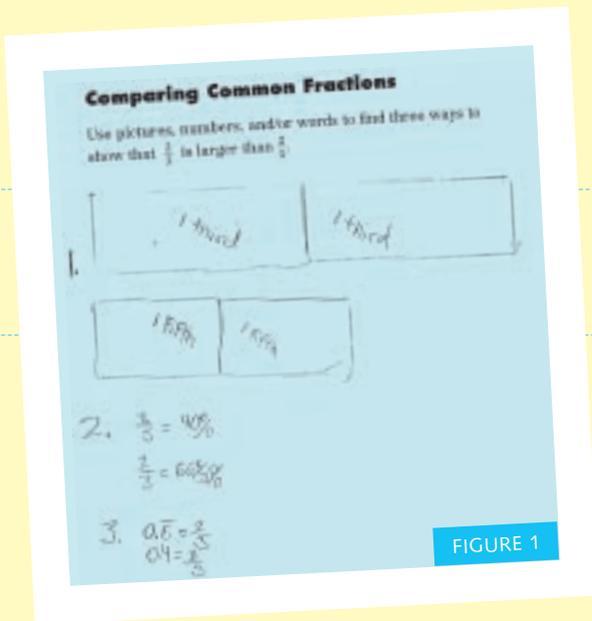
In fifth grade, the district was in the first year of implementing the NCTM standards-based curriculum, *Investigations in Number, Data, and Space*, developed by TERC. Darrell appeared to understand what he was being asked to do, but after a few weeks, the math work stopped coming home, and his mother called the school to find out what happened. She was told, "He's not ready for this curriculum because he needs to be more automatic with the multiplication facts first." Darrell was placed with all

felt comfortable. Because he was included in the general math class in fourth grade, Darrell had an increased sense of confidence. Darrell especially enjoyed the group work and the practice with math games. He was paired with a friend who was more successful at school mathematics, but who admired Darrell for his artistic and athletic abilities. The school system put an aide in his classroom during math time two days a week. Fortunately, because of his parents' professional contacts, they had access to the teacher's guide for the curriculum, and the classroom teacher emailed the math lesson plans to Darrell's mother in advance so she could plan how to support him. Darrell's mother saw that the curriculum fit with his ability to build on what he knew. For example, the fractions unit presented relationships between fractions, decimals, and percents (see Figure 1, student work), which drew on his accurate sense of proportion and ability to reason.

### Math in Meaningful Contexts

Although Darrell has gaps in his mathematical understanding, such as remembering times tables and sequencing steps for procedures for adding and subtracting fractions, he also has areas of strength in geometry, measurement, and comparing fractions, and he has interests outside of school that motivate him to learn mathematics.

For example, Darrell successfully completed a scuba diving certification test while in the sixth grade that many adults fail the first time, and for which one can receive college credit. The test required him to interpret data tables and pressure gauges. To figure out how long to wait until his next dive, he needed to record the deepest depth he went to and the minutes he was under water. His mother used a laminated clock face to help him learn to add up his cumulative underwater time. Knowing that he learns well from observation, his parents bought him an instructional video, which he watched over and over. They got him the diving course textbook months in advance. Darrell used the book for his independent reading assignments during the school year, and he took the quiz at the end of each chapter. He completed worksheets to practice recording the information about his dives and interpreting the conversion tables (see Figure 2, scuba worksheet). Darrell joined a diving club to practice regularly. In order to pay for renting the diving gear and purchasing his own tank, he mowed a neighbor's lawn, recording his expenses and earnings and using a calculator to find totals. Darrell was



of the 22 students from the fifth grade who were on Individualized Educational Plans for a broad range of needs. They met in the cafeteria with teacher aides who had not received any professional development in math. Darrell brought home worksheet after worksheet of drill activities. He would say, "I hate math. I'm with all the dumb kids."

### Inclusion at Last

In December, Darrell's parents met with the school and pressed to have him included in the general math class. At first, Darrell was anxious about joining the class mid-year, knowing that he had missed the foundation, but he soon

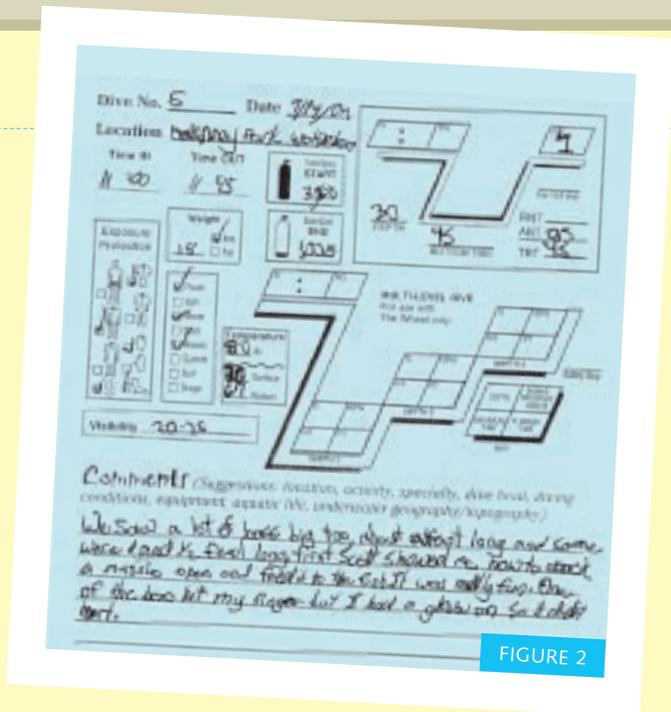


FIGURE 2

successful with the diving test because over many years, he, his parents, and his teachers had developed strategies to build on his strengths. After varied experience with mathematics instruction, Darrell has developed insight into how he best learns mathematics, and he is aware of the difference between teachers who are prepared to work with him and those who are not. (See Figure 3, interview.)

Darrell is fortunate to have several advantages. His parents are educators who were able to support him through their knowledge of mathematics education and through resources they obtained from colleagues, and who were able to advocate for him. In addition, he has multiple strengths, including a strong spatial sense, an ability to know how he learns and when to ask for help, and persistence to engage fully in his many interests. These characteristics along with his parents' strong support sustained his self-esteem. When he was finally included in the general education classroom, his classmates saw him as capable and skilled in many areas.

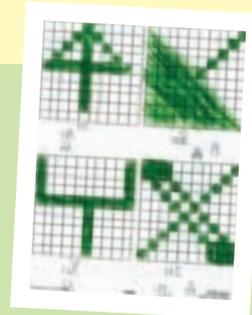
What happens to the children whose strengths may not be as easily apparent and who do not have family members who can be advocates and tutors? These are the questions that lead the staff of the Accessible Mathematics project to work with teachers to foster inclusive mathematics communities that respect all learners.

*Adapted from the article, "Including All Students in Meaningful Mathematics: The Story of Darrell," in Teaching Exceptional Children Plus, Volume 1 (2004), Issue 3. Full article online at [escholarship.bc.edu/education/tecpplus/](http://escholarship.bc.edu/education/tecpplus/).*

*The Accessible Mathematics project is funded by the National Science Foundation #HRD-0090070.*

*Figure 2, © International PADI, Inc. 2005. All rights reserved. Reprinted with permission of International PADI, Inc.*

FIGURE 3



## Darrell's reflections on his learning

Darrell's mother interviewed him at the end of fifth grade. The following excerpt illustrates Darrell's growing ability to reflect on his school experience and to understand how he learns mathematics:

**Mom:** How did math class go this year?

**Darrell:** Okay, a little bit better than being in the separate math class.

**Mom:** What went well?

**Darrell:** Doing group work and playing games.

**Mom:** What could have gone better?

**Darrell:** It would have been better if the teacher were familiar with how Investigations worked. The teacher was good at doing math but not teaching math.

**Mom:** Describe a good math class.

**Darrell:** The class wouldn't be too big or too small. The kids would be at my level, or a little better than me in math so I could learn from them. Tools available when I need them, for example, fraction strips, equivalency charts, calculators. No time pressure or math drills. A good teacher.

**Mom:** What things in math are you good at?

**Darrell:** Estimating length. Reading thermometers when the lines aren't too close. Drawing humans and animals in proportion.

**Mom:** What things in math are hard for you?

**Darrell:** Some times tables. Estimating things like 424,389 divided by 28. Division.

**Mom:** What are ways that a good teacher could help you learn in math?

**Darrell:** Don't rush me. Teach me slowly step by step. Don't panic if I don't know the times tables. Don't get angry. Don't say, "You should know this by now. We shouldn't spend time doing this."

The teacher knows how to do math well and teach math really well. The teacher would be able to explain things in different ways and show me strategies I can use.

**Mom:** What are ways you have learned to help yourself?

**Darrell:** On tests, I need to be calm. Like on my diving test, the final exam, was a 50 question test, I got 4 wrong. I took 45 minutes longer than anyone else—the teacher knew it was okay. I thought, "Darrell, just be calm, do one at a time." Don't compare my work to others. Go really slowly and don't try to keep up with other kids.

# New Projects



*Tabletop project archives*

## **Building an Inclusive Mathematics Community**

TERC will develop teacher professional development modules to help K-6 students with disabilities learn meaningful mathematics and to reach their potential as mathematics learners through participation in the classroom community. Materials will include video episodes with guiding questions for professional development providers. Funded by the National Science Foundation.

## **Children and Science Tests**

This project seeks to understand how elementary school children from diverse ethnic, linguistic, and socioeconomic backgrounds interpret items on high stakes achievement tests. Chèche Konnen Center researchers will analyze the conceptual, linguistic, textual, and representational demands of science items on the MCAS, and the forms of knowledge, reasoning and interpretative practices that children from diverse backgrounds use in responding to such items, and how they interact in children's performance. Funded by the National Science Foundation.

## **Data on Enacted Curriculum 2**

This project will provide leadership of professional development workshops and technical assistance to states and district educators on use of Surveys of Enacted Curriculum (SEC) and data analysis and applications from the Surveys. It will also provide support for the SEC Collaborative. Funded by Council of Chief State School Officers.

## **Evaluation of the National Biotechnology Teacher-Leader Program**

TERC will evaluate the impact of a summer teacher-leader program on participants' classroom practice and outreach training of other educators. The project will collect data from high school and college faculty about changes in their own learning and instructional practices as well as teacher impressions of student response, including student appreciation of biotechnology and their engagement in biotechnology lessons. Funded by the Biotechnology Institute through a grant from Merck.

## **Field Research in Montserrat**

This project will enhance existing research collaborations with Montserrat investigators and government officials in the creation of research projects designed for K-12 and two-year college faculty and students. Funded by Massachusetts Institute of Technology (MIT) through a grant from the US Department of Commerce.

## **Fulcrum Institute for Education in Science**

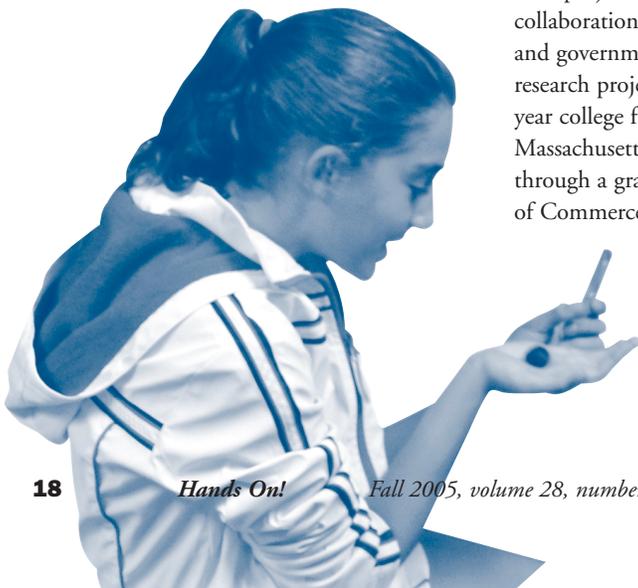
TERC, in partnership with Tufts University, is offering leadership institutes for K-8 science educators. Ultimately, the institutes will be offered fully online for credit as a gateway into Tufts' Master's in STEM Education program. The institutes will focus on the important question of how learners' scientific understandings evolve. Funded by Tufts University through a grant from the National Science Foundation.

## **Honors Earth Science Planning Work**

This project will develop ways to enhance typical Earth science courses to make them more challenging for use in honors level classes, by focusing on inquiry, visualizations, and Earth as a system. The goal is to encourage honors students to pursue further studies and careers in Earth sciences. Funded by University Corporation for Atmospheric Research (UCAR) through a grant from the National Science Foundation.

## **Horizon Dissemination**

TERC will disseminate findings of the Local Systemic Change research, focusing on technical assistance organizations, professional organizations, and professional development providers. TERC will help identify key research findings and target audiences and appropriate methods for dissemination, prepare two journal articles, and make four conference presentations. Funded by Horizon Research.





*Early Algebra/Early Arithmetic project archives*

## Learning in Practice

The Chèche Konnen Center at TERC will collaborate with the King Open School in Cambridge, Massachusetts, to create and study a professional learning-in-practice community organized around the goal of developing teachers' capacity to teach to the intellectual strengths of all children, especially those from underserved communities. Funded by the National Science Foundation.

## Lifelike Virtual Tutors to Support Authentic Learning

This project will explore the feasibility of animated, lifelike 3D interactive online characters in performing students' tasks and interpreting actions in real time. The work will be embedded in the learning activities of the Marble Roll, one of the Online Scienceathon challenges. Funded by Vcom3D through a grant from the National Science Foundation.

## Making the Connections in STEM Education

TERC is evaluating a project designed to improve teachers' understanding of and familiarity with specific areas of data analysis and principles of design and engineering through a professional development course, and to increase grades 5-8 students' motivation to consider STEM careers by working with mentors to complete projects and showcase them in public. Funded by Central Massachusetts Pipeline through a grant from the Massachusetts Board of Higher Education.

## Methods for Studying Adult Development in Math Professional Development

This pilot study will explore how teachers' experiences in a math professional development program are affected by differences in Order of Mind (as described by Bob Kegan), and relationships between teachers' content knowledge, pedagogical beliefs, and instruc-

tional approaches, as well as the self-complexity demands of the professional development program, and the kinds of support teachers receive in their schools. Funded by the National Science Foundation.

## Mixing in Math

TERC, collaborating with the YMCA, US Air Force, BELL, St. Louis Science Center, Girls Inc., and Citizen Schools, will support afterschool programs nationwide in integrating math into their programs. The project will develop math materials for afterschool, support staff development, and ensure that the materials are institutionalized throughout all participating programs. Funded by the National Science Foundation.

## The Ocean in Our Backyard

This afterschool science program allows middle school youth throughout Boston to explore the biology and ecology of Boston Harbor. Students conduct investigations at tide pools, salt marshes, local beaches, and the Boston Harbor Islands. They carry out lab activities and are connected with scientists and ocean stewards. Students engage in environmental stewardship by cleaning local beaches, testing water quality, and monitoring invasive species. Pilot tested in Fall 2004, the program will reach six afterschool centers in 2005.

## Professional Development for Mathematics Leadership

TERC is providing a series of professional development workshops and coaching support for Baltimore elementary and middle school principals on issues of mathematics leadership and instructional improvement. Funded by the Fund for Excellence in Education.

## RODES Workshop

The R2K Open Data Exchange System (RODES) project has established and operates a web-accessible searchable data management system for the NSF RIDGE

2000 science initiative. This project will collaborate with the Digital Library for Earth System Education Data Services project at TERC to run a workshop to provide input on the development of the RODES web site to facilitate educational use and to develop student activities built around real ocean sciences data sets. Funded by Columbia University through a grant from National Science Foundation.

## Second Conference on the Revolution in Earth Science Education

This follow-up to the 2001 conference focuses on state-based implementation plans to make the revolution real. Experts in Earth science, education, and state and federal policy will develop a framework for state action plans in reforming Earth science education. Initial states are California, Texas, New York and North Carolina. Funded by UCAR through a grant from the National Science Foundation.

## Signing Science Dictionary

TERC will create an interactive sign language dictionary to support science learning among students in grades 4-8 who are deaf or hard of hearing and whose first language is sign. Powered by Vcom3D's SigningAvatar® assistive technology, this resource will offer teachers a library of standardized signs for discussing scientific ideas with students. Funded by the NEC Foundation of America.

# Get Involved



ISS EarthKAM: Bangladesh and Bay of Bengal  
Lat: 22.0°N Long: 89.6°E

## ← 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](http://www.earthkam.ucsd.edu).

## Lifelike Virtual Tutors to Support Authentic Learning

Teachers of students in grades 4-8 are needed to pilot test a web-delivered Virtual Reality simulation that incorporates lifelike virtual tutors capable of communicating in written or spoken English or sign language into the Marble Roll—an Online Scienceathon challenge. For more information, contact [judy\\_vesel@terc.edu](mailto:judy_vesel@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 human organs; a second unit focuses on genes. Each unit encourages students to build ideas of science content and process through hands-on and web-enhanced investigation of a cen-

tral 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](mailto:judy_vesel@terc.edu).

## Signing Science

Teachers of deaf or hard-of-hearing elementary and middle-grades students are needed to pilot test an interactive 3D sign language dictionary. The dictionary is designed to provide students whose first language is sign access to science material delivered on the web, via electronic media, and in hard copy. Additionally, it is designed to offer teachers and parents a library of recognized signs for discussing scientific ideas with students. For more information, contact [judy\\_vesel@terc.edu](mailto:judy_vesel@terc.edu).

## Tabletop

Looking to enhance data analysis in your classroom? Tabletop, the popular tool for graphing and organizing data, is seeking teachers to test revisions of this fun and interactive software. Participants will test the data tool and web-based curriculum in their grades 3-12 classrooms. Field testers will receive access to the software and web-based curriculum, including brief and extended lesson plans and projects. Please call Scot Osterweil, at TERC or email [scot\\_osterweil@terc.edu](mailto:scot_osterweil@terc.edu) for more information.



TERC

2067 Massachusetts Avenue  
Cambridge, Massachusetts 02140  
617.547.0430 phone  
617.349.3535 fax  
[www.terc.edu](http://www.terc.edu)

Nonprofit Org.  
U.S. Postage  
**PAID**  
Permit No. 375  
Nashua, NH