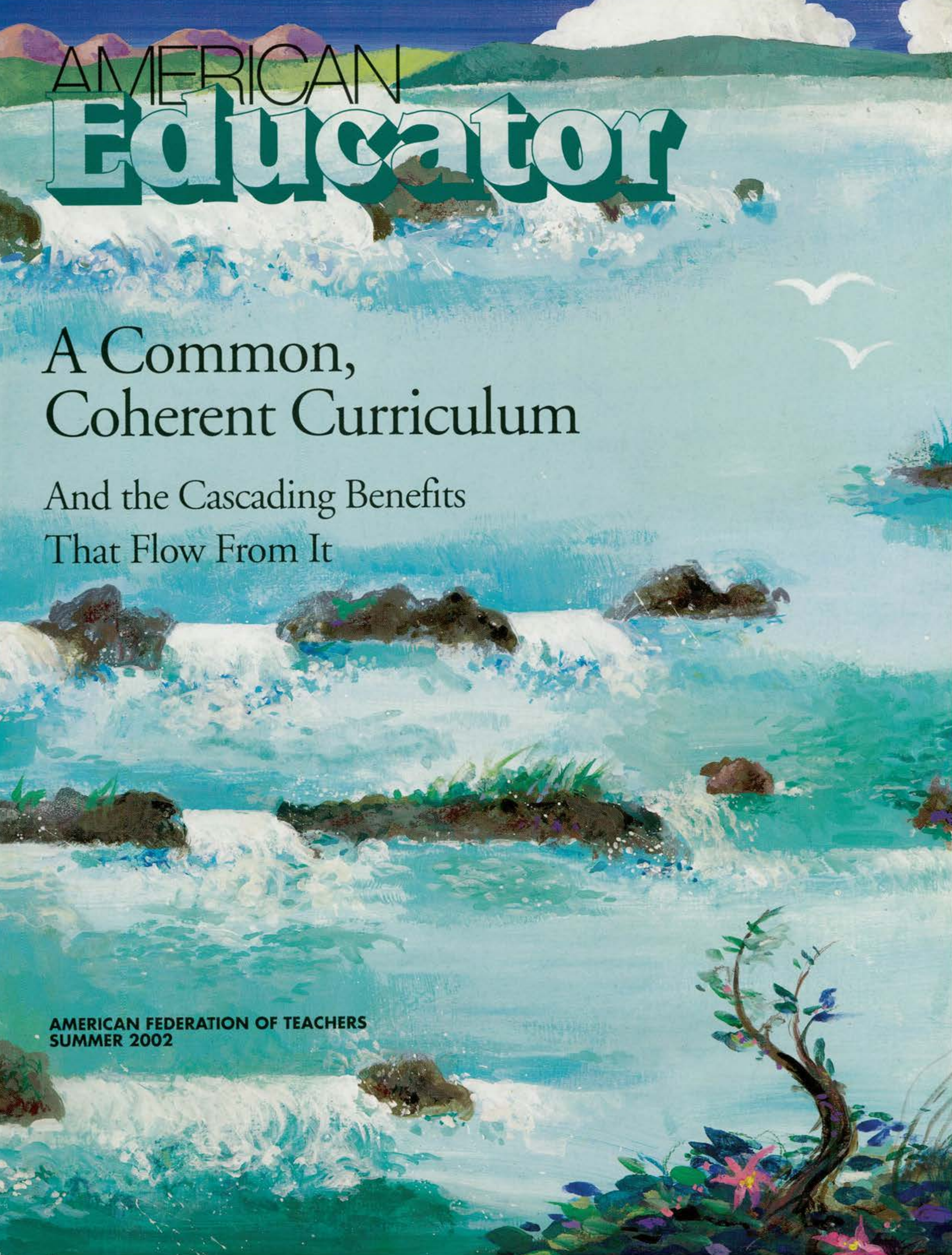
AMERICAN Educator



A Common, Coherent Curriculum

And the Cascading Benefits That Flow From It

AMERICAN FEDERATION OF TEACHERS
SUMMER 2002

What if 30 percent of your teachers had a deadly disease?

What if you could do something to help?

THIS YEAR IN SOUTH AFRICA, MORE THAN 1,000 TEACHERS WILL DIE OF AIDS. In Zimbabwe more than 30 percent of the country's teachers carry HIV. Hundreds of thousands of schoolchildren have lost a parent to the epidemic. Throughout Africa, the statistics tell a similar story—**teachers' lives lost and whole education systems endangered.**

THE AFT WILL BE LAUNCHING a multi-year, multi-country campaign in partnership with African teacher unions to provide resources to fight the spread of this deadly disease. **But we will need your help to make this campaign a success.** Your contribution to the campaign will go directly for union initiatives in Africa to provide resources for HIV/AIDS education, teaching materials, and supplies.

FOR MORE INFORMATION about the AFT-Africa AIDS Campaign, visit the AFT's Web site at **www.aft.org/africa_aids**, or write us at **AFT-Africa AIDS Campaign, AFT Educational Foundation, 555 New Jersey Ave. N.W., Washington, DC 20001**.

AFT-AFRICA AIDS CAMPAIGN
A project of the American Federation of Teachers Educational Foundation

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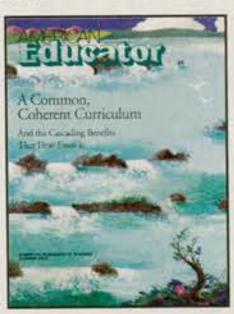

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LETTERS

The Story of the Atom

I am a seventh- and eighth-grade science and language arts teacher. Our pre-K-8 school would be an ideal test site for Joy Hakim's new history of science series (*The Story of the Atom*, Spring 2002). Burley Elementary is a reading and writing specialty school. Additionally, our seventh- and eighth-graders participate in a laboratory science program. Our staff is highly committed to developing lifelong readers and believes in the power of storytelling, reading aloud, and literature discussions. For these reasons, we do not have science textbooks, but instead rely on trade books and periodicals such as *Science World* to communicate science concepts. As you must know, trade books in the area of science for middle-schoolers are sparse and it has been quite a challenge. This is just what I have been looking for! My colleagues and I are big fans of Ms. Hakim's *A Story of US,* and we are looking forward to reading more from her new series.

—HEIDI LUEBS
Burley Elementary, Chicago, IL

I am extremely interested in knowing more about Joy Hakim's *History of Science* and becoming a test site for their use. We are using her *History of US* and find her use of narrative, awareness of young adolescents, and inclusive telling of American history to be the best there is. I am excited to think she has brought her skills and insight to the wonders and mysteries of science!

—HOLLY PERRY
Academy for Middle Years (NW), Philadelphia, PA

It was with great hope that I thumbed through your latest issue of *American Educator*. I stopped to read "The Story of the Atom" and was greatly dismayed.... Ms. Hakim starts her long string of errors when she states the following:

> A long, long time ago...there lived a man named Thales. He is said to be the world's first philosopher-scientist.... We don't know much about Thales as a person, except what others tell us. And they tell of a many-sided genius who was a lawgiver, a civil engineer....

I found this error to be quite amusing since anyone who has studied African history, specifically Egypt, then known as Khemet, would know that Imhotep was in fact the first known multi-genius. In fact, he is the designer of the first Great Pyramid.... Imhotep ...was alive with Pharaoh Djozer, which is dated back to 2720 B.C.E. – over 4,000 years ago by Ms. Hakim's point of reference. So we see that Ms. Hakim distorts the historical record by placing Thales at the head of scientific discovery, thereby overlooking over 2000 years of scientific advancement that occurred before him....

Another error in this article dealt with Pythagoras, to whom the equation $A^2 + B^2 = C^2$ has been credited. She tries to cover her tracks by stating: "Some historians say that the Babylonians knew the theorem before Pythagoras, but he understood its importance and introduced it to the Greek-speaking world....There is an exactness to the world, an orderliness, and it follows

Let us know what you think!

*Please send letters to the editor via e-mail to **amered@aft.org** or by mail to* American Educator, *555 New Jersey Ave. N.W., Washington, DC 20001. Letters to the editor may be edited for style, clarity, and length.*

rules that can be proven with numbers—that's what Pythagoras told us." If Ms. Hakim had read Pythagoras' own writings, she would have discovered that they state that he received schooling from the Egyptians on this particular subject matter.... These ideas are readily available by perusing *The Egyptian Book of the Dead* or Cheikh Anta Diop's work titled, *Civilization or Barbarism,* which explains that the Papyrus of Moscow shows "that the Egyptians, two thousand years before the Greeks, studied the mathematics of the pyramid and of the cone, and that they even used different trigonometric lines, the tangent, the sine, the cosine, the cotangent in order to calculate their slopes."

... I want to be clear that the intent of this letter is not to put down Ms. Hakim, but rather to alert the author and the readers of this magazine that they must be very careful of what information they are presenting as fact.

Thank you,

—SONDJATA K. OLATUNJI
Hackensack, NJ

The author responds:
Thanks to Ms. Luebs and Ms. Perry for their enthusiasm. Mr. Olatunji, I appreciate your comments; I, too, believe that there is much in history that has been overlooked. For a long time, most western history was Eurocentric, but I think we are beginning to move past that. Exciting new tools are telling us things we didn't know before. Archaeologists are making astonishing discoveries at the same time that we have enhanced abilities to interpret them. DNA and new approaches to linguistics are adding to our knowledge. Egyptologists in the Valley of the Kings have just found a limestone carving that seems to show that Egyptians were doing true writing before the Sumerians. Everyone's history book will have to be changed. The work that you discuss is valuable. It opens the field to possibilities. Some of those you cite have made some generally accepted points, such as the African roots and multiracial character of Egyptian civilization, but some of their other points, including the extent of Egyptians' mathematical knowledge, are still being debated by historians, Egyptologists, and archeologists.

You read an excerpt from three books. In those books I do, for instance, tell of the importance of Pythagoras' background. I say that he was trained in Egypt and probably in India. I say in the excerpt that "whatever the historical truth, [Pythagoras] usuallly gets the credit." I'm writing for young readers and trying to get them to understand that much of ancient history is unknown. We do our best to interpret what we have – and history is anything but static.

Much of our knowledge of ancient peoples comes from secondary sources. When the fires consumed the great library at Alexandria, most of the original work was lost. I wish I could be a fly on the wall of Alexander's tent, or perched on Aristotle's elbow, or buzzing around the Pharaoh Djozer. Your letter will get me to revisit my pages.

—JOY HAKIM

If you are interested in having your class or school serve as a test site for Joy Hakim's History of Science *series, please contact* ***byron@amerhispub.com***.

Mystic Chords of Memory

I very seldom agree with articles in your magazine but I must admit that "Mystic Chords of Memory" by Walter Berns (Spring 2002) was excellent and should be read to every student in the public schools. More articles like this would help your cause.

"The Story of the Atom" was also enjoyable and informative.

—DAVID ROSE
Marblehead, MA

The Road to Interest and Curiosity

Ron Rude put it into words—the feeling and intensity that I could not explain to my teenagers. I could not explain why, at the age of 52, I am going back to school part-time to get my teaching degree. I could not explain why I jump at the chance to help my kids do their initial research for reports and projects (they call me the "Queen of Research"). I've seen it time and again in my kids and myself. Sometimes curiosity has to be jump-started.

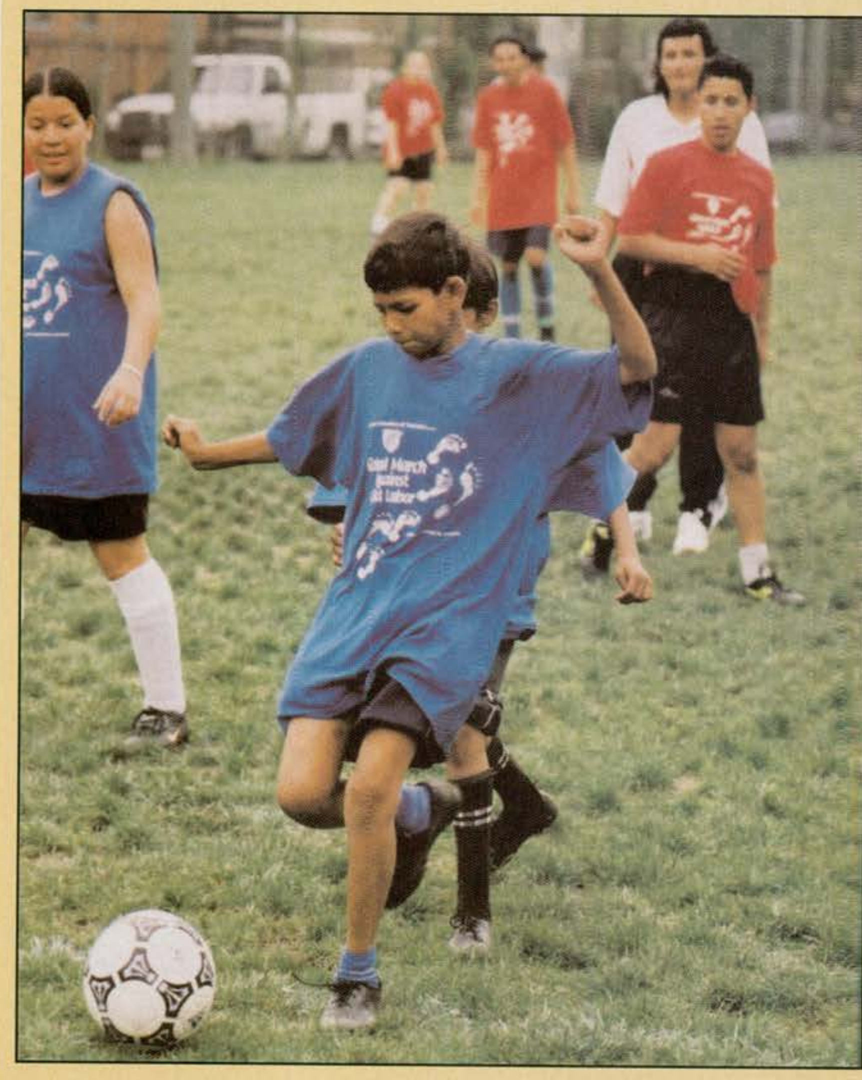
—JAN HADDEN
Atlantic West Elementary, Margate, FL

NOTEBOOK

Funding Opportunities

Would you like to apply for a grant, but never have time to meet the deadline? Start looking for grants that are awarded on a rolling basis. Two extensive lists are offered by the eSchool News Funding Center (**www.eschoolnews.org/resources/funding/ongoing.cfm**) and School Grants (**www.schoolgrants.org/grant_opps/nation_no_deadline.htm**). Both sites direct educators to dozens of opportunities. For example, the Coca-Cola Foundation offers grants of $5,000 to $25,000 for K-12 initiatives such as teaching seventh-graders about the civil rights movement, and Chevron Corporation makes grants and contributions to schools for programs in four areas: math and science education, educational quality, educational equity, and best practices in the classroom.

Once you've found the perfect grant, brush-up your proposal-writing skills by visiting The Foundation Center's online Learning Lab at **http://fdncenter.org/learn**. This site allows you to work through free tutorials, read condensed versions of the center's how-to publications (or purchase the full versions), e-mail questions to the Foundation librarian, and review frequently asked questions.



PHOTOGRAPH BY MICHAEL CAMPBELL

Ending Child Labor

To draw attention to the more than 250 million child laborers who are not only forced into harmful working conditions, but are also prevented from attending school, the AFT is an active participant in the Child Labor Coalition. In anticipation of the United Nations Special Session for Children held this May, the AFT co-sponsored a soccer game in Washington, DC, starring rescued child laborers. The game highlighted the World Cup Campaign 2002, designed to prevent children from working in the factories that make soccer balls, apparel, and other related products. To learn more about the AFT's Child Labor Project and link to instructional resources, visit **www.aft.org/international/child**.

Support for Science Teachers

The Children's Book Council and National Science Teachers Association has released their annual list of the best science trade books for K-12 students. Several categories such as life sciences, biography, and technology and engineering make skimming the list quick and easy. Under the archaeology, anthropology, and paleontology category you'll find books such as *Dinosaur Parents, Dinosaur Young: Uncovering the Mystery of Dinosaur Families* by Kathleen Weidner Zoehfeld. The annotation includes information on the publisher, number of pages, and cost, as well as this brief review, "Using the latest findings, the author describes some amazing discoveries that changed forever the way scientists think about dinosaurs. The book provides evidence about how some types of dinosaurs tended their eggs and cared for their young. The book includes beautiful illustrations and full-color photographs." Current and previous lists are available at **www.nsta.org/ostbc**.

A Map of Freedom for Social Studies Teachers

The annual Map of Freedom published by Freedom House is now available. By categorizing each country as Free, Partly Free, or Not Free, it provides students with an easy and instant portrait of the state of freedom around the world. Teachers can get a free copy of the map by calling Freedom House at (212) 514-8040.

The research basis for the map is the just-published, 600-page *Freedom in the World 2001–2002*. This annual, comprehensive survey by Freedom House evaluates the state of political rights and civil liberties in every country. Its findings are widely regarded as the definitive statement on the condition of freedom and democracy in the world. The book also includes essays by leading social scientists and charts and tables that illustrate the ebb and flow of freedom in different regions and among differing cultures. It's all available on the Web at **www.freedomhouse.org**.

Helpful Programs for Sparking Student Interest and Effort

As the school year progresses, motivating students to do their best can become a big challenge. Next year, consider a national competition or opportunity for publication to keep your students engaged, focused, and willing to work hard. From history to science, exciting challenges for all students abound.

National History Day

National History Day is not just a day, but a year-long education program that culminates in a national contest every June. While this competition is the core of the program, NHD also offers workshops, seminars, and curriculum materials for teachers, as well as summer internships for students. The program is open to all students (public, private, gifted, and special needs) in grades 6-12. For the local, state, and national competitions, students produce dramatic performances, imaginative exhibits, multimedia documentaries, and research papers related to an annual theme (which, in 2003, is "Rights and Responsibilities in History"). In the national competition, awards are given in several age categories and for a wide range of topics. There are also special awards, such as the Best Senior Student Individual Documentary Presentation sponsored by The History Channel and the prize on Labor History sponsored by the AFL-CIO. There is also an annual award for a teacher that makes an outstanding contribution to history education. To learn more about National History Day, visit **www.NationalHistoryDay.org**.

DuPont Challenge Science Essay Contest

The DuPont Challenge is a chance for budding scientists to receive national recognition for their research papers. Topics students choose to research and write about are diverse—from astronomy to physics, from biotechnology to paleontology. Top essays always possess careful thought, insight, research, clear writing, and genuine enthusiasm for an important subject. To get a clear sense of these qualities, students can view winning essays on the Web site. The winners of the junior (grades seven to nine) and senior (grades 10 to 12) divisions are flown to Space Center Houston (along with their sponsoring science and English teachers) and receive $1,500. To find out more about the DuPont Challenge, visit **www.glcomm.com/dupont/**.

Stone Soup

Stone Soup is the only magazine made up entirely of the creative work of children. Young people through age 13 from all over the world contribute their stories, poems, book reviews, and art work to *Stone Soup*. *Stone Soup* is published six times a year, in January, March, May, July, September, and November. The staff, which includes the two founders of *Stone Soup*, carefully read through every story and poem sent. If asked, the staff will try to reply to the author with brief comments and suggestions within four weeks of the submission. Items that combine both "beautiful writing and original ideas" are selected for publication. To read a sample issue and learn more about *Stone Soup*, visit **www.stonesoup.com**.

National Geographic Bee

Generate excitement around geography with the National Geographic Bee, for fourth through eighth grade. The Bee occurs in three stages, beginning at the school level. Each school winner takes a written test, and the top hundred scorers in each state and territory compete at the state level. The 55 state and territory winners meet at National Geographic Society headquarters in Washington, DC, for the national competition where the top three students will be awarded college scholarships of $25,000 for the winner, $15,000 for second place, and $10,000 for third place. For more information on the Bee, including sample questions through the online GeoBee Challenge, visit **www.nationalgeographic.com/geographybee/**. An official Bee study guide is now in bookstores. To participate, schools must register by October 15th.

ILLUSTRATED BY DAVID CHEN

Lost at Sea

Without a Curriculum, Navigating Instruction Can Be Tough —Especially for New Teachers

By David Kauffman, Susan Moore Johnson, Susan M. Kardos, Edward Liu, and Heather G. Peske

"You want me to teach this stuff, but I don't have the stuff to teach." With this statement, Gail* captured the challenge many new teachers face as they enter schools today. She understood that the academic curriculum is the core of her work and responsibility as a teacher. She recognized the increased focus on academic performance and accountability that is prevalent in an era of standards-based reform. She acknowledged the expectation that she prepare her fourth-grade students for the state's standards-based assessment. Yet, Gail looked at the spare curriculum and lack of instructional materials presented to her as a first-year teacher and wondered just what it was that she was supposed to be teaching.

As large numbers of U.S. public school teachers retire and enrollments rise during the next decade, over two million new teachers will enter the profession. They begin their careers during an era of standards-based reform and high-stakes assessments.

For new teachers, learning to teach well is difficult work. Managing a classroom, deciding what skills and knowledge to cover, designing lessons and implementing them effectively, accurately assessing students' understanding, and adjusting to students' needs are complex tasks; and new teachers need support to develop the necessary knowledge and skills to carry them out. The curriculum and its associated materials are potential sources of this support and they play important roles in teacher development.

While the term "curriculum" conjures a host of meanings, we define it here as what and how teachers are expected to teach. A complete curriculum specifies content, skills, or topics for teachers to cover; suggests a timeline; and incorporates a particular approach or offers instructional materials. If well developed, it can also help give new teachers insight into how students make sense of key concepts, the potential misunderstandings students may have along the way to comprehension, and the instructional strategies that are particularly effective for teaching a given concept or skill.

Through interviews with 50 first- and second-year teachers in Massachusetts, we sought to better understand how new teachers experience the curriculum and assessments they encounter. What curricular expectations and materials do they find in their schools? In what ways do they feel supported by the curriculum and materials they encounter, and in what ways do they feel constrained? And, how do state-mandated assessments affect their experiences?

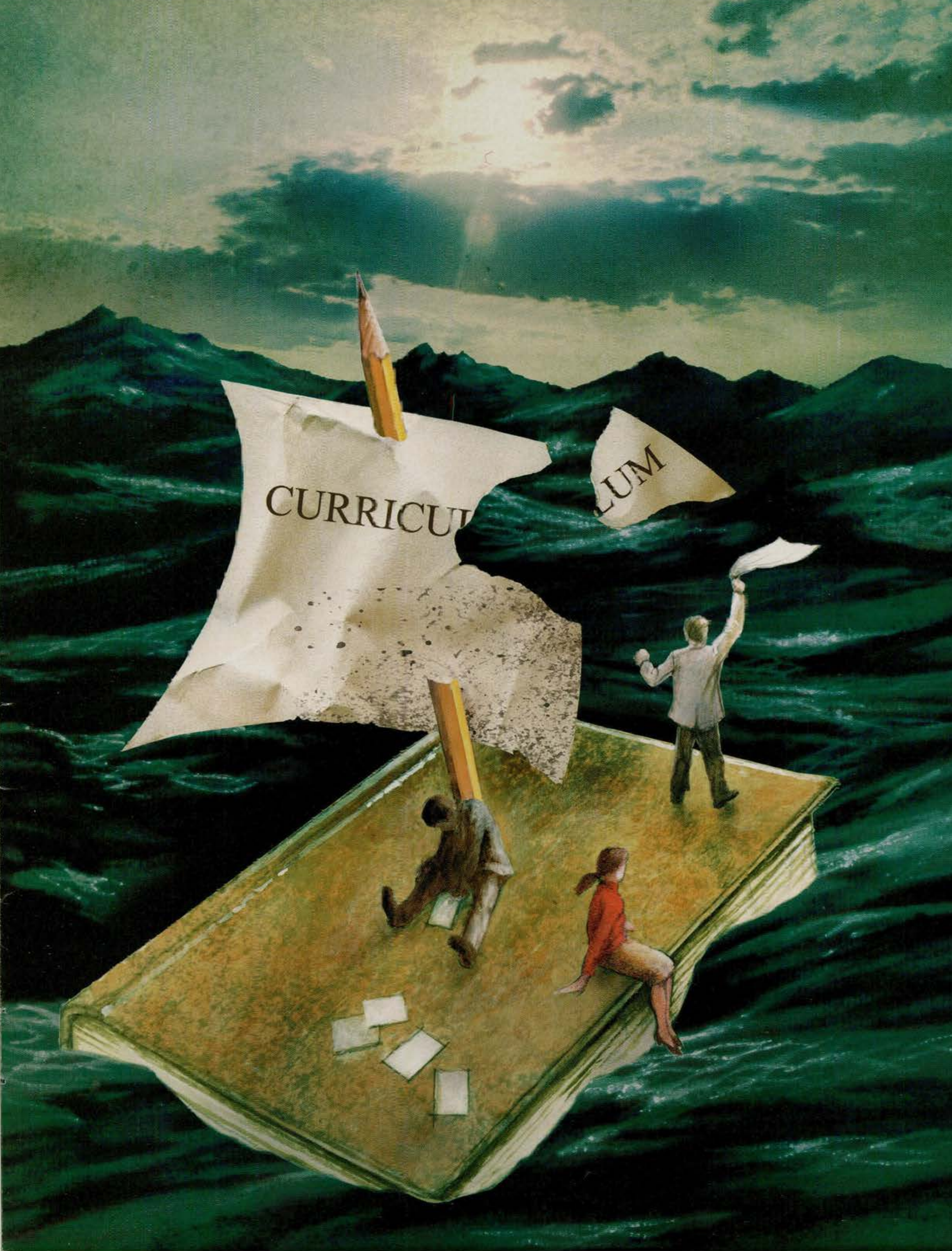
The Massachusetts Education Reform Act of 1993 required the state department of education to develop a series of curriculum framework documents that describe state standards for seven subject areas. In addition, the legislation created the Massachusetts Comprehensive Assessment System (MCAS), a high-stakes standardized test first administered in 1998 to fourth-, eighth-, and tenth-grade students.

We expected that new teachers in this context might feel constrained and frustrated by the rigidity of the curricula they encountered. Instead, we found that despite Massachusetts' detailed system of standards and accountability

Susan Moore Johnson is a professor of education at the Harvard Graduate School of Education and the principal investigator for the Project on the Next Generation of Teachers. David Kauffman, Susan M. Kardos, Edward Liu, and Heather G. Peske are research assistants with the Project.
This article has been excerpted with permission from "Lost at Sea: New Teachers' Experiences with Curriculum and Assessment," Teachers College Record, *Vol. 104(2), pp. 273-300, Blackwell Publishing, Oxford, UK. This research was funded by the Spencer Foundation, which bears no responsibility for the findings or views expressed here.*

* *To protect teachers' privacy, pseudonyms are used throughout this article.*

ILLUSTRATED BY NENAD JAKESEVIC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Left to their own devices, new teachers struggled day-to-day to prepare content and materials instead of developing a coherent plan to address long-term objectives.

measures, most new teachers we interviewed received little or no guidance about what to teach or how to teach it. The curriculum frameworks from the state department of education described academic standards students should achieve; but, unlike a curriculum, they did not include details about specific content, sequence, instructional materials, or pedagogical methods. Yet new teachers reported that many districts and schools relied on these frameworks as *the curriculum,* rather than as *the basis for developing a curriculum.* Left to their own devices, they struggled day-to-day to prepare content and materials instead of developing a coherent plan to address long-term objectives. Rather than lamenting a lack of freedom or expressing a need to assert their autonomy, they longed for greater specification of their curriculum—both what to teach and how to teach it.

Amy, who taught second grade at an urban elementary school, said she started her first school year with "no set curriculum" for social studies:

> No one has ever told me anything I am supposed to cover. They kind of just said, "Here are the books." And the books—I didn't know where they were. I had to ask for them.... No one has ever told me anything that I had to cover. No one has actually given me the [local district] curriculum. I actually had it, luckily, from a previous class in college. But no one ever told me, "You need to teach that."

So how did Amy decide what to teach in social studies? She said, "I kind of made it up on my own." At least one-fifth of the new teachers in our sample described receiving no operational curriculum at all, meaning they were left on their own to decide both what to teach and how to teach it. Theresa, who taught at a suburban school, explained that "no one really knows what the curriculum is" for seventh-grade math, which leaves it "pretty much up to the teacher." One teacher described his charter school curriculum as "frustratingly open" and asked, "How are you supposed to come up with curriculum while you teach?"

Over half of our respondents encountered a curriculum that specified topics or skills to be taught but provided no materials or guidance about how to address them. Some of the new teachers we interviewed appreciated the flexibility of this arrangement, such as an elementary-school teacher who noted that there was "enough room to do it in different ways." Most, however, thought there was insufficient guidance. For example, a suburban middle-school teacher said that this topical curriculum was not something she could "follow week-to-week or day-to-day." Gwen, who taught fourth grade at an urban elementary school, described feeling "lost at sea without any map or anything, without an astronomer to figure out where you were going." She worked hard to create units and worksheets for math topics that were not included in the materials provided: "I'm not bitter about that, that's part of my job. But having no resources at all for that, it's very difficult. And then, imagine having to do that for every subject."

Some of our respondents described not being sure how to organize their materials and create a lesson plan. According to Peggy, who taught second grade in a suburban district:

> They gave me stuff, but sometimes when you get all this material, especially a lot of written stuff and books and things, it can be overwhelming because you're looking at it all and thinking, "Where do I start? What do I begin with?" There's no handbook.

Without some assistance or guidance to organize the materials, having too much may be as disorienting as having too little.

In response to having little or no curriculum, our respondents said they spent an inordinate amount of time and money developing their own content and materials from scratch. This occurred amidst expectations that they would learn to maintain discipline, facilitate class discussions, communicate with parents, grade papers, and negotiate the complicated red tape of school.

Only a few of the new teachers we interviewed described having a highly specified curriculum for one or more subjects or classes. These curricula provided detailed lessons that one teacher described as "pretty much scripted." Amanda, an urban elementary teacher, described her first grade math program as being

> ...pretty straightforward. There's a little bit of prep involved. But you open a book, it will tell you, you know, "Pour this much rice into these two containers and ask the children to describe what they see."

Such step-by-step directions allowed these teachers to feel some degree of confidence, even when teaching a lesson for the first time.

Although much of the literature suggests teachers value their autonomy and do not want to be told what to do, nearly all of these new teachers appreciated what curricular guidance they had, but wished for more. They wanted to use and adapt lessons and materials that had proven successful for teachers before them. These new teachers were not looking for easy solutions, but they suggested that they were not yet well qualified to design curriculum from scratch. In calling for greater specification, these new teachers stopped well short of asking that their every move be dictated. As a suburban middle-school teacher stated, "I don't think I would want, necessarily, everything handed to me. But at the same time, having nothing handed to you makes it so much more work." These new teachers thought that a more highly specified curriculum would have reduced the frantic and last-minute nature of lesson planning.

They also worried that their haphazard approaches short-

(Continued on page 46)

The Cascading Benefits of a Common, Coherent Curriculum

The Massachusetts teachers described in "Lost at Sea" are not alone. Across the country, teachers have very little support in their effort to prepare students to meet new, high standards and demonstrate their knowledge and skills on rigorous (or not-so-rigorous) tests. According to *Making Standards Matter 2001*, AFT's annual report on standards-based reform, no state has a fully developed curriculum (including how topics within a sequence relate to each other, recommended instructional resources and ideas, and sample performance levels) in English, mathematics, social studies, and science. In fact, only nine states have at least half of these curriculum components fully developed. In New York City, where students take consequential tests sponsored by the state and district, the curriculum vacuum is so severe that the local union, the 140,000-member United Federation of Teachers, is developing a curriculum on its own—filling a gap that the city and state should have addressed.

At its best, a formal, specific curriculum represents a kind of distilled wisdom about how best to help students reach specific academic goals. Such a curriculum—which indicates what is to be taught at each grade, suggests a sequence of topics within each grade, and offers instructional ideas and insights—can offer direct guidance to teachers.

But more importantly, when such a curriculum is commonly taught to students across districts and states (in contrast to American practice in which the actual, taught curriculum varies enormously across schools and districts—and even between classrooms within a school!), a cascade of additional benefits can follow. Teachers know exactly what students must learn to be well prepared for the next grade; teachers need not guess the meaning of vague standards—or pick and choose what to teach from among an excessive number of specific standards; textbooks can be tightly focused on these curricular goals; students who are behind can be easily identified and provided special assistance; and each fall, teachers know what their new students have already been exposed to and can move immediately to build on that knowledge. Further, preservice education and professional development can prepare teachers to know and understand the curriculum they'll be teaching and how to teach it.

These benefits characterize education in the highest-achieving countries in the world. This kind of coordinated educational system, pegged to high standards, is what America and its leaders envisioned when they embraced—in many national reports and educational summits—what has become known as standards-based reform. It was this kind of alignment, culminating in high quality assessments that could elicit student effort and greater accountability, that we all believed could help American students achieve at world-class levels. Unfortunately, as states have worked to realize this vision, curriculum has too often been neglected. The result can be the perversion of standards-based reform. Where there are high-stakes assessments but no curriculum, teachers are often pushed to peruse previous tests and slavishly "teach to" them. In effect, the assessment works to narrow teachers' instruction—the reverse of what standards-based reform intended.

American Educator devotes this special section to the importance of a common, coherent curriculum, the cascading benefits it can provide, and catalyzing action on its behalf.

—EDITOR

A Coherent Curriculum

The Case of Mathematics

By William Schmidt, Richard Houang, and Leland Cogan

Consider the agricultural prospects of two countries: In Country A, the nation takes the best that's known about growing crops and translates it into clear, coherent, manageable guidelines for farming. These guidelines are distributed to all farmers in the country. Further, Country A makes available to all farmers up-to-date tools (tractors, balers, harvesters, etc.) and training on how to use these tools that allow them to implement the wisdom contained in the guidelines. Just as in any other country, some farmers have inherently greener thumbs than others; they find ways to surpass the guidelines and cultivate extra-rich crops. But the broad availability of the guidelines and tools puts a floor beneath farming quality. As a result, the gap between the most- and least-effective farmers is not very great, and the average quality of farming is quite good. Moreover, the average quality slowly increases as the knowledge of the best farmers is incorporated into the guidelines.

In Country B, the situation is very different. States, and sometimes towns, assemble a list of everybody's favorite ideas about farming. The list is available to any farmer who seeks it out, but it's up to the individual farmers to develop their own guidelines based on the list. The ideas are interesting, but there are too many ideas to make use of, no indications of which ideas are the best, and no pointers on which ideas fit together with other ideas. Plus, using the ideas requires tools—and training about how to use the tools. Few farmers have ready access to either.

The result: A few particularly skilled farmers in Country B figure out how to farm productively. They are mainly the farmers in more affluent areas—they have been able to attend great local agricultural schools and can afford the tools suggested by their training. A few additional farmers—those with a special knack—do fine anyway, despite their lack of training and use of poor tools. But most of Country B's farms aren't particularly efficient, certainly not in comparison with Country A's. In Country B, the gap between the most- and least-effective farms is huge, and the productivity of the average farm is far less than its Country A counterpart.

This analogy explains much of the difference between schooling and teaching in the highest achieving countries in the world and in the United States. Like the farmers in Country A, teachers in the highest achieving countries have coherent guidelines in the form of a national curriculum. They also have related tools and training—teacher's guides, student textbooks and workbooks, and preservice education—that prepare them to teach the curriculum and provide opportunities for curriculum-based professional development. In contrast, like the farmers in Country B, teachers in the U.S. have long lists of ideas about what should be taught (aka standards) and market-driven textbooks that include something for everyone but very little guidance, tools, or training.

Why should we be concerned if teachers in the U.S. have to work a little harder to figure out what they are going to teach? A new analysis of data from the Third International Math and Science Study (TIMSS) provides evidence that American students and teachers are greatly disadvantaged by our country's lack of a common, coherent curriculum and the texts, materials, and training that match it.

Some people think that the purpose of an international comparison is to see which country is best and then get the U.S. to emulate its practices. That idea is naïve. You cannot

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lift something from one cultural context and expect it to work in another. But international research can cause us to challenge some of our common assumptions about education and consider alternatives to what we are doing.

First, let us briefly review what TIMSS is and the TIMSS findings to date, which have been published in a series of previous reports. Then we will turn to our more recent findings in grades one through eight mathematics curricula, in which we can see that high-performing countries teach a very similar, very coherent, core math curriculum to all of their students—and we, decidedly and clearly, do not. Lastly we will look at the importance of this finding by examining the cascade of benefits that flow from attaining a coherent, common curriculum.

I. The Early TIMSS Findings

TIMSS is the most extensive and far-reaching cross-national comparative study ever attempted. It was conducted in 1995, with 42 countries participating in at least some part of the study. TIMSS tested three student populations: those who were mostly nine years old (grades three and four in the U.S.); those who were mostly 13 years old (grades seven and eight in the U.S.); and students in the last year of secondary school (12th grade in the U.S.). In addition to the student tests, the study included a great deal of other data collection, including extensive studies of curriculum. Findings from the curriculum study are the heart of this article; but first, let's review what's already been reported in the general press about TIMSS.

The Horse Race

The horse race—who comes in first, second, and third—is not particularly important in and of itself. In fact, the ranking of nations is simply the two-by-four by which to get people's attention.

At the fourth-grade level, the U.S. did reasonably well on the TIMSS exam. Our students scored above the international average in both math and science. In science, in fact, we came very close to being number one in the world; our fourth-graders were second only to the South Koreans. In mathematics, on the other hand, our performance was only decent; it was above average, though not in the top tier of countries. (Detailed findings, including tables and graphs, can be found on our Web site, **http://ustimss.msu.edu**, or at the U.S. Department of Education's TIMSS Web site, **http://nces.ed.gov/timss**).

By eighth grade, however, the U.S. dropped to the international average, slightly above average in science and slightly below average in mathematics. In other words, just four years along in our educational system, our scores fell to average or even below average. The decline continues so that by the end of secondary school our performance is near the bottom of the international distribution. In both math and science, our typical graduating senior outperformed students in only two other countries: Cyprus and South Africa.

Some people might ask, "What difference does it make if we can't do fancy math problems?" It does make a difference. A typical item on the TIMSS 12th-grade math test shows a rectangular wrapped present, provides its height, width, and length, as well as the amount of ribbon needed to tie a bow, and asks how much total ribbon would be needed to wrap the present and include a bow. Students simply need to trace logically around the package, adding the separate lengths so as to go around in two directions and then add the length needed for the bow. Only one-third of U.S. graduating seniors can do this problem, however. This is serious.

Another part of the 12th-grade TIMSS study involved advanced students, those taking courses like calculus or college-preparatory physics. The results are quite startling: We are near the bottom of this international distribution also. In the past, when international results have been reported, many people have suggested, "It's really not a problem because our best students are doing okay." That's simply not true. In fact, a comparison of mathematics scores in 22 countries revealed that U.S. eighth-graders who scored at the 75th percentile were actually far below the 75th percentile in 19 of the other countries. The most dramatic results were in comparison to Singapore—a score at the 75th percentile in the U.S. was below the 25th percentile in Singapore. The problems we must address affect not only our average students, but even those who are above average.

Curriculum Matters: What You Teach is What You Get

Now these horse race results are interesting and disquieting. But they hide important results that we think help with understanding our poor performance and give us the keys to fixing it. To really understand the TIMSS results, you have to examine student achievement in different areas of the curriculum within math and science.

When you look at the performance of eighth-grade students in different math and science content areas, you will find that U.S. performance is remarkably different on different topics. And, the same is true for virtually every other country. For example, Singapore was number one in science at eighth grade, but students there were not number one in all of the different science areas.

One of the most important findings from TIMSS is that the differences in achievement from country to country are related to what is taught in different countries. In other words, this is not primarily a matter of demographic variables or other variables that are not greatly affected by schooling. What we can see in TIMSS is that schooling makes a difference. Specifically, we can see that *the curricu-*

lum itself—what is taught—makes a huge difference.

Consider the performance of Bulgarian students in science. They were tops in the world in the area of the structure of matter, but almost dead last in the area of physical changes. Consider, too, the remarkable variations in U.S. performance in mathematics. Our eighth-grade students did their very best math work in the area of rounding. Our kids are among the world's best rounders. We obviously teach it thoroughly. But based on the TIMSS results, we are obviously not doing an adequate job of teaching measurement; perimeter, area and volume; and geometry.

These findings emerged from a substantial line of research within TIMSS that examined what is taught in 37 countries. To get a rich picture of math and science instruction in each country, we looked at the "intended" content—that is, what officials intended for teachers to teach; and "enacted" content—that is, what teachers actually taught in their classrooms. In most countries, the intended content was simply the national curriculum. But in the handful of countries without a national curriculum, we sought out other formal statements of intended content at the regional or local level. For example, in the U.S. we examined state and district standards. In all of the countries we determined the enacted content by surveying teachers about what they believed they had covered. Additional information on what is taught came from a review of several major textbooks in each country and, in a few countries, classroom observations.

Based on these studies of the "intended" and "enacted" content in mathematics, we can make some general claims. We know that in most countries studied, the intended content that is formally promulgated (at the national, regional, or state level) is essentially replicated in the nation's textbooks. We can also say that in most countries studied, teachers "follow" the textbook. By this we mean that they cover the content of the textbook and are guided by the depth and duration of each topic in the textbook. From this knowledge, we can say with statistical confidence that what is stated in the intended content (be it a national curriculum or state standards) and in the textbooks is, by and large, taught in the classrooms of most TIMSS countries. Knowing all of this, we can often trace the strengths and weaknesses that a nation's students display on given topics to comparable strengths and weaknesses in the intended content. In short, our study shows clearly that curriculum matters. If a nation asks teachers to teach a particular set of topics in a particular grade, that is what teachers will likely teach—and, in the aggregate, it is what students will likely learn. This was true even after we controlled for students' socioeconomic status.[1]

Curricula in the U.S.: A Mile Wide, an Inch Deep

Based on these early analyses of TIMSS data, we can characterize the intended math and science content (as stated in sets of standards and textbooks) in the U.S., relative to others in the world, in four ways:

1. Our intended content is not focused. If you look at state standards, you'll find more topics at each grade level than in any other nation. If you look at U.S. textbooks, you'll find there is no textbook in the world that has as many topics as our mathematics textbooks, bar none. In fact, according to TIMSS data, eighth-grade mathematics textbooks in Japan have around 10 topics, but U.S. eighth-grade textbooks have over 30 topics. (See photo on page 20.) And finally, if you look in the classroom, you'll find that U.S. teachers cover more topics than teachers in any other country.

2. Our intended content is highly repetitive. We introduce topics early and then repeat them year after year. To make matters worse, very little depth is added each time the topic is addressed because each year we devote much of the time to reviewing the topic.

3. Our intended content is not very demanding by international standards. This is especially true in the middle-school years, when the relative performance of U.S. students declines. During these years, the rest of the world shifts its attention from the basics of arithmetic and elementary science to beginning concepts in algebra, geometry, chemistry, and physics.

4. Our intended content is incoherent. Math, for example, is really a handful of basic ideas; but in the United States, mathematics standards are long laundry lists of seemingly unrelated, separate topics. Our most recent analysis has more to say about this and we will return to it in the next section.

As a result of these poorly designed standards and textbooks, the curriculum that is enacted in the U.S. (compared to the rest of the world) is highly repetitive, unfocused, unchallenging, and incoherent, especially during the middle-school years. There is an important implication here. Our teachers work in a context that demands that they teach a lot of things, but nothing in-depth. We truly have standards, and thus enacted curricula, that are a "mile wide and an inch deep."

One popular response to a study like TIMSS is to blame the teachers. But the teachers in our country are simply doing what we have asked them to do: "Teach everything you can. Don't worry about depth. Your goal is to teach 35 things briefly, not 10 things well."

II. The Coherent Curriculum

Discussion of the TIMSS achievement results has prompted policymakers in the U.S. and elsewhere to wonder just what it might mean to have a world-class mathematics or science curriculum. In response to this interest, we investigated the top achieving TIMSS countries' curricula in mathematics and science to distill what they considered essential content for virtually all students[2] over the different grades of schooling. With this new analysis, we can go beyond the critique of our "mile-wide-inch-deep curricula" and look at the character and content of a world-class curriculum.[3] Although we conducted this analysis for both math and science, in this article we will only address the math findings.

After identifying the top achieving (or A+) countries and devising a methodology to determine the topics that were common to their curricula, we developed a composite set of topics consisting of the topics that at least two-thirds of the A+ countries included in their curricula. This A+ composite is displayed in Figure 1. Next, composites for U.S. mathematics standards from 21 states (Figure 2) and 50 districts (Figure 3, page 21) were also developed and compared to the A+ composite. (For more details on the methodology, please see page 47.)

While examining the A+ composite, it is important to keep in mind that this figure represents a "core" curriculum, not a complete curriculum. Our goal in developing the composite was to find out which topics at least two-thirds of A+ countries believed to be essential. Not surprisingly, these countries' points of agreement resulted in a smaller set of topics in our composite than any one of these countries includes in its national curriculum.[4]

To represent the full scope of a complete mathematics curriculum in a typical A+ country, roughly three topics would have to be added at each grade level in addition to those listed in Figure 1. As noted in the last line of Figure 1, the average number of topics that would have to be added range from one (in grades four and five) to as many as six (in grades two and seven). This is important information for Americans who understand that there is a need for a com-

FIGURE 1

A+ Composite: Mathematics topics intended at each grade by at least two-thirds of A+ countries.

Note that topics are introduced and sustained in a coherent fashion, producing a clear upper-triangular structure.

TOPIC GRADE:	1	2	3	4	5	6	7	8
Whole Number Meaning	■	■	■	▒	▒			
Whole Number Operations	■	■	■	■	▒			
Measurement Units	□	■	■	■	■	■	▒	
Common Fractions			□	■	■	▒		
Equations & Formulas			□	▒	▒	▒	■	■
Data Representation & Analysis			□	□	▒	▒		□
2-D Geometry: Basics			□	▒	▒	▒	■	■
Polygons & Circles				▒	▒	▒	■	■
Perimeter, Area & Volume				▒	▒	▒	▒	□
Rounding & Significant Figures				▒	▒			
Estimating Computations				▒	▒	▒		
Properties of Whole Number Operations				□	▒			
Estimating Quantity & Size				□	□			
Decimal Fractions				▒	■	▒		
Relationship of Common & Decimal Fractions				▒	■	▒		
Properties of Common & Decimal Fractions					▒	▒		
Percentages					▒	▒		
Proportionality Concepts					▒	▒	▒	□
Proportionality Problems					▒	▒	■	■
2-D Coordinate Geometry					□	□	▒	▒
Geometry: Transformations						▒	▒	▒
Negative Numbers, Integers & Their Properties						□	▒	
Number Theory							▒	□
Exponents, Roots & Radicals							▒	▒
Exponents & Orders of Magnitude							□	□
Measurement Estimation & Errors							□	
Constructions w/ Straightedge & Compass							■	□
3-D Geometry							▒	■
Congruence & Similarity								■
Rational Numbers & Their Properties								□
Patterns, Relations & Functions								□
Slope & Trigonometry								□
Number of topics covered by at least 67% of the A+ countries	3	3	7	15	20	17	16	18
Number of additional topics intended by A+ countries to complete a typical curriculum at each grade level	2	6	5	1	1	3	6	3

□ – intended by 67% of the A+ countries ▒ – intended by 83% of the A+ countries ■ – intended by 100% of the A+ countries mon, prescribed curricular core, but also believe some local discretion must be accommodated. The A+ composite shows that, at least in math, it is eminently sensible and doable to think of some math topics as part of a required core taught in particular grades and others as topics that can float according to, say, state or district discretion.

The A+ Composite

Figure 1 presents the A+ composite for mathematics by topic and grade. The 32 topics listed are those that are in the national curricula at a given grade in at least two-thirds of the A+ countries. As evidenced by the "upper-triangular" shape of the data, the A+ composite reflects an evolution from an early emphasis on arithmetic in grades one through four to more advanced algebra and geometry beginning in grades seven and eight. Grades five and six serve as a transitional stage in which topics such as proportionality and coordinate geometry are taught, providing a bridge to the formal study of algebra and geometry.

More specifically, these data suggest a three-tier pattern of

FIGURE 2

State Composite: Mathematics topics intended at each grade by at least two-thirds of 21 U.S. states.

Note that topics are introduced and sustained in a way that produces no visible structure.

TOPIC	GRADE: 1	2	3	4	5	6	7	8
Whole Number Meaning	■	■	■	■	▒	□		
Whole Number Operations	■	■	■	■	▒	□		
Measurement Units	▒	■	■	▒	■	■	■	▒
Common Fractions	□	▒	▒	▒	■	▒	□	□
Equations & Formulas	□	□	▒	▒	▒	■	■	■
Data Representation & Analysis	■	■	■	■	■	■	■	▒
2-D Geometry: Basics	▒	▒	▒	▒	▒	▒	▒	▒
Polygons & Circles	■	■	■	■	■	■	■	▒
Perimeter, Area & Volume		□	□	□	▒	■	■	▒
Rounding & Significant Figures								
Estimating Computations	□	□	▒	▒	▒	▒	▒	▒
Properties of Whole Number Operations	□	□	□	□				
Estimating Quantity & Size			□					
Decimal Fractions			□	▒	▒	▒	□	□
Relationship of Common & Decimal Fractions				□	□	□		
Properties of Common & Decimal Fractions								
Percentages					□	▒	▒	□
Proportionality Concepts						▒	□	
Proportionality Problems						▒	▒	▒
2-D Coordinate Geometry			□	▒	□	□	□	▒
Geometry: Transformations	▒	▒	▒	▒	▒	▒	▒	▒
Negative Numbers, Integers & Their Properties						□	▒	□
Number Theory					▒	□	□	□
Exponents, Roots & Radicals						□	□	■
Exponents & Orders of Magnitude							□	□
Measurement Estimation & Errors	□	□	▒	□	▒	▒	▒	□
Constructions w/ Straightedge & Compass								
3-D Geometry	■	■	■	▒	■	▒	■	▒
Congruence & Similarity					□	▒	▒	□
Rational Numbers & Their Properties						▒	▒	□
Patterns, Relations & Functions	▒	■	■	■	▒	■	■	■
Slope & Trigonometry								
Number of topics covered by at least 67% of the states	14	15	18	18	20	25	23	22
Number of additional topics intended by states to complete a typical curriculum at each grade level	8	8	7	8	8	5	6	6

□ – intended by 67% of the states ▒ – intended by 83% of the states ■ – intended by 100% of the states increasing mathematical complexity. The first tier includes an emphasis primarily on arithmetic, including common and decimal fractions, rounding, and estimation. It is covered in grades one through four. The third tier, covered in grades seven and eight, consists primarily of advanced number topics such as number theory (including primes and factorization, exponents, roots, radicals, orders of magnitude, and rational numbers and their properties), algebra (including functions and slope), and geometry (including congruence and similarity, and 3-dimensional geometry). Grades five and six appear to serve as an overlapping transitional tier with continuing attention to a few arithmetic topics, but also with an introduction to more advanced topics such as percentages; negative numbers, integers and their properties; proportional concepts and problems; two-dimensional coordinate geometry; and geometric transformations.

The curriculum structure also includes a small number of topics that provide a form of continuity across all three tiers. These continuing topics (such as measurement units, which are covered in grades one through seven, and equations and formulas, which are covered in grades three through eight) seem to support the overall curriculum structure. These topics have an

The Benefit to Equity

By E.D. Hirsch, Jr.

When children share a common base of knowledge, their classroom instruction can be far more effective. Why is this? Anyone who has ever taught a class knows that explaining a new subject will induce smiles of recognition in some students, but looks of puzzlement in others. Every teacher who reads exams has said or thought, "Well, I *taught* them that, even if some of them didn't *learn* it." What makes the click of understanding occur in some students, but not in others?

Research has shown that the ability to learn something new depends on an ability to accommodate the new thing to the already known. When the automobile first came on the scene, people called it a "horseless carriage," thus accommodating the new to the old. When a teacher tells a class that electrons go around the nucleus of an atom as the planets go around the sun, that analogy may be helpful for students who already know about the solar system, but not for students who don't. Relevant background knowledge gives students a greater variety of means for capturing the new ideas.

This enabling function of relevant prior knowledge is essential at every stage of learning.

When a child "gets" what is being offered in a classroom, it is like someone getting a joke. A click occurs. People with the requisite background knowledge will get the joke, but those who lack it will be puzzled until somebody explains the background knowledge that was assumed in telling the joke. A classroom of 25 to 30 children cannot move forward as a group until all students have gained the taken-for-granted knowledge necessary for "getting" the next step in learning. If the class must pause too often while its lagging members are given background knowledge they should have gained in earlier grades, the progress of the class is bound to be excruciatingly slow for better-prepared students. If, on the other hand, instead of slowing down the class for laggards, the teacher presses ahead, the less-prepared students are bound to be left further and further behind.

For effective classroom learning to take place, class members need to share enough common reference points to enable all students to learn steadily, albeit at differing rates and in response to varied approaches. Harold Stevenson and James Stigler in their important book, *The Learning Gap,* show that when this requisite commonality of preparation is lacking, as it is in most American classrooms today, the progress of learning will be slow compared with that of educational systems that do achieve commonality of academic preparation within the classroom. It is arguable that this structural difference between American classrooms and those of more effective systems is an important cause of the poor showing of American students in international comparisons.

The learning gap that Stevenson and Stigler describe is a gap in academic performance between American and Asian students. Subsequently, work by Stevenson and his colleagues has shown that this gap grows wider over time, putting American students much further behind their Asian peers by 11th grade than they were in the sixth grade. The funnel shape of this widening international gap has an eerie similarity to the funnel shape of the widening gap *inside* American schools between advantaged and disadvantaged students as they progress through the grades. A plausible explaimplied breadth that means they could move from their most elementary aspects to the beginning of complex mathematics during the elementary and middle grades.

Another pattern identified in Figure 1 is the number of grades in which a topic is covered in the A+ composite—mathematics topics in these countries are generally intended for an average span of three years. Only eight out of the 32 topics are covered for five or more years. In addition, five out of the 32 topics are covered for only one year in grades one through eight. (These five topics reappear in the upper secondary mathematics curricula of A+ countries, but Figure 1 does not include this information.) As you will see, the short duration of topic coverage stands in stark contrast to the U.S.

These data indicate that across the A+ countries there is a generally agreed-upon set of mathematics topics—those related to whole numbers and measurement—that serve as the foundation for mathematics understanding. They constitute the fundamental mathematics knowledge that students are meant to master during grades one to five. Future mathematics learning builds on this

nation for the widening in both cases is that a lack of academic commonality in the American classroom not only slows down the class as a whole thus making us lag behind other countries, but also creates an increasing discrepancy between students who are lucky enough to have gained the needed background knowledge at home and those who have to depend mainly on what they get sporadically in school. The learning of luckier students snowballs upon their initial advantage while that of the less fortunate ones—those dependent for their learning on what the incoherent American school curricula offer—never even begins to gather momentum. The lack of shared knowledge among American students not only holds back their average progress, creating a national excellence gap, but more drastically, holds back disadvantaged students, thus creating a fairness gap as well.

What chiefly makes our schools unfair, then, even for children who remain in the same school year after year, is that some students are learning less than others, not because of their innate lack of academic ability or their lack of willingness to learn, but because of the inherent shortcomings in curricular organization. A systemic failure to teach all children the knowledge they need in order to understand what the next grade has to offer is *the* major source of avoidable injustice in our schools. It is impossible for a teacher to reach all children when some of them lack the necessary building blocks of learning. Under these circumstances, the most important single task of an individual school is to ensure that all children within that school gain the prior knowledge they will need at the next grade level. Since our system currently leaves that supremely important task to the vagaries of individual classrooms, the result is a systemically imposed unfairnesss even for students who remain in the same school. Such inherent unfairness is greatly exacerbated for children who must change schools, sometimes in the middle of the year.

A systemic failure to teach all children the knowledge they need in order to understand what the next grade has to offer is *the* major source of avoidable injustice in our schools.

Consider the plight of Jane, who enters second grade in a new school. Her former first-grade teacher deferred all world history to a later grade, but in her new school, many first-graders have already learned about ancient Egypt. The new teacher's references to the Nile River, the Pyramids, and hieroglyphics simply mystify Jane and fail to convey to her the new information that the allusions were meant to impart. Multiply that incomprehension by many others in Jane's new environment, and then multiply those by further comprehension failures which accrue because of the initial failures of uptake, and we begin to see why Jane is not flourishing academically in her new school. Add to these academic handicaps the emotional devastation of not understanding what other children are understanding, and add to avoidable academic problems the *un*avoidable ones of adjusting to a new group, and it is not hard to understand why newcomers fail to flourish in American schools. Then add to all of these drawbacks the fact that the social group with the greatest percentage of school changers is made up of low-income families who move for economic reasons, and one understands more fully why disadvantaged children suffer disproportionately from the curricular incoherence of the American educational system.

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foundation. At the middle and upper grades, new and more sophisticated topics are added—and, significantly, *the foundation topics then disappear from the curriculum.*

A Structure that Reflects the Discipline of Mathematics

To date, most discussions and evaluations of the quality of American standards have revolved around such characteristics as clarity, specificity, and, often, a particular ideology. For example, in mathematics these distinctions have been revealed in what is called the "math wars," a debate over what constitutes basic mathematics for the school curriculum.

With our look at the A+ composite, our definition of

The Benefit to Subject-Matter Knowledge

In this article, we discuss America's curriculum gap—the difference between the quality of our curriculum and that of the A+ countries. Others (especially Harold Stevenson and Jim Stigler) have written about a learning gap and a teaching gap. Perhaps one of the biggest gaps—and it's related to the others—is the subject-matter knowledge gap that exists between our mathematics teachers and those in the highest performing countries. If we are serious about making our math curriculum more rigorous, this gap—which reflects the limited subject-matter preparation that many of our teachers receive—will have to be addressed.

In 2001, a survey asked a sample of Michigan teachers if they felt prepared to teach 12 specific mathematics topics such as equations, porportionality concepts, and data representation concepts. How many teachers thought they were prepared to teach all 12? Ten percent of the third-grade teachers, 20 percent of the fourth- and fifth-grade teachers, 45 percent of the sixth-grade teachers, about half of the seventh- and eighth-grade teachers, and only three-fourths of the high-school teachers felt adequately prepared, in a subject matter sense, to teach all 12 topics. Teachers recognize the inadequacy of their training for teaching the more advanced curriculum that we need in order to close the learning gap.

To better understand why this subject-matter gap exists, we must again look abroad to reflect on our own practices. To begin with, in the A+ countries, candidates for middle- and secondary-teaching positions would typically have a strong math background, often including the equivalent of a major in the subject. Even elementary teachers, by virtue of having been educated in these systems, would have quite substantial math backgrounds. This is not trivial and must be addressed as we consider criteria for hiring the next generation of teachers. But I want to focus here on a different aspect of these foreign systems: their equivalent of in-service education, or professional development.

In the high-achieving nations, there is a clearly articulated curriculum specific to each grade, which is usually common for the entire country.

But don't mistake the curriculum itself for the wonder drug. These nations also make carefully planned professional-development investments.

Significantly, these high-achieving nations generally do not attempt generic sorts of professional development, a practice which is fairly common in this country, where, on occasion, you take all the K-12 teachers and put them into one room and call it professional development. Professional development in high-performing countries is generally geared to the grade in which teachers teach. The subject matter content and how to teach it are often the focus. It is about the content that they are teaching their students in the classroom, not about abstract mathematical or other content. In turn, it's not necessary to teach all teachers in a particular field, like mathematics, advanced topics—not all math teachers need to take and know calculus. What fourth-grade teachers need, for example, is an advanced treatment of elementary mathematics. They need to know, for instance, that fractions are part of a rational numbers system. Fractions aren't alien beasts to whole numbers, but they are often presented that way. Deeper knowledge of the structure of the advanced parts of elementary mathematics would enable fourth-grade teachers to carry out the kind of instruction that demonstrates connections between mathematical concepts.

Further, the textbook connection cannot be ignored when thinking about professional development. In the U.S., the correlation between textbook coverage and what teachers teach is .95 (which is comparable to other countries). If we pretend the textbook doesn't exist—and conduct professional development in ways that assume teachers will implement an entirely different approach to the content than the texts take—believe me, the textbook will win. Professional development must be intimately tied to the actual tools teachers use. That's the essence of curriculum-based professional development.

—*William Schmidt*

quality moves beyond these issues to what we believe is a deeper, more fundamental characteristic. We feel that one of the most important characteristics defining quality in content standards is what we term coherence.

We define content standards and curricula to be coherent if they are articulated over time as a sequence of topics and performances that are logical and reflect, where appropriate, the sequential or hierarchical nature of the disciplinary content from which the subject matter derives. That is, what and how students are taught should reflect not only the topics that fall within a certain academic discipline, but also the key ideas that determine how knowledge is organized and generated within that discipline.

This implies that "to be coherent," a set of content standards must evolve from particulars (e.g., the meaning and operations of whole numbers, including simple math facts and routine computational procedures associated with whole numbers and fractions) to deeper structures inherent in the discipline. This deeper structure then serves as a means for connecting the particulars (such as an understanding of the rational number system and its properties). The evolution from particulars to deeper structures should occur over the school year within a particular grade level and as the student progresses across grades.

Based on this definition of coherence, the A+ composite is very strong and seems likely to build students' understanding of the big ideas and the particulars of mathematics and to assure that all students are exposed to substantial math content.

In sum, the "upper-triangular" structure of the data in Figure 1 implies that some topics were designed to provide a base for mathematics understanding and, correspondingly,

A Glimpse of an A+ Curriculum...and How It Is Used

Basic Content/Objectives	Detailed Content	Time Ratio	Notes on Teaching
Rate, ratio, and proportion **Objectives:** To develop the ability in the use of rate, ratio, and proportion in problems connected with everyday life.	1.1 Meaning of rate, ratio, and proportion	3	Students are expected to understand clearly the meaning of rate, ratio, and proportion through using everyday examples such as walking rate, reduction rate, and the ratio of the number of boys to that of girls in a class. These examples should lead students to see their relationship.
	1.2 The notion of a two-term ratio a:b or a/b, where b≠0	2	The notion of a two-term ratio a:b is introduced. This can be represented by the fraction a/b, where b≠0. Students should note that a ratio is unaltered if the two numbers (or quantities) of the ratio are both multiplied or divided by the same number. The notion of a two-term ratio may be extended to a three-term ratio or more, e.g. a:b:c=1:2:3.
	1.3 Examples from science and mensuration [i.e., measurement] including similar triangles. Problems on direct and simple inverse proportion. Graphs in two variables	6	Students should be able to deal with rate, ratio, and proportion in examples from science and mensuration, including similar triangles. Practical problems on direct and simple inverse proportion should also be investigated. (N.B. Maps and scale plans are common examples of proportion.) Students may use graphs to see the relationship between two quantities.

Source: Hong Kong eighth-grade curriculum, excerpted from the Syllabus for Mathematics: Forms I-V, *the curriculum that was in effect until spring of 2001 (and during the TIMSS).*

Unlike a typical set of state standards in this country, the Hong Kong curriculum contains much more than just the content that teachers ought to cover, yet the information it provides is not overwhelming. The time ratio provided allows teachers and others taking guidance from the curriculum to easily see which topics should be emphasized, though it does not put teachers on a strict schedule. The notes on teaching offer valuable tips and examples and explain how topics and subtopics relate. As another example, consider these notes on teaching seventh-graders the use of letters to represent numbers:

> The use of letters to represent numbers arises quite naturally when formulae such as A = b + l and P = 2(b + l), where A stands for area, b for breadth, l for length, and P for perimeter of a rectangle, are considered. Teachers can point out that even in daily life, letters may be used to represent numbers, e.g. in a secret code.

Keep in mind that this curriculum is the beginning, not the end, of support for instruction. It serves as the basis for a raft of well-aligned classroom materials, including:

- classroom assessments for teachers to use at their discretion;
- highly focused textbooks that flesh out the curriculum with closely-aligned explanations and problem sets;
- preservice education that prepares teachers to teach the curriculum; and
- multiple opportunities for content-based professional development.

were covered in the early grades. Increasingly over the grades, the curricula of the top achieving countries becomes more sophisticated and rigorous in terms of the mathematics topics covered. As a result, it reflects a logic that we would argue is inherent in the nature of mathematics itself. As we will see, the U.S. state and district standards do not reflect a comparable logical structure.

The A+ composite is stunningly coherent, and it's a pole star that can guide our curriculum and standards-writing efforts. But the huge educational impact of the curriculum in A+ countries lies in several additional related facts: In every A+ country, there is a single national curriculum.[5] It does not sit on a shelf unread and unused, nor is it an exceedingly long document that teachers pick through on their own, selecting which topics to emphasize and de-emphasize. The national curriculum as a whole is meant to be the enacted curriculum; related training, tools, and assessments are provided that make such enactment possible (and likely). The curriculum's coherence is translated into textbooks, workbooks, diagnostic tests for teacher use, and other classroom materials that enable teachers to bring the curriculum into the classroom in a relatively consistent, effective way. In turn, the curriculum serves as an important basis for the nation's preservice teacher education and for ongoing professional development, which again adds to the generally consistent, high quality of teaching across classrooms and schools.

Underlying all of this and making it all possible, is the fact that the curriculum is common—that is, the same coherent set of topics is intended to be taught in the same grade to virtually every child in the country—at least from grades one through eight (the focus of our study). Regardless of which school you attend or to which teacher you are assigned, the system is designed so that you will be exposed to the same material in the same grade.

PHOTOGRAPH COURTESY OF LELAND COGAN

Mathematics textbooks in the U.S. cover more topics than texts in other countries, and, as a result, are substantially larger. The photo above compares five eighth-grade texts commonly used in the U.S. (right) to the eighth-grade texts from five of the A+ countries, which often use two slim books per year (left).

This common, coherent curriculum makes possible a cascade of benefits for students' education. The possible net effects of these benefits are: 1) to positively influence overall student achievement (as reported in the opening section of this article); 2) to greatly reduce the differential achievement effects that are produced (in the U.S.) by standards and curricula of different quality; and, as a result, 3) to substantially weaken the relationship between student achievement and socioeconomic status (a link which is quite strong in the U.S.).

III. Repetition and Incoherence in the U.S.

As we know, unlike the A+ countries, the U.S. does not have a single, national curriculum. To determine the intended math curriculum, we looked primarily at the math standards that have been established at the state level. We also reviewed district-level standards.

State Standards

In Figure 2 we show a composite of the math standards in the 21 states that volunteered for our study. Since Figure 1 includes topics that were intended by at least two-thirds of the A+ countries, a similar two-thirds majority was applied to create the state composite shown in Figure 2 (on page 15).[6] The resulting pattern for the composite of U.S. states is very different from that of the A+ countries. The state standards do not reflect the three-tier structure described previously. The majority of the 32 mathematics topics that A+ countries teach at some point in grades one through eight are likely to be taught to American students repeatedly throughout elementary and middle school.[7] *In fact, the average duration of a topic in state standards is almost six years. This is twice as long as for the A+ countries.*

This long duration means that U.S. states include many more topics at each grade than do A+ countries. That, in turn, means each topic is addressed in less depth. In general, the state standards increase the duration of a typical topic by introducing it at an earlier grade. For instance, even more demanding topics such as geometric transformations, measurement error, three-dimensional geometry, and functions are introduced as early as first grade. In the A+ composite, these same topics are first covered in middle school.

If coherence means that the internal structure of the academic discipline is reflected within and across grades, then clearly these results for U.S. states suggest a lack of coherence, even if the claim is that these topics are only presented initially in an elementary or introductory fashion. The U.S. standards, with their early introduction and frequent repetition of topics, appear to be just an arbitrary collection of topics. Here are several specific examples of this incoherence:

- **Prerequisite knowledge doesn't come first.** For example, properties of whole number operations (such as the distributive property) are intended to be covered in first grade, the same time that children are beginning to study basic whole-number operations. This topic is first typically introduced at grade four (and not earlier than grade three) in the top-achieving countries.

■ **Topics endure endlessly.** The A+ composite did not intend for any topic to be covered at all eight grades, yet 10 topics were intended for such enduring coverage in the state composite.

■ **Consensus about when to teach topics is lacking.** The state composite has blank rows for three fundamental topics—rounding and significant figures, the properties of common and decimal fractions, and slope. This odd finding reflects the lack of consensus among states as to the appropriate grade level for these topics. The state standards all cover rounding and significant figures, as well as common and decimal fractions, but these topics cannot be part of the state composite because at least two-thirds of the states do not agree on the proper grade placement for these topics. The absence of slope from the state composite reflects both a lack of agreement and a lack of rigor—most states do not

FIGURE 3

District Composite: Mathematics topics intended at each grade by at least two-thirds of 50 districts in one state.

Note that the structure of the district composite is very similar to that of the state composite—and likewise, lacks a visible structure.

TOPIC GRADE:	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Whole Number Meaning	◼	◼	◼	◼	◼	□	□	□
Whole Number Operations	◼	◼	◼	◼	◼	◼	□	□
Measurement Units	■	■	◼	◼	◼	◼	◼	◼
Common Fractions		◼	◼	◼	◼	◼	◼	□
Equations & Formulas	□	◼	□	◼	◼	◼	◼	◼
Data Representation & Analysis	◼	◼	◼	◼	◼	◼	◼	◼
2-D Geometry: Basics		□	◼	□	□	◼	◼	◼
Polygons & Circles	◼	◼	◼	◼	◼	◼	◼	◼
Perimeter, Area & Volume			◼	◼	◼	◼	◼	◼
Rounding & Significant Figures				□			□	
Estimating Computations		□	□	◼	□	□	□	□
Properties of Whole Number Operations		□	□					
Estimating Quantity & Size								
Decimal Fractions			□	□	◼	◼	◼	◼
Relationship of Common & Decimal Fractions							□	
Properties of Common & Decimal Fractions								
Percentages					□	◼	◼	◼
Proportionality Concepts						□	□	□
Proportionality Problems						□	□	◼
2-D Coordinate Geometry						□	□	□
Geometry: Transformations		□	□	□	□		□	□
Negative Numbers, Integers & Their Properties							□	□
Number Theory					□		□	□
Exponents, Roots & Radicals							□	□
Exponents & Orders of Magnitude							◼	□
Measurement Estimation & Errors			□			□	□	□
Constructions w/ Straightedge & Compass								
3-D Geometry	◼	◼	◼	◼	◼	◼	◼	◼
Congruence & Similarity							□	□
Rational Numbers & Their Properties							□	◼
Patterns, Relations & Functions	◼	◼	◼	◼	◼	◼	◼	◼
Slope & Trigonometry								
Number of topics covered by at least 67% of the districts	8	13	16	15	16	18	27	25
Number of additional topics intended by districts to complete a typical curriculum at each grade level	9	6	4	7	8	9	3	4

□ – intended by 67% of the districts ◼ – intended by 83% of the districts ■ – intended by 100% of the districts intend for slope to be covered until high school.

The longer topic coverage combined with the absence of the three-tier structure suggest that state standards are developed from a laundry-list approach to mathematics that lacks any sense of the logic of mathematics as a discipline. For many of the individual states it seems that almost all topics are intended to be taught to all students at all grades.

District Standards

Arguably, teachers pay more attention to district standards than to state standards. Are they substantially different? It doesn't appear so. We have done dozens of analyses of district standards from across the U.S. In this article, we present a composite of district-level standards from one selected state.[8] Looking at this composite (Figure 3, page 21), it is clear that the districts' standards tend to include slightly fewer topics than are specified in state standards. But, like the states, the districts still specify many more topics per grade than do the A+ countries. Furthermore, the district data, like the state data, indicate a great deal of repetition of the topics across grades. Five of the 10 topics intended for coverage in all eight grades in the state composite are similarly intended for such coverage in the district composite; an additional three of the topics are intended for coverage in seven of the eight grades. Overall, then, we can see that the districts' standards are nearly as incoherent as the states' standards.

One can assume that given the broad scope of these standards, teachers are forced to cut back from what's intended

The Benefit to Professional Development

Most studies of professional development don't even consider the effect on student achievement; and most studies of educational reform that include a teacher-training component do not isolate the impact of the training. But the few studies that do examine the link between professional development and student achievement suggest this: Professional development is most effective 1) when it is focused on the content teachers must teach and how to teach it, or 2) when it is provided in concert with a curriculum and helps teachers to understand and apply that curriculum. Such professional development can raise achievement substantially.

Some evidence for this comes directly from TIMSS. Unlike the rest of the United States, eighth-graders in Minnesota attained scores that were second only to Singapore's eighth-graders in science. Intrigued, the National Education Goals Panel commissioned a case study of the state's approach to science in the seventh and eighth grades. The study found that through an "incremental but cumulative" process, a consensus was built in Minnesota about what constituted good science content and instruction in the middle grades.

By the time TIMSS was administered in 1995, the vast majority of Minnesota seventh-graders took life science and eighth-graders took earth science. There had been a large number of professional-development activities geared to these courses, and "science teachers in the middle grades were more likely to use the same or similar texts and common instructional practices." Not only was the curriculum common, it was also coherent. Unlike the typical science curriculum in the U.S. (in which large numbers of topics are introduced each year, with few covered in depth), in Minnesota "there were far fewer topics introduced and more time devoted to developing them in depth." The National Educational Goals Panel concluded that, "This research suggests the necessity of aligning teacher training, professional development, and other teacher support mechanisms with the overall reform process." (To read the Panel's full report, please visit **www.negp.gov/promprac/promprac00/promprac00.pdf**.)

Further evidence for curriculum-based professional development was reviewed by Grover Whitehurst, assistant secretary for research and improvement, U.S. Department of Education, for the White House Conference on Preparing Tomorrow's Teachers. He stated that out of seven teacher characteristics that could increase achievement (things like certification, workshop attendance, and experience), participation in professional development that is focused on academic content and curriculum was second only to a teacher's cognitive ability. In contrast, participation in typical professional-development workshops was the least effective of the seven characteristics. Summarizing the relevant research on in-service training, Whitehurst said, "when professional development is focused on academic content and curriculum that is aligned with standards-based reform, teaching practice and student achievement are likely to improve."

To illustrate his point, Whitehurst described a study of Pittsburgh schools that implemented a standards-based mathematics curriculum. The resulting differences in student achievement between the strong and weak implementers of the curriculum were dramatic. In the strong implementation schools, 74 percent of African-American students and 71 percent of white students met the established performance standard on the New Standards Mathematics Reference Exam. But in the weak implementation schools, only 30 percent of African-American students and 48 percent of white students met the standard. After pointing out that strong implementation eliminated racial differences in the outcome measure, Whitehurst explained that the impressive results were in fact due to the implementation, not differences in the teachers: "There is no reason to believe that any...individual differences in teachers..., such as cognitive ability or education, differed among the weak...versus the strong implementation schools. Yet the teachers in the strong implementation schools were dramatically more effective than teachers in in state and district standards. It's not likely that many can distill a coherent curriculum from the incoherence that's offered them. Further, teachers are likely to prune back the state/local standards in different, idiosyncratic ways. This is what leads to the well-known American phenomenon—and special bane of transient students—in which what's actually taught in a given grade varies wildly from class to class, even in the same school, district, or state.

It goes without saying that under these circumstances, a serious investment in curriculum-based professional development is not feasible; nor is it really feasible to align preservice education or texts to a non-existent curriculum. Any statewide assessment must choose between asking vague or low-level questions—or risk asking specific questions about particular content that teachers haven't taught.

Overall, Figures 2 and 3, representing composites of state and district standards, suggest that in America we tend to treat mathematics as an arbitrary collection of topics. There is no visible sense-making or structure. The math—for both students and teachers—looks and feels like a bunch of disconnected topics rather than a continuing development of the main concepts of mathematics that fit together in a structured, disciplinary way.

To complete this picture of the intended American math curriculum, we must take note of the especially huge curricular variation that becomes visible in the eighth grade, when most schools offer a variety of math courses, each with different content and rigor. In our study of eighth-grade math courses offered in American

the weak implementation schools. Thus [the]...effect of curriculum implementation swamped effects of individual differences in background among teachers." Diane Briars, head of Mathematics and Science Education for the Pittsburgh Public Schools and an author of the study, told the Committee on Education and the Workforce in the U.S. House of Representatives that in strong implementation schools "teachers were given time to meet and work together to improve their instruction."

Noting that most studies of professional development do not address student achievement, Whitehurst recommended just a handful of high-quality studies. Excerpts from two of them are provided below. (To read Dr. Whitehurst's full presentation, visit **www.ed.gov/inits/preparingteachersconference/whitehurst.html**.)

—*EDITORS*

The Case of California

By David Cohen and Heather Hill

Most reformers, including many governors, President George W. Bush, and many business officials concerned with schools, have argued that schools need to be shaped up with stronger academic standards, stiffer state tests, and accountability for students' scores. Our decade of detailed study on California's effort to improve mathematics teaching and learning shows that standards, assessments, and accountability are more likely to succeed if they are accompanied by extended opportunities for professional learning that are grounded in teachers' practice. But our study also strongly suggests that not all opportunities for teachers to learn are created equal.

The 1985 Mathematics Framework for California Public Schools was one of the first major state reforms. The goal was to provide much more academically demanding work for students. The initiative offered more detailed guidance for teaching and learning—in assessments, curricular frameworks, student curricula, and professional education—than has been commonly provided by most state governments during most of our history.

Having failed to persuade textbook publishers to produce much less conventional textbooks, in 1989 the reformers began encouraging curriculum developers to create "replacement units" on specific topics like fractions. To aid teachers further, these units were accompanied by "replacement unit workshops"—two-and-a-half-day sessions in which teachers would do the mathematics themselves, talk with each other about the content, and observe examples of student work on the materials.

These kinds of opportunities to learn seemed not only to increase teaching practices associated with the new math framework but to decrease use of conventional methods; teachers did not simply add new practices to a conventional core, but also changed that core teaching approach. This is quite significant when compared with the "Christmas tree" approach most teachers bring to their learning from professional development, in which they festoon an otherwise stable and conventional practice with attractive, new—and often inconsistent—additions.

In contrast, when teachers used their professional-development time to attend special-topics workshops, there was nearly zero association with teachers' ideas and practices (whether conventional or innovative). We suspect that this occurred because special-topics workshops were not chiefly about the mathematical content, though they were consonant with the state math frameworks in some respects.

(Continued on page 24)

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schools, we learned that eighth-graders tend to be enrolled in any of about six different types of mathematics courses, ranging from remedial math focused on arithmetic, to pre-algebra, algebra, and even geometry.[9] Not surprisingly, student achievement at the end of eighth grade roughly corresponded to the courses students had taken. In short, a student's achievement corresponded substantially to his or her opportunity to be exposed to more or less rigorous material.

It is probably no surprise to report another finding: that a student's opportunity to study in a higher-level math course was related to his or her geographic location. We determined that while 80 percent of eighth-graders had access to a "regular" math course, only 66.5 percent of eighth-graders attend schools that even offered an algebra course. That is, a full third of eighth-graders don't even have such a course as an option. In rural and urban settings, 60 percent of students attended schools that offered algebra and other more challenging classes. In suburban and mid-sized cities, 80 percent of students attended schools with such classes.

As with the farming ideas available from states and towns in Country B, it's not a great loss that the various state and district standards are so difficult to implement consistently, as they are of questionable quality. Like the farmers in Country B, American teachers often don't have the tools (textbooks or classroom materials) or training to make use of any wisdom they might be able to cull from the standards anyway. But without the benefit of the distilled national wisdom about mathematics education or the tools and training to go with it, American teachers are at a great disadvantage. Some get a hold of excellent curricula; some have a knack—coupled with a lot of blood and

The Benefit to Professional Development

(Continued from page 23)

Such workshops might have encouraged cooperative learning or new techniques for students who have not traditionally performed well in math rather than any change in core beliefs and practices concerning mathematics and teaching mathematics.

Our central finding is that California's effort to improve teaching and learning did meet with some success, but only in this circumstance: When California teachers had significant opportunities to learn how to improve students' learning, their practices changed appreciably and students' learning improved. The things that made a difference to changes in their practice were those things that were integral to instruction: curricular materials for teachers and students to use in class, assessments that enabled students to demonstrate their mathematical performance—and teachers to consider it—and instruction for teachers that was grounded in these curriculum materials and assessments.

The difficulty with countless efforts to change teachers' practices through professional development has been that they bore no relation to central features of the curriculum that students would study, and consequently have had no observable effect on students' learning. Many efforts to "drive" instruction by using "high-stakes" tests failed either to link the tests to the student curriculum or to offer teachers substantial opportunities to learn. These and other interventions assume that working on only one of the many elements that shape instruction will affect all the others. The evidence presented here, however, suggests that instructional improvement works best when 1) it focuses on specific academic content, 2) there is a curriculum for improving teaching that overlaps with curriculum and assessment for students, and 3) teachers have substantial opportunities to learn about the academic content, how students are likely to make sense of it, and how it can be taught.

Content Matters Most

By Mary Kennedy

The one-shot workshop is a much maligned event in education. Researchers and policy analysts have generated a number of proposals for how inservice education programs should be organized instead. Surprisingly, these reform proposals generally deal with the *structure* of the professional development, but rarely specify the *content* that inservice teacher education programs should provide. Specifically what the content should be—generic teaching techniques versus research findings on how students learn specific content, for instance—is rarely discussed.

Although the literature on inservice programs is voluminous, that volume subsides quickly when you limit yourself, as I did, to studies that include evidence of student learning and concentrate on either mathematics or science. The studies I found are organized into four groups according to the content they provide teachers. While the study addressed both mathematics and science, only the mathematics findings are presented here:

■ The two studies in group 1 prescribe a set of teaching behaviors that are expected to apply generically to all school subjects. These behaviors might include things like cooperative grouping, and the methods are expected to be equally effective across school subjects.

■ The seven studies in group 2 prescribe a set of teaching behaviors that seem generic, but are proffered as applying to mathematics. Though presented in the context of a particular subject, the behaviors themselves have a generic quality to them in that they are expected to be generally applicable in that subject.

■ The two studies in group 3 provide teachers with some theory about student learning and then move to a recomsweat—for figuring out how to teach even the most challenging students fairly well. The most effective and most affluent school districts can attract a disproportionate share of the most well-prepared teachers; plus, many of these districts provide reasonable materials and training to their faculty.

Yet most teachers, especially those working in the poorest school districts and poorest schools, cannot turn to their districts or states for much help. For most teachers, it's an ongoing, consuming challenge to dream up a basic curriculum and the daily lesson plans to execute it. Not many teachers have the additional time or resources to go beyond that to devise special, unique ways of reaching the kids in the class (or, in secondary school, in a number of classes) who aren't catching on for a wide variety of different reasons.

This lack of curriculum, materials, and training produces the same results for American students as Country B's policy produced for its crops. Curriculum really matters. Schools are supposed to provide opportunities for students to acquire the knowledge that society deems important, and structuring those learning opportunities is essential if the material is to be covered in a meaningful way. The particular topics that are presented at each grade level, the sequence in which those topics are presented, and the depth into which the teacher goes are all critical decisions surrounding the curriculum that have major implications for what children learn.

IV. The U.S. Result: Lower Achievement and Less Equity

Based on our findings of curriculum differences between A+ countries and the U.S., we can say that our students and teachers are severely hampered—both by the inadequacy of the curriculum in this country and by the loss of the benefits

mended set of teaching strategies and a recommended curriculum that is justified by that knowledge of student learning.

■ The one study in group 4 focuses on the particular mathematical content that students will learn and on the particular kinds of difficulties they are likely to have in learning this content. Teachers were not provided with a set of invariant teaching strategies, but the researchers engaged teachers in discussions about different ways of teaching different types of math problems to children.

The table below shows the average size per group of program effects on student achievement outcomes in mathematics. Groups 3 and 4 clearly had greater impacts on student achievement than did groups 1 and 2.

Average Standardized Effect Sizes in Mathematics

Group	Basic Skills	Reasoning & Problem Solving
1	–.14	.10
2	.17	.05
3	.13	.50
4	.52	.40

This pattern of outcomes suggests that the content of inservice programs does indeed make a difference and that programs that focus on subject-matter knowledge and on student learning of particular subject matter are likely to have larger positive effects on student learning than are programs that focus mainly on teaching behaviors.

These more successful programs provided knowledge that tended *not* to be purely about the subject matter—that is, they were not courses in mathematics—but instead were about *how students learn* that subject-matter. The programs in groups 3 and 4 were very specific in their focus. They did not address generic learning, but instead addressed the learning of particular mathematical ideas.

I suspect this type of program content benefits teachers in two ways. First, in order to understand how students understand particular content, teachers also have to understand the content itself so that subject-matter understanding is likely to be a by-product of any program that focuses on how students understand subject matter. Second, by focusing on how students learn subject matter, inservice programs help teachers learn both what students should be learning and how to recognize signs of learning and signs of confusion. So teachers leave these programs with very specific ideas about what the subject matter they will teach consists of, what students should be learning about that subject matter, and how to tell whether students are learning or not. This content makes the greatest difference in student learning.

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that can flow from making a quality curriculum common.

We saw at the beginning of this article that the average achievement in the U.S. is low in comparison to many other countries. Moreover, the gap in students' achievement between our most- and least-advantaged schools is much greater than the comparable gap in most TIMSS countries. In fact, a recent study conducted by researchers at Boston College demonstrated that in the U.S. about 40 percent of the variation among schools in students' test scores is explained by socioeconomic factors. In comparison, across all of the TIMSS countries, socioeconomic factors explain less than 20 percent of this type of variation.[10]

We believe that America's poor average achievement, as well as our strong link between achievement and SES, can be traced in part to our lack of a common, coherent curriculum. The A+ countries have a common curriculum for virtually all students through the eighth grade. In those countries, all schools have roughly comparable access to the full array of materials, professional development, and assessments that can help teachers lead students to high achievement.

Further, students' opportunities to learn are enhanced by the benefits that accompany a common curriculum: teachers can work together with a shared language and shared goals; new teachers can receive clear guidance on what to teach; professional development may be anchored in the curriculum that teachers teach; textbooks may be more focused and go into greater depth with a smaller set of topics; and transient students (and teachers) may more easily adapt to new schools. All of this contributes to greater consistency and quality across schools.

We intend to conduct additional studies to further test the veracity of these arguments. But we would argue strongly that the weight of the evidence—and the high stakes, which include reducing the achievement gap and raising average achievement—should dissuade us from waiting around for more evidence before acting.

As we said at the outset, the practices of other nations can rarely be imported whole-cloth. Institutions and cultures differ too much. But we can learn from other nations and find ways to adapt to our own use those practices that seem particularly effective. In all likelihood, we won't adopt—certainly not in the near term—a national curriculum like the A+ countries have—after all, most of the A+ countries are small (though the largest is almost half our size).

How Would Your District Standards Compare?

Working with the TIMSS researchers, the North Central Regional Educational Laboratory created a Web site that allows districts to create maps of their mathematics and science standards. Just indicate which of 44 math and 79 science topics are supposed to be taught at each grade, and the site will develop the map. Then, you'll have the option of comparing your district standards to those of top-achieving countries. Visit **http://currmap.ncrel.org** to develop your map.

But similar benefits could flow from adaptive arrangements that provide a common, coherent, rigorous curriculum to large groups of our students, such as adopting curriculum at the state level, or facilitating groups of states in adopting a common curriculum.

One way or another, we should be moving on a variety of fronts to bring about a more common, coherent curriculum and to let the benefits of that flow to our schools, our teachers, and especially our students—who deserve no less than the quality of education experienced by children in the A+ countries. □

Endnotes

[1] Schmidt, W.H., McKnight, C.C., Houang, R.T., Wang, H., Wiley, D.E., Cogan, L.S., and Wolfe, R.G. (2001). *Why Schools Matter: A Cross-National Comparison of Curriculum and Learning.* San Francisco, CA: Jossey-Bass.

[2] In each of these countries there is a document outlining the content that is to be taught to virtually all children in the school system. Some students may receive additional advanced problems for specific topics. In Hong Kong, for example, textbooks may indicate Level 2 problems that teachers are encouraged to assign to their more advanced students. But the composite presented on page 14 (Figure 1) is based on the material that all students are exposed to.

[3] Schmidt, W.H., Wang, H.A., and McKnight, C.C. (no date). Curriculum Coherence: An Examination of U.S. Mathematics and Science Content Standards from an International Perspective. Paper being prepared for publication.

[4] To make sure that our analysis of the A+ composite did in fact apply to a complete curriculum, we developed a second composite that included all of the additional topics from the A+ countries. This complete composite confirmed that the basic three-tier structure that is discussed in the section on the A+ composite is retained even after the additional topcics are added.

[5] Belgium actually has two national curricula, one for each of its two national language groups. For all practical purposes, though, a given group of teachers and students are only governed by one, so it functions like a single national curriculum.

[6] A methodological note: The majority of states had grade-specific content standards. But several states specify a cluster of grades in which a topic could be taught, then leave it up to local districts to determine in which grades the topic is actually taught. For the few states that used a cluster approach, our method assumes that the topic is intended in each of the cluster grades. This seems reasonable since some data indicate that districts and textbook publishers tend to use the clusters in this fashion.

[7] This holds true for *each* of the states studied—not just for the composite. When we did individual displays of each state's standards, we found that most were even more repetitive than the state composite. In addition, none of the state's standards were even remotely as coherent as the A+ composite.

[8] This state volunteered for the district analysis, however the results presented here are consonant with the results from our other district studies.

[9] Cogan, L.S., Schmidt, W.H., and Wiley, D.E. (2001). Who Takes What Math in Which Track? Using TIMSS to Characterize U.S. Students' Eighth-Grade Mathematics Learning Opportunities. *Edu-*

(Continued on page 47)

Getting There In America's Decentralized Education System

For over a decade, there's been a consensus among American leaders and the public that our schools can and should be improved based on the vision outlined in these pages: clear standards for what students should know and be able to do; a coherent curriculum that maps a route to the standards; professional development tied to the curriculum; excellent texts and materials; quality assessments; and a fair accountability system that encourages students to put forward their best effort and assures that schools get the intervention they need.

With America's traditional wariness of federal involvement in curriculum matters, however, there has also been a consensus that this vision should be achieved at the state level. But the ambition of this vision has exceeded the resource capacity of most states. Perhaps not surprisingly, most states have only gotten as far as developing student achievement standards (that are often vague) and generally inadequate assessments.* Without a curriculum and without the training materials to teach the curriculum, many teachers (and parents and students) feel that the assessments are simply a "gotcha" exercise—not an instructionally useful and valid tool. On these rough shoals, America's longest running education reform movement could founder.

If standards-based reform is to succeed in lifting student achievement, we need new ideas and structures. If the development costs for quality curriculum, training, and assessments are too great for a single state, let a number of states come together and jointly develop them. If states find it politically impossible to gain agreement on the details of a specific curriculum, perhaps we can turn to independent organizations like the International Baccalaureate described in this issue (see page 28). States could certify the curricula and assessments of these groups as being consistent with the state's vaguer standards; and schools or districts could be encouraged to adopt them and make use of their training opportunities and materials. In Virginia, for example, students who do well on an IB exam are exempt from the corresponding state exam. Likewise in Florida, students have an incentive to take the IB courses (and schools, therefore, have an incentive to offer them) because IB diploma holders receive full scholarships to state colleges.

One very promising initiative, the Mathematics Achievement Partnership (MAP), is being launched by Achieve, an organization representing the nation's governors and business leaders.

We highlight MAP as a project that's well-along and generally well conceived. We look forward to other initiatives that find ways to navigate a path from America's traditional embrace of local control of curriculum to a higher-quality, aligned educational system that students abroad enjoy and benefit from—and students here so far don't.

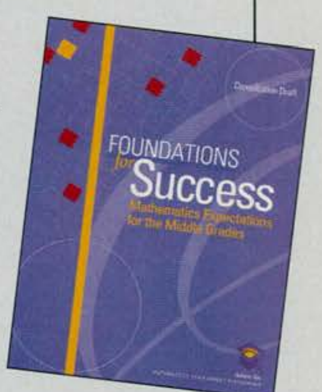
—*Editor*

* For a full report see *Making Standards Matter 2001*, published by the AFT, available online at **www.aft.org/edissues/standards/MSM2001** or prepaid ($10 each; $8 for orders of five or more) from the AFT Order Department, 555 New Jersey Ave. N.W., Washington, DC 20001. Please reference item No. 39-0262.

MAP: A Promising Initiative

Achieve's Mathematics Achievement Partnership has brought together a consortium of states to jointly develop key components of standards-based reform, all focused on middle-school math and culminating with an end-of-eighth-grade assessment. Its coordinated components will include:

- **Focused and rigorous expectations** for what students should know and be able to do at the end of eighth grade: Called *Foundations for Success*, a consultation draft of these world-class expectations is currently available at **www.achieve.org/dstore.nsf/Lookup/Foundations/$file/Foundations.pdf**. Unlike most expectations documents, *Foundations* includes sample problems that illustrate the depth of conceptual understanding that students should attain. Achieve hopes to publish a final version of these expectations in late 2003.



- **A grade-by-grade sequence:** Also expected in 2003, this sequence will suggest what material students need to learn in sixth, seventh, and eighth grades in order to meet the *Foundations* expectations at the end of the eighth grade.
- **Content-based professional development:** The professional development component, which enables teachers to increase their knowledge of mathematics and their skill in teaching it, is now being piloted in several districts.
- **Diagnostic and cumulative assessments:** MAP will include diagnostic, classroom-based tests aligned to the sequence that will help teachers ensure that all students progress toward meeting the expectations. At the end of eighth grade, there will be an internationally benchmarked assessment that is aligned with the MAP expectations.

As noted in these pages, a curriculum with grade-by-grade specifics, including teaching ideas, is an indispensable element for designing effective professional development, classroom materials, and assessments—and for assuring that all these pieces are aligned with each other. We hope that as MAP's grade-by-grade sequence takes shape, it will include the specifics that will make such alignment possible and give teachers the guidance they need and deserve.

*To learn more about MAP, visit **www.achieve.org/achieve.nsf/MAP?OpenForm**.*

A Test Worth Teaching To

The IB's Course Guides and Exams Make a Good Marriage

By Robert Rothman

At a time when teachers in America are concerned that an excessive focus on tests threatens to drive out effective teaching and learning, the International Baccalaureate offers a counterweight: a program where examinations encourage high levels of instruction and achievement.

Many people have heard of the IB, but what is it? The International Baccalaureate is a prestigious program developed in 1968 to accommodate the needs of mobile foreign diplomats. As these diplomats moved from post to post, they wanted their children to have access to a school program that would be consistent across locations and that, importantly, would prepare their children to pass the rigorous university entrance examinations back home.

In the last decade, the IB has grown rapidly in the United States; currently, some 400 high schools in this country offer the program. Some of the growth occurred during the 1980s, when schools in the post-*Nation at Risk* period sought to add rigor to the high school curriculum. More recently, the program has grown because educators see it as consistent with the standards movement's emphasis on challenging expectations for student performance.

Even though it remains a specialized program, it offers a number of lessons to educators and public officials who are implementing standards-based reforms in an effort to raise the level of rigor for all students. With its challenging external examinations, its well-planned course guides tied to those exams, and its extensive training for teachers, the IB represents a good example of an effective, instructionally sound, exam-based system.

A close look at the IB provides some insight into issues that reformers throughout the United States are confronting. The IB shows ways to use exams in the classroom to model and encourage effective instruction. With detailed course syllabi that allow teachers to choose which topics to cover and carefully aligned exams that allow students to choose which questions to answer, it suggests one way to design courses that strike a balance between breadth and depth and between knowledge of facts and the ability to understand concepts. It shows how teachers can use their judgment within a common framework to craft a course of study that will cover the necessary content while leaving room for engaging lessons. Above all, it shows that, despite fears among teachers that external mandates can stifle their practice, external exams and a common curriculum can strengthen teaching and improve instruction throughout a school.

Robert Rothman is an education writer based in Washington, DC, and a consultant for the Annenberg Institute for School Reform and other organizations. He has worked at the National Research Council and the National Center on Education and the Economy and is a former reporter and editor for Education Week.

ILLUSTRATED BY ROBERT BARKIN

Consistent with Research

With its external exams tied to a challenging curriculum, the IB program appears consistent with the types of systems Cornell University economist John Bishop has found are associated with high levels of student achievement. In a study that analyzed the results of several international assessments, Bishop controlled for the participating countries' wealth and found that students in countries with curriculum-based external exit examinations significantly outperformed those in countries that lacked such exams. He also found that students in New York State, which for many years administered Regents' Examinations for students wishing to earn specialized diplomas, outperformed those in other states on the SAT.

Bishop argues that curriculum-based exit examinations help motivate students to work hard in school because they

Rewarding Requirements: A Closer Look at the IB

To earn an official IB diploma that is recognized worldwide, students must follow a two-year IB Diploma Programme during their junior and senior years that includes prescribed coursework, "internal" and culminating assessments, and designated special projects:

Coursework

IB requires coursework in six areas:

- Language, or literature and writing in the student's home language;
- Second Language;
- Individuals and Societies, including courses such as history, economics, geography, philosophy, and social anthropology;
- Experimental Sciences, including biology, physics, environmental systems, and design technology;
- Mathematics;
- Arts and Electives, including visual arts, music, and theater arts.

Students must take at least one course in each of the six areas (however, the arts and electives course can be replaced by an additional course from one of the first five areas). At least three, but no more than four, courses must be at the *Higher Level* (HL), which requires a minimum of 240 teaching hours. The rest are taken at the *Standard Level* (SL), which entails roughly 150 teaching hours.

In addition to the subject-area coursework, students in the IB Diploma Programme also take Theory of Knowledge, an interdisciplinary course in which the students explore issues such as subjective bias and evaluate the evidence used to support arguments.

Assessments

Each of the courses includes two forms of assessment required by IB. The "Internal Assessment" is completed as part of the coursework and represents about 25 percent (depending on the course) of a student's total score for the course. The culminating examination is administered at the same time throughout the world (in May in the Northern Hemisphere and in November in the Southern Hemisphere) and accounts for the remaining 75 percent of the official IB course grade. The Internal Assessment is by the teacher, but a sample of the students' work (and teacher's grades) is reviewed by IB to ensure that the world standards are being upheld. The culminating exam is scored externally by some 3,400 educators who are specially trained for the task.

Students have two options if they don't perform well on exam day. For one, they can retake the exam during the following school year. That is, 11th-graders can try again in May of their senior year and 12th-graders can try again in November or the following May. In either case, students are still eligible to earn an IB diploma. Students' other option is to simply forgo the IB diploma and accept a regular diploma from their school—IB allows high schools to set their own policies as to how IB grades are tied to students' GPAs and eligibility for earning a regular diploma. During the school year, teachers assign a variety of papers and tests that both prepare students for the IB assessments and provide a basis for a regular course grade.

Special Projects

Students in the IB Diploma Programme also write a 4,000-word Extended Essay on a topic of their choice. Like the exams, the essay is graded by IB's trained examiners. Lastly, students must complete and document 150 hours of "Creativity, Action, Service," which includes participation in cultural events, extracurricular activities, athletics, and community service outside of school hours.

As students complete each of these requirements, they are not being assessed by IB in terms of passing or failing. Instead, they are earning points toward the IB diploma. For each of the six courses, IB gives a final grade on a scale of 1 (very poor) to 7 (excellent) points. Students can earn another three points based on their combined performance in the Theory of Knowledge course and Extended Essay. Points are simply added, not averaged, resulting in the maximum possible "grade" of 45 points.

While IB students do not pass or fail classes, they can fail to earn the IB diploma. In 2001, the diploma was awarded to students who earned at least 24 points, provided the students met several criteria such as, "there is no *grade one* in any Higher Level subject." In general, these criteria are designed to ensure that all of the requirements have been met and that poor performance in one or two subjects is balanced with high achievement in other subjects.

By making explicit the criteria on which their work will be judged, the IB Programme makes expectations for performance very clear. Students say such clarity provides a focus for their work.

reward high achievement in academic subjects. At the same time, Bishop suggests that such exams make it more likely that schools will improve curriculum and instruction. Because the exams offer a payoff for such improvements—more students doing well—parents and taxpayers will be more likely to support the improvements. In addition, Bishop says, such exams can induce improvements in the support of instruction, such as professional development around subject-matter content.

The IB Programme also appears consistent with research on learning that emphasizes the importance of clear expectations for student performance. In a synthesis of learning research, Lauren B. Resnick, director of the Learning Research and Development Center at the University of Pittsburgh, suggests that making the goals of learning clear—and providing vivid examples of what "good" work looks like—help students by pointing them toward excellence.

By making explicit the criteria on which their work will be judged, the IB Programme makes expectations for performance very clear. Students say such clarity provides a focus for their work. "Here, we know what we have to get done," says Dylan Moore, a senior at Schenley High School in Pittsburgh.

Exams Worth Teaching To

Worldwide, 80 percent of those who attempt the IB diploma earn it. In America, an IB diploma often means college scholarships and even up to a year's worth of college credit. How does IB produce such success? To teachers involved with the program, the answer is obvious: the IB's curriculum-based exams and course materials. By following the course of study set forth by IB and preparing students for the exams, teachers say they ensure that students know their subjects well and are able to use their knowledge to solve problems and develop new insights. Unlike many standardized tests currently administered in American schools, teachers consider the IB exams worth teaching to.

Daniel Blackmon, an IB history teacher at Coral Gables Senior High School in Florida, begins planning his IB courses by looking at the course of study and past exams, all of which are essay questions that require students to demonstrate substantial knowledge and understanding of the subjects and strong writing skills. (See page 32 for excerpts from the 2000 IB standard level history exam). He uses the structure and content of these exams as a guide for developing his class syllabus and as a primary source of assignments for developing students throughout the school year. By the time Blackmon's students face the IB history exam, they have already prepared dozens of similar essays. (To learn more about how Daniel Blackmon uses the exam in his courses, see the sidebar on page 35.)

Teachers frequently assign students exercises that mirror those on the IB exams. This is a form of "teaching to the test," a practice generally frowned upon because of the narrow scope of most standardized tests. Yet teachers consider teaching to the IB exam worthwhile because it is good instruction. Jane Greenaway, the IB coordinator at Coral Gables, explains that the tests' emphasis on instruction also influences students' attitudes about classwork. "Students don't put up with busy work," she says. "It needs to be meaningful. They get that from the exams." The exam preparation exercises develop students' ability to write, to back up statements with evidence, and to draw connections among topics in a discipline or across disciplines. These are the kinds of abilities teachers want students to develop, and the IB exam encourages teachers to design lessons to foster such skills.

For example, students at Schenley High School are constantly marshalling evidence and arguing persuasively—skills they need to demonstrate on the exams. During a biology lesson at Schenley High School, students did not simply have to identify the characteristics of an ideal cell; they had to write a brief essay explaining why the cell they modeled was ideal.

Teachers are often quite explicit with their students about how a particular lesson or project will prepare them for the IB exam. Denise Rahne, an English teacher at Patrick Henry High School in Minneapolis, for example, prepares a detailed syllabus each semester that shows the texts that students will be studying and the IB assessment topics based on those texts. Students know, for instance, that the IB language assessments will include an option for a comparative study of two world literature works. In her class, they will be prepared for that portion of the exam by studying three books selected by Rahne: *Medea, Oedipus Rex,* and *The Stranger.*

Rahne, like many IB teachers, also provides her students with IB materials that show the students the criteria by which their exams will be evaluated and how previous students succeeded or failed. Rahne and her students find IB's school reports particularly helpful. School reports are written by IB examiners for individual schools. Based on the materials submitted to IB to be graded, these reports clarify the expectations that students will have to meet in order to achieve IB's high standards.

Steve Duesterbeck, a history teacher at Henry, says the school reports have helped him and other teachers adjust their instruction to improve students' performance. Four years ago, he notes, students' exam scores were lower than in previous years, and the school report provided by IB suggested that the students did not sufficiently justify their statements. In response, Duesterbeck required students to provide at least three supporting statements for each assertion in every assignment and paper. Since then, he notes, some 200 of his students have taken the exams and not a single one has scored poorly.

"As a teacher, you can be missing something and not realize it," says Jane Kostik, the co-coordinator of the IB program at Henry. "When you get a report like that, you know what to look for."

Teachers also explicitly prepare students for the Internal Assessments they take as part of the IB Diploma Programme. Unlike the final course examinations, the Internal Assessments are completed during the school year and can take various forms—from written essays to oral presentations to musical performances and art pieces to mathematics and science projects. In history, for example, the IB syllabus suggests diverse approaches such as a genealogical study, an analysis of an historical database, a report based on an archaeological site, or a traditional research paper. The criteria for evaluating the project are common across all IB schools.

To help prepare students for the Internal Assessments, teachers work with students to select a project, go over the criteria with them, and practice with them before the "real" assessment. For example, an Internal Assessment in IB English asks students to prepare an oral presentation on the writing technique in a work of literature. The week before the assessment, students at Schenley met in small groups to discuss one such technique—the use of imagery—in *The Scarlet Letter*, a book assigned for the class, and took oral quizzes to feel confident about speaking.

As with the external exams, teachers feel that preparing students for the Internal Assessments represents good instruction. "If someone stands up and talks to you about Hamlet, or how a problem in math works out, then you know he really understands," says Joseph Mulcahy, the IB coordinator at Benjamin Banneker High School in Washington, DC.

Excerpts from the IB History Exam

The IB history exam consists of two to three papers depending on whether students are taking a Standard Level or Higher Level course. The samples below are drawn from the May 2000 Standard Level history exam.

Paper 1: Document-Based Questions

Students have one hour to complete this portion of the exam. Paper 1, taken by both Standard and Higher Level history students, is based on documents and consists of four questions in each of three pre-announced topics. While students may choose which topic to address, they must answer all four of the questions on that topic. As a sample, three of the documents and two of the questions for one preset topic—the Cold War—are provided below. A close look suggests that this exam not only tests the discreet skill of "document analysis," it requires students to use that skill in connection with a rich base of content.

Prescribed Subject 3: The Cold War 1945-1964

These documents relate to rising tension in the Cold War in Europe 1946 to 1951.

Document B

An extract from a speech in which General George C. Marshall announced an ambitious plan of economic aid to the whole of Europe, June 5, 1947.

The truth of the matter is that Europe's requirements for the next three or four years of foreign foods and other essential products—principally from America—are so much greater than her present ability to pay that she must have substantial economic help, or face economic, social and political deterioration [decline] of a very grave character.

...It is logical that the United States should do whatever it is able to do to assist in the return to normal economic health in the world, without which there can be no political stability and no assured peace. Our policy is directed not against any country or doctrine but against hunger, poverty, desperation, and chaos. Its purpose should be the revival of a working economy in the world so as to permit the emergence of political and social conditions in which free institutions can exist.

Document C

An extract from a speech by Vyshinsky, Deputy Foreign Minister and Soviet spokesperson at the United Nations, to the UN on September 18, 1947 (published in the UN records of the meeting).

The so-called Truman Doctrine and Marshall Plan are particularly glaring examples of the manner in which the principles of the United Nations are violated [disregarded], of the way in which the organization is ignored.

... It is becoming more and more evident to everyone that the implementation of the Marshall Plan will mean placing European countries under the economic and political control of the United States and direct interference by the latter in the internal affairs of those countries.

Moreover, this Plan is an attempt to split Europe into two camps and, with the help of the United Kingdom and France, to complete the formation of a *bloc* of several European countries hostile to the interests of the democratic countries of Eastern Europe.

...The intention is to make use of Western Germany and German-heavy industry as one of the most important economic bases for American expansion in Europe, in disregard of the national interests of the countries which suffered from German aggression.

Structure, Not Rigidity

While the exams provide considerable guidance for IB teachers, the program also includes syllabi that outline courses of study to prepare students for the exams. This type of common syllabus for all schools—in which teachers are given certain topics to cover in mathematics and certain events and themes to emphasize in history, for example—is typical in most high-achieving countries, but rare in the United States.

Teachers in the IB program acknowledge that the curriculum is more prescriptive than they are accustomed to, but they do not object. "Teachers do need to follow the [IB] curriculum, that's true. I can't go off on my own tangent," says Jane Greenaway of Coral Gables High School. "But the student gets a really well thought-out curriculum, one that might be better than one I can think up."

Greenaway and others note that the IB's course of study guides set parameters within which teachers can use their own skills to design a creative and challenging instructional program. The course of study for history, for example, includes six topics and outlines major themes and materials for more detailed study. For example, under the topic "causes, practices, and effects of war," the syllabus suggests the following as possible study materials: the Algerian War, the Arab-Israeli Wars, the Chinese Civil Wars, the First and Second World Wars, the Korean War, the Mexican Revolution, the Nigerian Civil War, the Spanish Civil War, and the Vietnam War. Based on this type of information, teachers design a program that prepares students for the exams. Since the exams include choices, IB advises teachers not to cover all six of the history topics. More importantly, such a program has intrinsic value, as teachers and students have opportunities to explore their interests while completing a diversified history curriculum.

Such an approach is designed to strike a balance between breadth and depth. Although students are not expected to

Document D

An extract from 'The Blockade of Berlin' by historian Philip Windsor (published in History of the Twentieth Century, BPC publishing, London, 1968).

When the Russians cut road and rail links to the West, the four-power city of Berlin was left stranded a hundred miles inside the Soviet sector of occupied Germany.... It was over Berlin that the Soviet Union and the United States came to their decisive trial of strength. But is that what the Soviet rulers intended? Did they intend to cut off Western access to Berlin? Was the trial of strength deliberate, or was it the product of a series of accidents and misapprehensions [misunderstandings]?

Exam Questions

- In what ways and to what extent do Marshall in Document B and Vyshinsky in Document C disagree about the motives behind the Marshall Plan?
- Using the documents and your own knowledge, explain why the Soviet Union launched the Berlin Blockade in June 1948.

Paper 2: Essay Questions on Six Prescribed Topics

Students have 1½ hours to complete this paper. The Standard and Higher Level history syllabus includes six topics; IB recommends that teachers cover two or three of them in preparation for Paper 2. This portion of the exam offers a choice of five questions per topic; students must answer two questions, each chosen from a different topic. The following sample includes two (out of five) questions from four (out of six) topics.

Causes, practices, and effects of war [Topic 1]

- Compare and contrast the effects for the country concerned of *two* of the following: the Chinese Civil War, the Nigerian Civil War, the Spanish Civil War.
- In what ways have wars (a) caused suffering and hardship to women and (b) helped promote women's equality? Specific evidence must be given from at least *two* regions.

Nationalist and independence movements, decolonizsation, and challenges facing new states [Topic 2]

- Why has colonialism become an 'outdated and unpopular concept' in the 20th century?
- In what ways, and why, have social and economic conditions changed since independence in *two* of the following: Algeria, Cuba, Indonesia, Zaire?

The rise and rule of single-party states [Topic 3]

- In what ways, and for what reasons, did rulers of single-party states play an important role in world affairs between 1917 and 1945?
- Account for the rise to power and longevity of the rule of *either* Fidel Castro in Cuba *or* Julius Nyerere in Tanzania.

The state and its relationship with religion and with minorities [Topic 6]

- Evaluate the methods used by *two* minorities (ethnic, racial, or religious) in their efforts to preserve their culture and identity.
- Explain why, and to what extent, *two* of the following minorities are considered to have been disadvantaged: Aborigines in Australia, Chinese in Malaysia, Kurds in West Asia, Quebecois in Canada.

know every fact about 20th-century world history, they are expected to have sufficient command of relevant facts to illustrate several of the major themes set forth in the course of study.

In designing a class syllabus based on the course of study, it is common for teachers to consult past exam questions. They also rely on their knowledge of their students and choose topics that might be engaging to them. "We cover as much as we can, content-wise, of what the IB requires," says Duesterbeck of Henry High School.

For example, Duesterbeck knows from the IB history syllabus and previous exams that students will be required to display detailed knowledge of at least two regions of the world. He also makes sure to include the Vietnam War, which is of particular interest to his students, many of whom are Hmong immigrants.

Duesterbeck also plans his curriculum with Rahne, the English teacher, so that they can coordinate their lessons. Students in Duesterbeck's history class will be studying the Vietnam War at the same time Rahne is teaching Tim O'Brien's *The Things They Carried,* a novel about the war. Rahne's class reading list also includes *The Sorrow of War* by Bao Ninh, a Vietnamese novelist, in addition to Shakespeare, Steinbeck, and Whitman.

To help students learn material in depth, the curriculum allows time for students to prepare long-term projects. In one recent history class at Schenley, for example, students met in small groups to prepare skits on topics related to World War II, such as a café discussion of the attack on Pearl Harbor or a radio broadcast of the dropping of the atomic bomb on Hiroshima. In the skits, students would have to demonstrate that they knew the facts about the event the skits were describing, as well as understand the public reaction to the event and its significance. The teacher, Barak Naveh, says such lessons are not only engaging to students, they also develop their understanding in ways that will help them select and answer the challenging questions on the exam. "My students won't be able to answer all 25 [questions on the exam], but they will be able to answer two in depth," Naveh says. "The IB exam lends itself to activities like this."

Yet this does not mean that Naveh's class, nor any IB class, is devoted solely to long-term projects; IB exams require students to demonstrate both their knowledge and their deep understanding. Teachers lecture, assign readings, and quiz students on their factual knowledge. During the same class period that Naveh assigned the skits, for example, he delivered a half-hour lecture on the war in the Pacific from 1942 to 1945 and the events leading up to the dropping of the atomic bomb.

Becoming an IB School

To participate in an IB program, schools must submit to IB a detailed and comprehensive application. The IB organization reviews the application and sends a team to the school to determine if the school can implement the program effectively; the organization may recommend some changes in the school's curriculum or instructional offerings. For example, Benjamin Banneker High School in Washington, DC, began in late 2001 to upgrade its science laboratories because the IB organization considered them inadequate for the program.

The final decision on a school's application is made by the IB Director General in Geneva. If the organization accepts the application, the school enters a "year of affiliation," during which the school begins to implement the program on a trial basis and makes the changes recommended by the IB organization. The following year, if the school makes the changes, it can award IB diplomas according to IB rules and standards.

For more information on becoming an IB school, contact IB North America at **ibna@ibo.org** or (212) 696-4464.

Training for Teachers

In addition to providing exams and materials, the IB program also offers training for teachers in regional workshops held during the summer and periodically throughout the school year. As part of their application to participate in the program, schools need to demonstrate that teachers who will be involved in the program will take part in the training workshops.

The workshops familiarize teachers with the exams and the detailed syllabi. Because the syllabi change every four or five years, teachers regularly return to learn about the updates. Perhaps more importantly, the workshops provide opportunities for teachers from different schools and different states to meet to discuss how to teach. These opportunities are rare in the United States, where teachers lack a common curriculum and thus a common vocabulary for discussions of pedagogy. But they are frequent occurrences in countries like Japan, where teachers regularly get together to develop lessons based on the common curriculum.

"Teachers are all coming from the same experiences," says Jane Kostik, the IB co-coordinator at Henry. "They know what's expected and what kinds of things to teach. They share with each other what ways work best."

Some schools have arranged for their entire faculties to receive IB training. Joseph Mulcahy of Banneker High School in Washington, DC, says the training is useful even if teachers are not teaching in the program, particularly in a small school. "If they are not teaching IB English, they are teaching students who are going into IB English," he says.

To further assist teachers, schools in a number of states have formed informal networks. The networks provide an opportunity for coordinators from IB schools to discuss issues of mutual concern. They also provide additional opportunities for teachers to meet to talk about the curriculum.

Mary Edna Tookey of Chicago's Lincoln Park High School says her school's participation in one such network, which includes schools throughout the Great Lakes region, has been invaluable. "It's a chance to meet with colleagues from all over the Midwest, exchange ideas, and get help."

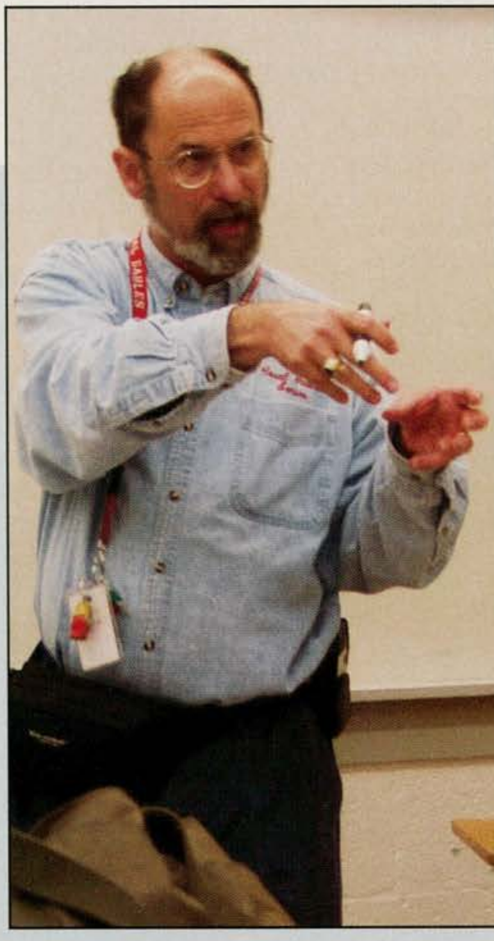
Student Support and Pre-IB Preparation

Teachers and administrators acknowledge that, with its rigorous academic demands, the IB is a stretch for many students, particularly those who lack the preparation and discipline the program requires. And although the International Baccalaureate Organization does not have any restrictions on which students can participate in IB, some schools restrict entry to the IB to students who can demonstrate—through test scores or other measures—that they are capable of handling the work.

Some schools offer students the option of taking selected IB courses, rather than the complete program, much as students take individual Advanced Placement courses. IB officials discourage this approach, however, and many program coordinators prefer the full Diploma Programme. "The IB is a well-rounded program," says Kostik. "You don't expect students to do superwell in every one of the six subjects, but you want students to have experience in all subjects."

Schools also provide support to help students through the program. At Henry High School, for example, where three-fourths of the students come from low-income homes, administrators recognize that many students lack the home support and academic preparation to allow them to move smoothly through a demanding curriculum. In response, the school opens its media center at 6 A.M. to provide students a quiet place to study, something they may lack at home.

In addition, Henry created after-school programs and a Saturday school, particularly for ninth- and 10th-graders preparing to take IB courses. The extended learning time enables students to work on their writing, as well as on study skills like note-taking and time management. The school encourages students who are struggling to



PHOTOGRAPH BY C.W. GRIFFIN

Teaching for the Test and the Students

Consider how Daniel Blackmon, a veteran IB and Advanced Placement teacher, uses the exam to develop his Higher Level IB course on the History of the Americas:

Part of what I do when I organize my course is to look at the examination. There is an implicit agreement between the kids and me that I will get them ready for the exam.

The Higher Level (HL) history exam has three parts, all of which allow students to choose which topics to address. This structure allows different teachers to take different approaches to the course and to preparing their students for the exam. I do not have to teach everything in the IB history syllabus, but the choices are structured to assure that all students will be taught key material. Teachers may structure their course in a way that allows them to teach to their own strengths, or choose to expand their own knowledge. Either way, students will have some choice of topics on the IB exam and will get to write to their strengths. IB finds out what a student knows.

My goal is to prepare students to write two of the three document-based questions in Paper 1, four or five essays from Paper 2, and five or six essays from Paper 3.

My next step is to look at the actual essay questions that have been given on previous exams and give them out to the kids. I might give them nine questions to brainstorm at home and let them know that four of the nine will be options for an in-class essay. In this case, the students will have to prepare five of the nine in order to be assured that they have one to write.

I should, perhaps, add that I permit students to rewrite any essay that is marked lower than a C. I re-grade the assignment and replace (not average) the grade. It means that a struggling student can do well by virtue of elbow grease. It also allows a student who catastrophically misunderstands a question to recoup the error. They see me as a partner in learning, not in an adversarial role.

I also build lessons around the essay questions. I break down what the question demands such as the thesis, subtopics, specific factual information to use, and conclusion.

I tend to lecture in the earlier part of the year and shift more to project-based learning as the year progresses. This spring, students prepared individual projects on a single-party state (Mussolini, Franco, Castro, Mao, or Peron). I paired the kids up to an IB essay question. They developed a PowerPoint presentation on how they would answer the question. Meanwhile, I select one exemplary project on each single-party state and photocopy it for the class.

> The workshops familiarize teachers with the exams and the detailed syllabi. Because the syllabi change...teachers regularly return to learn about the updates.

participate in the Saturday program; others come on their own, and as many as 50 or 60 students take part. Seniors often volunteer as tutors, and most earn credit toward their community service requirement for doing so.

Teachers at Henry also begin preparing students for IB exams long before they will sit for them. Duesterbeck, for example, begins assigning lengthy papers to his ninth-grade pre-IB students, many of whom had written little, if at all, before coming to Henry, to help them develop their skills by the time they take the exams.

As a result of that kind of support system, nearly all 10th-graders who indicated that they plan to enter the IB program do so in 11th grade.

IB for the Elementary and Middle Years

Many teachers have noted that some students, particularly in urban schools, would benefit from stronger preparation before entering high school. Mulcahy, of Banneker High School in Washington, DC, says many students come to the school without any background in a foreign language. To do well on the IB foreign language exam they need to learn in four years what would probably take five years to learn. Similarly, students taking algebra for the first time in ninth grade have to make up a lot of time to prepare for the mathematics exams. "The key to success of many high school programs is what went on in middle school," says Mulcahy.

Partly in recognition of the need for early preparation, in 1994 the IB organization created a Middle Years Programme. Suzanne Knowlton of IB North America notes that the Middle Years Programme quickly became so popular that the organization temporarily halted new applications until it could develop structures to accommodate the demand.

Some U.S. school systems have found it difficult to adopt the Middle Years Programme because it extends from grade six to grade 10, which can span three schools. Knowlton acknowledges that the program, as designed, is difficult to implement in the U.S. system, but says that many districts have overcome that problem by getting high schools and middle schools to work together to integrate the program. "The good news is that institutions that have rarely spoken to each other, have to cooperate with the program," she says.

The IB organization in 1997 also created a Primary Years Programme for grades K-5. Although this program is new, it too is spreading in North America, according to Knowlton. Currently 83 schools in North America are participating in the Middle Years Programme, and 12 are participating in the Primary Years Programme.

Evidence of Success

One of the most extensive studies on the effectiveness of the program was conducted at the University of Florida, which enrolls more IB diploma holders than any other institution in the world. (In large part, this is because of a state policy that provides full scholarships for IB diploma holders.) William Kolb, the director of admissions at the University of Florida, says he undertook the study to provide evidence to validate the university's policy of granting second-year status to students with IB diplomas.

"The faculty has no desire to give away credit," Kolb says. "So we've done a number of studies to satisfy the faculty that students coming from an IB program are able to compete at a sophomore level with those who have gone through freshman year at the University of Florida."

Kolb's analyses found that, in most cases, IB students earned higher grades in second-year courses than students who had taken freshman courses at the university. In addition, IB students complete graduate studies at a higher rate than regular students. Kolb hypothesizes that the amount of writing in the IB program gives students who have gone through it a leg up. "We strongly suspect that these people have done far more writing, on average, than the rest of students who come into the freshman class," Kolb says. "I don't think college writing is quite as frightening to them."

Though anecdotal support for the program is substantial, there is little formal evidence beyond Kolb's work. Recognizing the lack of research, the IB organization has established a research wing, based at the University of Bath in England, to commission studies on the program. One study of IB courses in mathematics and science was recently released by the National Research Council. While this was a largely favorable review, student outcomes such as performance in college were not examined.

Challenges of Implementation

Interest in the IB remains strong, but many school systems have faced challenges in implementation. One significant obstacle is the cost of the program. Participation in the program requires funds for training and transportation to the training workshops; the time of the IB coordinator, who usually has reduced teaching time; fees for participation ($7,785 per school) and assessments ($540 per student over the two years of the IB Diploma Programme); and postage to mail exam booklets and audio and videotapes to scoring centers around the world (approximately $600 a year per school). In all, an IB program could cost as much as $50,000 a year, depending on the size of the school. Schools typically cover these costs through a combination of district, school, and grant funds, though some schools charge student fees. At least two states, California and Florida, subsidize the costs for schools to encourage more schools to take part in the program, and a number of districts do so as well.

(Continued on page 46)

Allocating Student Study Time

"Massed" versus "Distributed" Practice

How does the mind work—and especially how does it learn? Teachers make assumptions all day long about how students best comprehend, remember, and create. These assumptions—and the teaching decisions that result—are based on a mix of theories learned in teacher education, trial and error, craft knowledge, and gut instinct. Such gut knowledge often serves us well. But is there anything sturdier to rely on?

Cognitive science is an interdisciplinary field of researchers from psychology, neuroscience, linguistics, philosophy, computer science, and anthropology that seek to understand the mind. In this new American Educator *column, we will consider findings from this field that are strong and clear enough to merit classroom application. This issue's question: How to allocate students' practice time as they learn new material.*

By Daniel T. Willingham

How much practice do students need to learn a given body of knowledge or group of facts? What strategies for learning different kinds of material work best? What's the most efficient way to allocate practice time? Cognitive science offers insights that can help answer these questions and thus help teachers shape their instruction in especially effective ways. In this article, we will consider one aspect of this broad topic for which the findings are especially consistent: how the "massing" or "distributing" of students' practice time influences students' long-term retention of factual knowledge. This is an important issue for an obvious reason: Knowing important factual information should be a residual effect of good schooling. In addition, in many cases, students' more advanced learning depends on their retention of previously learned material.

Let's begin. Suppose a student is going to spend one hour learning a group of multiplication facts. How should that hour be allocated? Should the teacher schedule a single, one-hour session? Ten minutes each day for six days? Ten minutes each week for six weeks? The straightforward answer that we can draw from research evidence is that distributing study time over several sessions generally leads to better memory of the information than conducting a single study session. This phenomenon is called the spacing effect.

The spacing effect was noted by Hermann Ebbinghaus, the psychologist usually credited with the first scientific study of memory in 1885. In a super-human feat of patience and endurance, Ebbinghaus tested his ability to learn hundreds of lists of meaningless syllables (e.g. "lum") under different conditions. Ebbinghaus noted that if he studied a 12-syllable list 68 times, he could remember the list perfectly the next day if he allowed himself a "refresher" of seven repetitions before the test. However, if he distributed his study over three days, (and again allowed seven repetitions as a refresher before the test) he needed to study the list just 38 times—*meaning he could cut study time nearly in half, with the same result, by distributing the practice.*

The spacing effect has held up remarkably well over the better than one hundred years that researchers have exam-

Daniel T. Willingham is associate professor of cognitive psychology and neuroscience at the University of Virginia and author of Cognition: The Thinking Animal. *His research focuses on the role of consciousness in learning.* *Special thanks to Alice Gill, Rosalind LaRocque, and Diane Airhart of AFT's Educational Research and Dissemination Program for their ideas in developing the classroom applications (see page 39).*

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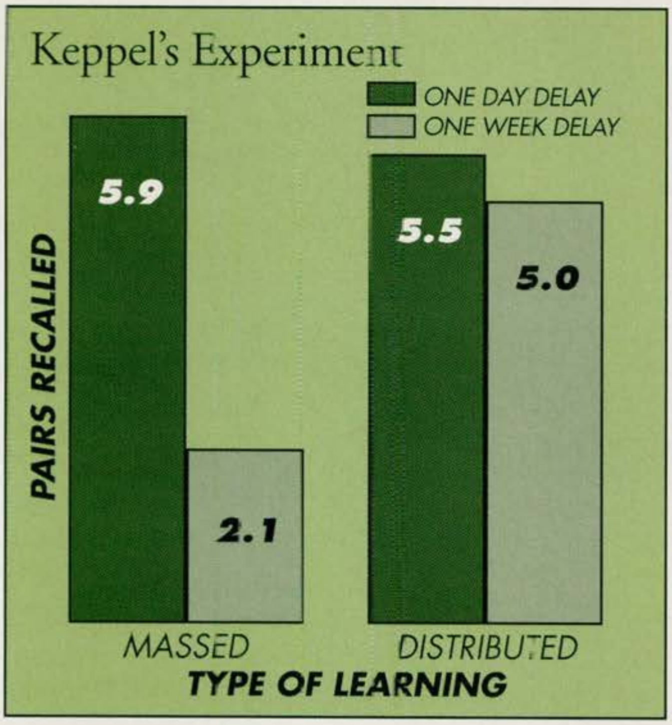

ined it. Here's another example published about 80 years after Ebbinghaus's work: Geoffrey Keppel (1967) had college students learn pairs of nonsense syllables and adjectives (e.g., lum-happy). They were to learn the list so that when they saw the syllable, they could provide the matching adjective. All subjects studied the list eight times, but for half of the subjects, all eight trials occurred on the same day (massed practice) and the other subjects studied the list two times on each of four successive days (distributed practice). Keppel tested their memory of the list either 24 hours after the final study session, or a week later. The results are shown in the chart above. The upshot is that the massed practice group does fairly well if they are tested the next day, but they show a considerable drop-off if they are tested a week later. The distributed practice group, on the other hand, shows very little forgetting, even after the delay.

Massed practice is obviously very similar to what is commonly and derisively called "cramming." These results make it look as though cramming might allow you to remember things for a test the next day, but not for the long haul.

These are interesting studies, but for teachers they should raise as many questions as they answer. Before looking at some of the questions, it's important to pause and emphasize what the spacing effect is *not*.

- The spacing effect does not address the issue of "review." Reviewing refers to presenting again, material that the student once knew but which has been subject to the ravages of forgetting. Review is designed to strengthen a fragile memory.

- The spacing effect does not address the usefulness of spending additional time on a topic. It refers only to the distribution of time one has already allocated to study some material.

Let's consider several questions raised by the research.

Does this spacing effect apply to school-age children as well as college students? Does it apply to the sorts of materials students learn and not just nonsense words like "lum"?

It seems to. Kristine Bloom and Thomas Shuell (1981) taught 20 new vocabulary words to high school students enrolled in a French course. Students either studied the words for one 30-minute session (massed) or for a 10-minute session on each of three consecutive days. The groups were indistinguishable on a test administered immediately after practice, with each group remembering about 16 of the 20 words. A retest administered four days later, however, showed that the distributed practice group still remembered the words (15 words correct), whereas the massed practice group forgot much more (11 words correct).

Another study was conducted by Cornelius Rea and Vito Modigliani (1985) with third-grade students. In this experiment, one group was taught spelling words and math facts in a distributed condition and another in a massed condition. A test immediately following the training showed superior performance for the distributed group (70 percent correct) compared to the massed group (53 percent correct). These results seem to show that the spacing effect applies to school-age children and to at least some types of materials that are typically taught in school.

So spacing practice time improves the likelihood that a student will remember new facts. Does spacing work for other types of material?

John Donovan and David Radosevich (1999) conducted a meta-analysis of spacing-effect studies performed on adults. A meta-analysis is a statistical technique that reveals trends across many studies. Donovan and Radosevich noted that spacing has the biggest effect for learning simple motor skills (such as typing), but is also present when subjects learn new facts, as in the studies above. Only a few experiments have investigated highly complex skills (e.g., running an air traffic control simulator), but in those studies, the spacing effect has disappeared altogether. Thus, this meta-analysis supports the idea that the spacing effect applies to some (but probably not all) of the sorts of things that children learn in school. Unfortunately, there is little laboratory data to suggest at what point along the continuum, from learning facts to learning complex material, the spacing effect loses its potency.

How large is the spacing effect's impact on learning?

The reality of the spacing effect is strongly supported by a good deal of data. But is its actual impact on learning large enough to justify altering our teaching plans to accommodate it? The effect could be real in statistical terms, but insignificantly small in practical terms. So just how big is it? Because different studies use different measures, it can be very difficult to compare the relative effectiveness of strategies; this, of course, is the old apples and oranges problem. To overcome this problem, statisticians use "effect size" measures—one of which is denoted *d*—that are independent of the particular measurement scale employed in a study.

According to Donovan and Radosevich's meta-analysis of spacing studies, the effect size for the spacing effect is d = .42. This means that the average person getting distributed training remembers better than about 67 percent of the people getting massed training. This effect size is nothing to sneeze at—in education research, effect sizes as low as d = .25 are considered practically significant, while effect sizes above d = 1 are rare.

To put this effect size in perspective, consider another effect size. People who have had a heart attack are often encouraged to take an aspirin each day to help prevent future heart attacks. The effect size associated with this treatment is a puny d = .03. Why, then, is it such a well-known treatment? Partly because the stakes are so high (we're trying to prevent heart attacks) and partly because there aren't many effective alternative treatments.

By all these measures, it seems that a strategy with a d = .42 effect is worth taking very seriously.

Does the spacing effect produce long-term effects or just short term effects?

The tests that we've described used rather short time-frames. Even the "distributed" delays were often minutes or hours, and the test was administered at most, a week (and often much less) after study. In education, we hope that students will remember material for years—both because the knowledge itself is valuable and because we must build on that initial knowledge in order to reach advanced knowledge. Suppose distributing practice helps memory for a month or so, but has no effect in the long run? If that were true, it certainly wouldn't be worth worrying about.

This question has not been investigated too often because of the practical difficulties of conducting studies that last a number of years. The few studies that have been done, however, suggest that distributed practice is very important in forming memories that last for years.

Harry Bahrick and Elizabeth Phelps (1987) examined the retention of 50 Spanish vocabulary words after an eight-year delay. Subjects were divided into three groups. Each practiced for seven or eight sessions, separated by a few minutes, a day, or 30 days. In each session, subjects practiced until they could produce the list perfectly one time.

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What Could This Look Like in the Classroom?

How can this research on the spacing effect be applied in the classroom? Here are a few ways to think about applications:

1) **Identify key facts and ideas for distributed study:** Think about the key sets of facts and ideas that you most want your students to remember twenty years from now—and next year. In an American history class, that set of ideas might include the key principles that the Founders intended to capture in the Constitution and the Bill of Rights. In elementary science, one such idea could be how electricity works. In first-grade math it could be addition and subtraction facts. Once you've identified this core content, you can use the next five strategies to engage students in studying this material on a number of occasions over several weeks or even months.

2) **Design homework assignments that distribute practice:** In developing homework assignments, strongly consider including material that was taught in previous weeks and even months. For example, at the end of a given unit, consider assigning homework that includes questions related to the previous several units (and even units going back to the beginning of the year).

3) **Discourage cramming for tests:** Carefully consider how to elicit student practice of test material several times before it appears on the test (for example, it might appear in a homework assignment; be elicited as part of a class discussion; and get quizzed in a quick class "bee"). When test time arrives, students have already distributed their learning a bit; the test becomes one more in a series of practice opportunities. In addition, make it a routine to include a number of items from previous units on each test—particularly material that many students did not do well on the first time around. This way students will know that they need to keep working on material that they find challenging—and that they won't be able to get away with just cramming on the current material.

4) **Take advantage of "down time" for practice:** Especially in elementary school, when children are lining up for recess or lunch or during other transitions, run down the line asking each student a question related to material that has been introduced and practiced in previous lessons.

5) **Break big ideas down into small pieces that can be easily practiced:** After introducing a topic and covering enough content for students to understand the key ideas, break those key ideas and their associated facts or skills into small pieces that can be practiced in a variety of ways like class discussions, short quizzes, homework assignments, and class games.

6) **Let students in on the secret:** By all means, explain to your students that an important part of learning is remembering—and that they're more likely to remember material if they revisit it a number of times. In fact, students may find that they can spend less total time studying for tests if they distribute their time over several sessions.

Do you have specific classroom applications of this research to recommend? Please write to: Cognitive Scientist, *American Educator*, 555 New Jersey Ave. N.W., Washington, DC 20001, or e-mail to **amered@aft.org**.

What Television Chases Out of Life

Right now in America, the vast majority of all families have two or more television sets, and 33 percent of the two- to seven-year-olds have a television set in their bedrooms. Moreover, the time invested in TV has been increasing over the decades. While 39 percent of nine-year-olds watched three to five hours of television daily in 1982, by 1999, 47 percent watched that much. Almost 60 percent of all families watch television during meals, and not necessarily at the same TV set. When do they talk about what they did that day? When do they make plans, exchange views, share jokes, tell about their triumphs or little disasters? When do they get to be a real family?

—Editor

By Marie Winn

Unlike most discussions of television's negative impact, this one does not deal with the usual suspects—violence or sex or relentless commercials. Instead, it focuses on television watching regardless of program content. Obviously kids learn from what they see on the screen. Some of what they learn is useful, some washes over them, and some of it has a negative impact.

But given the amount of time most children spend watching television, the question of quality pales in importance compared to questions about the experience itself and the time devoted to it—whether *that* is helpful or harmful. Sociologist Urie Bronfenbrenner dramatically posed this question by considering what else could be done during the hours spent viewing TV:

> Like the sorcerer of old, the television set casts its magic spell, freezing speech and action, turning the living into silent statues for as long as the enchantment lasts. The primary danger of the television screen lies...in the behavior it prevents: the talks, the games, the family festivities, and the arguments through which much of the child's learning takes place and through which his character is formed. Turning on the television set can turn off the process that transforms children into people.

One of the clearest demonstrations of this "displacement factor," as it has been called, is a unique study titled, "The Impact of Television: A Natural Experiment in Three Communities." It documents the effects of television's arrival on a small Canadian town, Notel, that had been without television reception (due to geographic factors) for a decade into the television era. University researchers, in advance of television's arrival, studied the television-free children and families, comparing them with the populations of two demographically similar towns—one that had had only one TV channel available during the previous decade and another that had had many channels.

The findings were revealing. Before television, the Notel children tested significantly higher than the kids in the other towns on various skills like creativity and reading comprehension. When retested a year after television's introduction, the Notel children's scores had gone down to the level of the kids in the other towns. The researchers, however, did not attribute the declines to the act of watching television. Rather, they explained that watching television displaced other more valuable experiences. Can one conclude, for example, that there is something about the act of watching television that makes kids less creative? Perhaps pursuing hobbies, going camping, or joining clubs broadens their base of experience in a way that makes them more creative. Similarly, in explaining the decline in reading comprehension, the researchers wrote, "We suspect that a displacement process is involved....The absence of reading practice is, in our view, more important than television per se."

Similarly, in 1997, a large-scale study conducted in the

Marie Winn has written for many newspapers and magazines, including the Wall Street Journal *and the* New York Times. *She has written 13 books including* Children Without Childhood *and* Red-Tails in Love: A Wildlife Drama in Central Park. *Excerpts adapted from* The Plug-In Drug, Revised and Updated *by Marie Winn, © 1977, 1985, 2002 by Marie Winn Miller. Used by permission of Viking Penguin, a division of Penguin Putnam Inc.*

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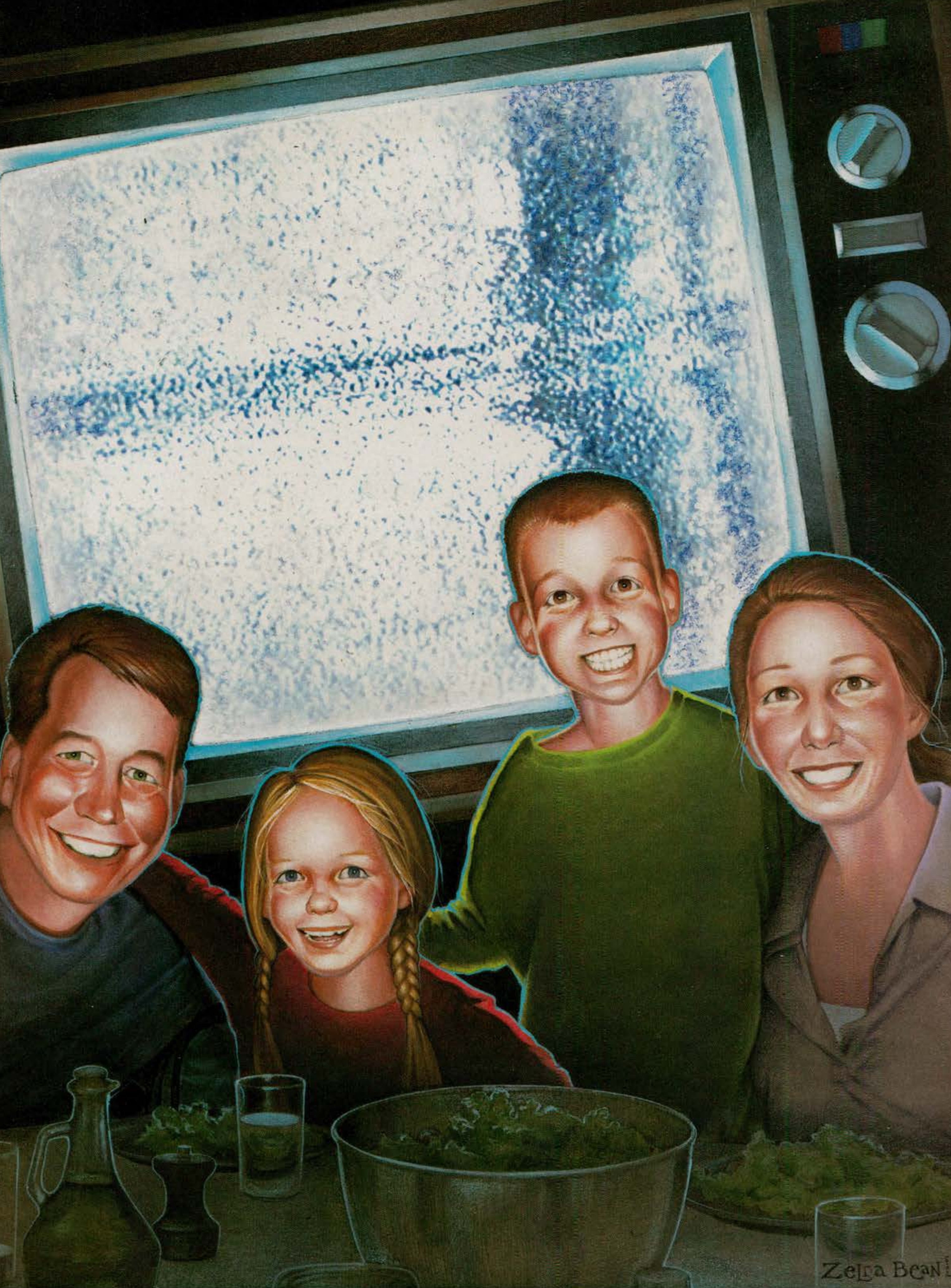

Zelda Bean

Netherlands concluded that television viewing had a negative impact on reading comprehension, largely as a result of television's displacement of reading as a leisure-time activity.

Evidence that the more television children view, regardless of program content, the worse they do in school, has been accumulating since research on television's impact on children began. Twenty years ago in a summary of television research organized by the National Institute of Mental Health, all but one of the numerous studies cited in the section on educational achievement showed a negative relationship between the amount of television viewing and school achievement.

In addition, a National Assessment of Educational Progress (NAEP) report assessing long-term trends in school achievement noted a strong negative relationship between time spent watching television and students' scores on the NAEP mathematics test. In all three age groups tested, the heaviest watchers scored lower than their peers who watched less. The content of programs watched was not a factor in this negative relationship.

What Television Chases Out of Family Life

A number of studies done when television was a relatively new medium demonstrated that television interfered with family activities and relationships. One survey showed that 78 percent of the respondents indicated no conversation taking place during viewing, except at specified times such as commercials. The study noted that, "The nature of the family social life during a program could be described as 'parallel' rather than 'interactive,' and the set does seem to dominate family life when it is on." Thirty-six percent of the respondents in another study indicated that television viewing was the only family activity participated in during the week.

Childhood Memories of the Ordinary Day

By its domination of the time families spend together, TV eliminates the very activities that distinguish one family from another and make childhood memorable—its rituals, games, recurrent jokes, familiar songs. A few decades ago, a parent described her family's evening this way:

> In principle, we have agreed on 2½ hours of TV a day—Sesame Street, Electric Company (with dinner gobbled up between), and two half-hour shows between 7 P.M. and 8:30 P.M., which enables the grown-ups to eat in peace and prevents the two boys from destroying one another. Their pre-bedtime choice is dreadful because, as Josh recently admitted, "There's nothing much on I really like."

Without conjuring up fantasies of bygone years with family games and long, leisurely meals, the question arises: Isn't there a better family life available than this dismal, mechanized arrangement of children watching television for however long is allowed them, evening after evening?

Of course, families today still do things together at times—go camping in the summer, go to the zoo on a Sunday afternoon. But their ordinary daily life together is diminished: those hours of sitting around at the dinner table, the little games invented by children on the spur of the moment, the scribbling, the chatting, and even the quarreling—all the things that form the fabric of a family, that define a childhood.

Strategies that Served Parents and Children

In the pre-television era, necessity often impelled parents to resort to certain parent-directed strategies that bought them some respite from childcare. These included giving firm direction to their children instead of offering choices, observing their children in order to steer them into self-directed play, and requiring nap time for older children.

■ Firmness: Parents were firmer before the television era, not because they believed this was a better way to raise kids, but simply because firmness was necessary for parents' survival. The child-rearing style so prevalent today—characterized by questions parents steadily ask their small children, such as, "Do you want to go shopping with Daddy?"—was unthinkable then. Four-year-old Nancy *had* to go shopping with Daddy so Mom could nurse the baby or help Buddy with his homework, and she was simply told in a nice firm voice that that's what was about to happen. Not knowing that she had a say in such affairs, the small child was more likely to comply than kids are today.

■ Observation: Before television, training children to play alone for periods of time was a vital part of parenthood. But accomplishing this goal was never a simple matter. Observing children's changing development was the pathway to success in getting children to entertain themselves successfully and reliably. A mother, for instance, might take pains to discover if her three-year-old was capable of learning to cut with a pair of blunted scissors. If this activity amused the child, it would be worth the mother's while to work on it a bit—to help the child learn how to cut properly and to provide a supply of colored papers or an old magazine, a jar of paste, perhaps—because once the skill was acquired, her reward would be a self-entertaining child.

■ The Nap: The most dependable survival aid for parents of the past was the nap. They saved up their telephone calls, their letter writing, reading, or sustained thinking for that interval of the day when an eye or an ear didn't have to be cocked in the direction of a small child. When at age two or three the child may have stopped physically needing the nap, the parents hadn't stopped needing it—far from it. Through firmness, based on a certain desperation as well as a strong sense that the period of quiet rest was still good for the child, parents succeeded in gradually turning the sleep nap into a quiet-play nap, during which time children were required to remain in their room, playing or listening to music, or dreaming, or puttering about quietly. Thus, the nap period begins to serve a new function: it provides children with their first regular opportunity to experience free time.

Free Time and Resourcefulness

Not so long ago, children were regularly faced with periods of time that they were required to deal with on their own.

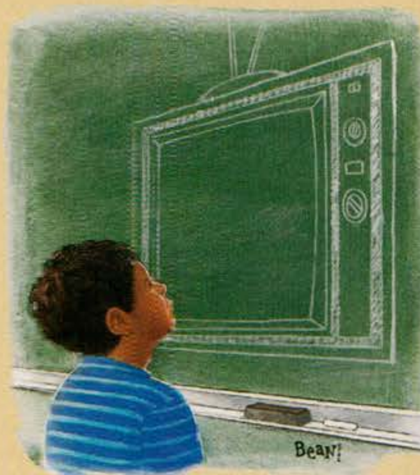
(Continued on page 44)

What TV Chases Out of the Classroom

An educator and authority on early childhood with forty years of experience as a teacher and principal has noted a change in children since the advent of television—they are more sophisticated but less mature:

> Young children today have a sophistication that comes from all their contacts with the outside world via television, but sophistication and maturity are not the same thing. Children today are often less mature in their ability to endure small frustrations or to realize that something isn't instant. They're less tolerant of letting themselves become absorbed in something that seems a little hard at first or that is not immediately interesting.

For educators, this means that getting children to engage in challenging work is more difficult than ever.



Demanding Coursework and Rigorous Homework

One of the indisputable ways in which television has changed the face of education is through the appearance of a new and increasingly popular addition to the curriculum—the study of television itself. Variously called "Media Literacy," "Critical Awareness," "Viewing Skills," and other names, these courses offer a tantalizing possibility: to make a stepping-stone out of a stumbling block by using television itself to transform a classroom of students into selective, critical viewers.

The reasoning behind the media-literacy movement goes like this: Children already watch a great deal of television and nothing much can be done about it. Let's help them get more out of their viewing by teaching them to be more critical about what they view. And thus children, to their delight, are finding that in place of arduous studies requiring reading and writing and concentrated effort, they can settle back in their seats, chat about TV, and watch programs in school that relate to those they enjoy at home.

One such program that made its way into second-, third-, and fourth-grade classrooms a number of years ago was called *Gettting the Most Out of TV.* Emanating from the Yale Family Television Research and Consultation Center and funded, not surprisingly, by a major TV network, the program's goal was to help young children distinguish what is real and what is unreal on television; it also pointed out that TV commercials often exaggerate. Children may indeed learn to watch television more critically, but it's hard to justify taking away valuable school time from other subjects to accomplish this questionable goal.

Today, TV is not only the subject of courses, it has become part of homework in traditional courses. Faced with large numbers of students who simply do not complete their homework, often as a result of home television viewing, many teachers have settled on a common compromise solution: television programs for homework. Sometimes these are shows such as *National Geographic* specials that may be related to a part of the curriculum. At other times, regular TV programs are assigned for whatever educational value they might provide.

For most teachers, assigning TV for homework is not a maneuver taken to lighten their workload—it is an act of desperation. Teachers hope that by engaging their students in the study of their favorite medium they might manage to sneak in some lessons of a more traditional sort along the way. A high-school teacher whose English class is entirely devoted to the making of video programs and the study of existing shows on television explains:

> One of my prime goals in this class is to use TV video as a motivational tool for reading and writing. We write scripts and we read about television. When I assign them to watch TV, they are aware of the content as well as the technical aspects.

It's not hard to understand why there's a waiting list to get into this teacher's class, or why more and more teachers are turning to television to make their classes more attractive to children of the television generation. Making video films in the classroom and watching situation comedies for homework is fun! Struggling with the complexities of a sonnet, striving to uncover subtle meanings, ironies, or patterns can be work, no matter how gratifying the final experience of reading might ultimately prove to be.

The trouble with using television as a motivational device arises when students must make the shift from the TV-related reading and writing to those forms of reading and writing that lead to clear thinking and a better understanding of people and events—that is, to the reading of literature and history or the writing of well-presented, logical ideas. When asked why he chose the television-centered English class instead of the customary, book-centered course, one student explained: "A regular English class gets boring—you just sit around and read books."

But in an era when children are known to spend 4,000 more hours watching television during their school careers than they actually spend in the classroom, is it not the responsibility of schools to redress this imbalance? Shouldn't teachers devote all their energies to the preservation of literacy and the development of those cognitive skills that will give children access to the heritage of the past—history, science, literature—and help them understand the increasing complexities of life in today's society?

—*Marie Winn*

Today, not merely are children's lives packed with more meetings, lessons, and other structured activities than ever before, but all the possible chunks of empty time cropping up between these activities are filled in with the mortar of television. That curiously unvalued commodity called free time has been eliminated almost entirely from children's lives.

Whether children are so used to immediate gratification via the television set that their abilities have atrophied, or whether a simple lack of experience with free time has left them with undeveloped abilities, these days they seem to have greater difficulty dealing with free time than children of past eras did. Today's children seem less likely to enlarge their interests by trying something new: inventing games, playing make-believe, reading, or writing to pen pals—activities that grow on a child and foster growth.

Family Rituals

Family ritual is defined by sociologists as "that part of family life that the family likes about itself, is proud of, and wants formally to continue." Mealtime rituals, going-to-bed rituals, holiday rituals—how many of these have survived the inroads of the television set? A young woman who grew up near Chicago reminisces about her childhood and gives an idea of the effects of television upon family rituals:

> As a child I had millions of relatives around—my parents both come from relatively large families. My father had nine brothers and sisters. And so every holiday there was this great swoop-down of aunts, uncles, and millions of cousins. I just remember how wonderful it used to be. The cousins would come and everyone would play and, ultimately, after dinner all the women would be in the front of the house, drinking coffee and talking, all the men would be in the back of the house, drinking and smoking, and all the kids would be all over the place, playing hide and seek. Christmastime was particularly nice because everyone always brought all their toys and games. Our house had a couple of rooms with go-through closets, so there were always kids running in a great circle route. I remember it was just wonderful.
>
> And then one year I remember becoming suddenly aware of how different everything had become. The kids were no longer playing Monopoly or Clue or the other games we used to play together. It was because we had a television set, which had been turned on for a football game. All the socializing that had gone on previously had ended. Now everyone was sitting in front of the television set, on a holiday, at a family party! I remember being stunned by how awful that was. Somehow the television had become more attractive.

Sickness As a Special Event

The diminishing cohort of adults who grew up before television has strong memories of childhood illnesses. A mother thinks back:

> My mother worked when I was a child, but when I was sick she stayed home for at least a few days. So I remember those times very well. I remember the endless card games and cutting out pictures from magazines with her. I remember lying in bed and calling her to come and bring me this or that, again and again and again. And I remember how wonderful it felt that she always came! I suppose I ran her ragged, but to this day, that's a very important memory for me.

Parents in those bygone days swallowed their impatience and suspended their weariness when the kids were sick. It wasn't that they were better parents than parents are today—it was because they had no alternative.

Nowadays, what makes sickness special for children is mainly that they are allowed to watch more television than ever. A mother who normally limits her children's television viewing says: "When the children are sick, I'm likely to let them watch all they want. Otherwise, I'd have to read to them all day." For today's children whose opportunities for shared experiences with their busy parents are already so limited, those stories not read, those card games not played, those quiet times not spent together are a particular loss.

Gaining Control

There's evidence that families with rules about TV viewing are better off than families without rules. In a recent study of children's media use, the researchers assessed the personal contentedness and social adjustment of a large group of children, then related the results to their media use. It turned out that children from families with rules about TV viewing scored higher (that is, were happier and better adjusted) than children in families without such rules. (The study also noted that children in families with rules were more likely to spend more time reading.) But even without rules, there are natural ways that parents can limit television.

Parental Control

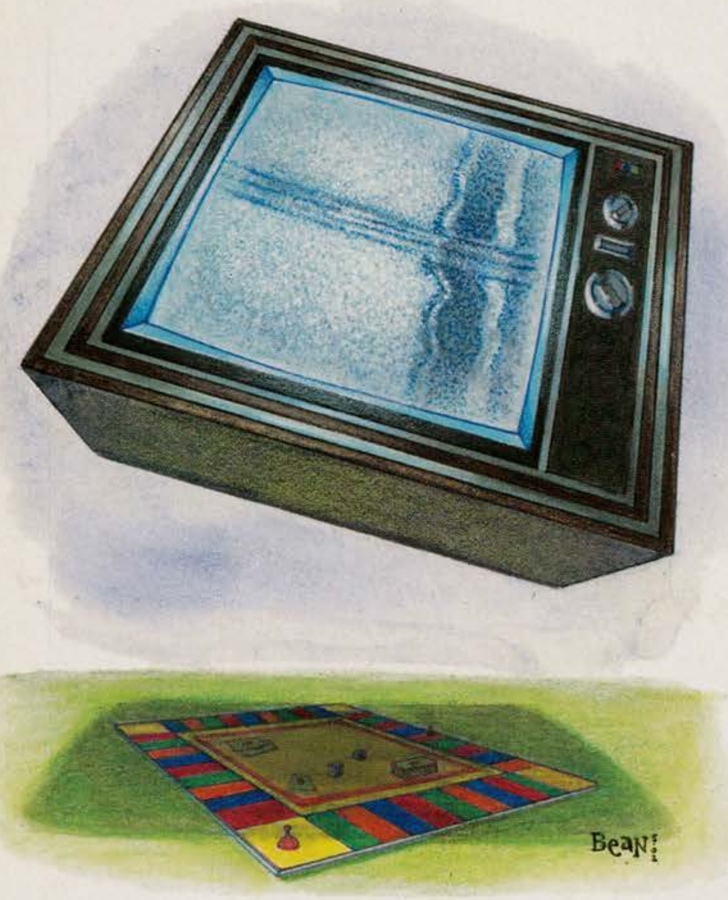
Setting up and maintaining new family rules about television is more easily said than done. Here are some rules to consider. (Note that new rules are easier to establish after a period of time spent without TV, either a vacation or after a deliberate TV turn-off week.)

1. *No TV on school days.* That's it. No counting hours, no checking listings for one or two permissible programs. No bargaining and haggling. Eliminating television on school days effectively eliminates television as a competitor for other, more fulfilling activities (lively family meals, conversations, games, reading aloud, and, of course, studying and doing homework) during a good chunk of the week.

2. *No TV at dinnertime or bedtime.* This is the rule that virtually every expert agrees on. With the exception of a brief annual vacation, dinnertime is often the only regular time a family can spend together. Whatever cohesiveness and family spirit is to exist, the evening meal is where it is consolidated. As for bedtime, there is nothing that can replace the bedtime story as a uniquely valuable experience in every child's life.

3. *A one-hour-a-day time limit.* Some families set a strict daily time limit of no more than one hour of viewing a day. This may work to "detelevisionize" family life considerably, but the competition between television and other activities continues. Children can spend two or more hours simply marking time until their permitted program comes on the air.

4. *Fewer or no "regular" programs.* A rule limiting or eliminating the watching of regular weekly series programs will usually reduce the quantity of TV watching considerably. (Many kids have numerous series programs they watch regu-



larly.) It also helps discourage families from planning their lives around the TV schedule.

Natural Limits

Although rules may be necessary, there are also ways to limit TV viewing naturally. The following strategies serve to diminish TV's negative impact on family life:

1. *The Set Itself.* The condition of the set itself can keep TV watching hours down. An eight-year-old boy who watches little television says, "I don't like watching television much because we have a terrible television set. It keeps messing up and either the sound is bad or the picture or both. Worst of all, we sometimes get a double picture."

2. *Location of the Set.* In deciding *where* to locate the television set, consider the following parent's testimony:

> We keep our set in the basement to have it out of the way. It's there because we don't like to talk over the TV, as happens at our friends' houses, or to have other people distracted by it and lose the thread of the conversation. Also, in the basement there's less temptation to just flick it on when you enter the house. You have to make a special trip down there to watch something.

Most important of all, there should not be a TV in the children's room. In February 2001, the American Academy of Pediatrics revised its (already strong) policy statement about parents' use of television. It advised pediatricians to tell parents: "Remove television sets from children's bedrooms."

3. *Number of Sets.* The number of sets a family possesses makes a considerable difference in how well parents can control their children's viewing. In a study of the factors affecting parental television control, researchers observed that the number of television sets in a home was "the crucial family variable," predicting whether parents were successful in controlling television.

4. *A Rich Social Life.* A rich social life may also serve as a natural limit to children's television viewing. A psychiatrist explains that:

> The television problem is related to small families. Amusing small kids would be perfectly easy if you had four or five kids of various ages around at all times to amuse each other. The whole idea of a mother entertaining a small child is kind of crazy anyway. It never happened prior to 1900.

A family with two children eight and ten years of age find that the TV is infrequently used in spite of a permissive attitude towards it. The mother reports:

> We live on the way to Lucy's school and she almost always brings girls home with her, sometimes ten at a time! Jeremy usually brings home a couple of kids since his school is also nearby. But he has a friend who lives upstairs, an only child, and that child watches TV a great deal. Maybe there's a connection.

Outside Support

Parents respond with gratitude and relief when help is offered by powerful outside institutions. Support from local schools as well as national organizations can bolster parents' efforts:

1. *School support.* A few years ago, when a well-known nursery school in New York City sent a letter to its entire parent body advising them to limit their children's viewing time to a maximum of one hour a day, the step was greeted with unusual enthusiasm. An article in the *New York Times* quoted one mother as saying, "That letter gave me the final push into curtailing television." Another mother described her three-year-old son's campaign to watch *Planet of the Apes* and other popular cartoons this way, "I was under heavy pressure, so when the letter arrived, I was relieved to tell him the school didn't want him to watch."

2. *The TV-Turnoff Network.* The TV-Turnoff Network held its first national TV Turnoff during the last week of April 1995, and has continued to organize a similar event every year since. So far, more than 24 million people have participated, at least partially, in the national Turnoff, with 6 million signing on in 2000 alone. Today, the TV-Turnoff Network leads an alliance that counts among its supporters the American Academy of Pediatricians, the Girl Scouts of America, and the Surgeon General of the United States. □

To learn more about the TV-Turnoff Network, visit ***www.tvturnoff.org****. Let us know if your school takes steps to limit TV watching by writing to* American Educator, *555 New Jersey Ave. N.W., Washington, DC 20001 or via e-mail at* ***amered@aft.org****.*

Lost at Sea

(Continued from page 8)

changed students. Mary, a mid-career entrant to teaching, expressed this dual concern for herself and for her students. She taught at a school that emphasized innovative ways of teaching and discouraged teachers from using textbooks and commercially-prepared materials. While she understood this approach, she found it unworkable for her and unfair to the students:

> You are...dealing with young people that you don't want to make that many mistakes on. It's not fair to them to sort of be trying all kinds of new things on them to see what works.

Mary said that deciding what and how to teach should not be left entirely to a new teacher.

The new teachers, however, reserved the right to adapt the prepared curriculum and materials to their own unique styles and to the specific needs of their students. Although the new teachers generally acknowledged their limited expertise as classroom teachers, they asserted their authority over what their students needed; they believed that nobody knew their students better than they did.

Without more specific curricula or adequate guidance and resources to translate the curriculum frameworks into curricula, state standards and accountability only served to frustrate new teachers. When Gail said, "You want me to teach this stuff, but I don't have the stuff to teach," she was anticipating her fourth-grade students taking the MCAS in the spring. The frameworks and high-stakes test introduced pressure without proven pedagogy and a mandate without materials.

These new teachers were often overwhelmed by the responsibility and demands of designing curriculum and planning daily lessons. They entered the classroom expecting to find a curriculum with which they would struggle. Instead, they struggled to develop a curriculum. Whatever confidence they may have had when they entered teaching was undermined daily as they realized that they did not really know what they were supposed to teach, that they had no instructional guides, that they lacked ready access to resources that might enhance their own subject knowledge, and that their private knapsack of instructional strategies was virtually empty. In response, these eager and anxious novices searched the Internet, eavesdropped on conversations to discover what other teachers did, photocopied frantically, spent hours preparing handouts, scoured library shelves for relevant background reading, and spent their own money on materials that would help them get by for a day or a week.

If state legislators and officials accept the premise of standards-based reform, then they must take seriously their responsibility to support its implementation in districts and schools. It is there that new teachers learn what and how to teach and decide whether or not to stay in the teaching profession. To support these new teachers, the development of curriculum and instructional materials, both with and for teachers, and ongoing high-quality professional development are essential. □

IB

(Continued from page 36)

But not all do. In Pittsburgh, Schenley High School pays for teachers' training but requires students to pay their own participation and examination fees. As a result, many Schenley students are unable to take part in the full Diploma Programme. In addition, the school is unable to afford some of IB's additional materials, such as school reports.

Also, the calendar of American high schools makes it difficult to accommodate the program. U.S. schools typically have to cover the IB requirements in a 180-day year, compared with more than 200 days in some European and Asian nations. Further, American school schedules often make it difficult for IB teachers to find time to work together to coordinate their instructional programs. But many schools have found ways to create common planning time for all IB teachers in a particular subject area, if not across disciplines. In addition, schools have used faculty meetings and other common times to coordinate IB instruction.

One potentially complicating factor—state testing requirements—does not appear to pose a challenge for IB programs, but it is somewhat fatiguing for IB students. Teachers say students in IB classes tend to do well on standardized tests and they do not have to adjust their instruction to accommodate the tests. However, some teachers say the time taken up by testing eats into instructional time; they point out that students see the state tests, on top of IB tests, as burdensome. "Students are sick of taking tests," says Jane Greenaway of Coral Gables. To address this, Virginia students are able to substitute IB exams for the state's Standards of Learning exams. The Virginia Department of Education is concerned with having students demonstrate that they have met high standards, and IB exams offer ample opportunities to do just that.

Overall, those involved with IB seem enthusiastic about the program and have confidence in its rigor. As Daniel Blackmon put it, "The more I work with IB, the more committed to the program I become. Regular curriculum revisions (every five years) force me to continue to study and grow personally. IB also places a high value on learning how to learn, which is an essential skill. IB is a great program—vital, growing, and relevant. I definitely want to teach IB the rest of my life." □

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Ask the Cognitive Scientist

(Continued from page 39)

Notice that in this experiment, the researchers didn't match the total amount of practice across groups. Rather, they matched the level of subjects' performance; at the end of each session, each subject could produce the list without error. Eight years later, people in the no-delay group could recall 6 percent of the words, people in the one-day delay group could remember 8 percent, and those in the 30-day group averaged 15 percent. Everyone also took a multiple choice test, and again, the spacing effect was observed. The no-delay group scored 71 percent, the one-day group scored 80 percent, and the 30-day group scored 83 percent.

This experiment, although impressive, was a bit different than those that came before it. Subjects were trained to a criterion (one perfect repetition of the list), which means that subjects in the longer delay condition studied a bit more than those in the shorter delays; they had forgotten the list during the delay, so they needed more practice to get to the criterion of one perfect recitation of the list. But, clearly, the payoff for this small cost was dramatic.

Nonetheless, this difference in total practice time raises an important issue: Perhaps the improved memory eight years later was not caused by the distributed nature of the practice, but by the slight increase in the number of practice trials.

In a follow-up experiment, Bahrick and his colleagues varied both the spacing of practice and the amount of practice. Practice sessions were spaced 14, 28, or 56 days apart, and totaled 13 or 26 sessions. They tested subjects' memory one, two, three, and five years after training. Once again, it took a bit longer to reach the criterion within each session when practice sessions were spaced farther apart, but again, this small investment paid dividends years later. It didn't matter whether testing occurred at one, two, three, or five years after practice—the 56-day group always remembered the most, the 28-day group was next, and the 14-day group remembered the least. Further, the effect was quite large. If words were practiced every 14 days, you needed twice as much practice to reach the same level of performance as when words were practiced every 56 days!

To summarize what we know from the laboratory: There is a mountain of evidence suggesting that spacing study time leads to better memory of the material; the effect applies to at least some of the types of learning students do—fact learning; and it seems to hold for school-age children. Most of that work used "distributed" timeframes that were not all that distributed—a matter of minutes or perhaps a day. But the small number of experiments that have used longer delays between practice sessions, and very long delays (years) before testing for retention, indicates that the spacing effect holds—and perhaps is even more robust after these long delays. □

Readers can pose specific questions to "Ask the Cognitive Scientist," American Educator, *555 New Jersey Ave. N.W., Washington, DC 20001 or to* ***amered@aft.org***.

Coherent Curriculum

(Continued from page 26)

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Appendix: Methodology

Development of the A+ Composite

To identify the top achieving (A+) countries in mathematics, we rank ordered countries from highest to lowest using their eighth-grade score. We then compared each country's score with every other country's score to determine which ones were statistically significantly different. The following countries, which statistically outperformed at least 35 other countries, became the A+ countries: Singapore, Korea, Japan, Hong Kong, Belgium (Flemish-speaking), and the Czech Republic.*

To analyze the A+ countries' intended content, a procedure called General Topic Trace Mapping (GTTM) was used. Education officials were given extensive lists of topics in mathematics and asked to use their national curriculum to indicate for each grade level whether or not a topic was supposed to be covered. The result was a map reflecting the grade level coverage of each topic for each country. Although none of the countries' maps were identical, the A+ countries' maps all bore strong similarities.

The A+ countries' topic maps were synthesized to develop a composite of the topics intended by at least two-thirds of the A+ countries (see Figure 1, page 14). The synthesis was done in three steps. First, we determined the A+ countries' average number of intended topics at each grade level. Second, we ordered the topics at each grade level based on the percentage of the A+ countries that included a particular topic in their curriculum. For example, since all of the countries included the topic "whole number meaning" in the first grade, that topic was placed at the top of the list for first grade. Third, we used the information from steps one and two to develop the A+ composite. At each grade, the composite was to include no more than the average number of intended topics. The composite was also to include only topics that were intended by at least two-thirds of the A+ countries. Therefore, the topics intended by the greatest percentage of countries were selected for the composite first, and only as many were chosen as were indicated by the mean number of intended topics at each grade level. Therefore, the topics in the A+ composite constitute the "core curriculum." In addition to these core topics, each country taught additional topics. The number of additional topics beyond the core that are intended at each grade level

* Valverde, G.A. & Schmidt, W.H. (2000). Greater expectations: learning from other nations in the quest for 'world-class standards' in U.S. school mathematics and science. *Journal of Curriculum Studies, 32*(5), 651-687.

can be seen in the number found in the last row in Figure 1 (see page 14).

Development of the U.S. Content Standards

The data on U.S. content standards in mathematics were collected from two sources: a sample of 21 states' standards and a sample of 50 districts' standards. These data indicated topics intended for instruction at each grade level through eighth grade.

Because the U.S. has so many sets of standards, using the General Topic Trace Mapping procedure would have been very difficult. Instead of using education officials' judgments about intended content, coders (graduate students with degrees in mathematics, engineering, and the various sciences) compared the actual standards documents referenced above to the same extensive list of mathematics topics that was used for the GTTM. More complex standards were identified with more than one topic as appropriate. Once the standards were coded by topic, state and district composites were developed in the same manner as the A+ composite.

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