

# AMERICAN Educator

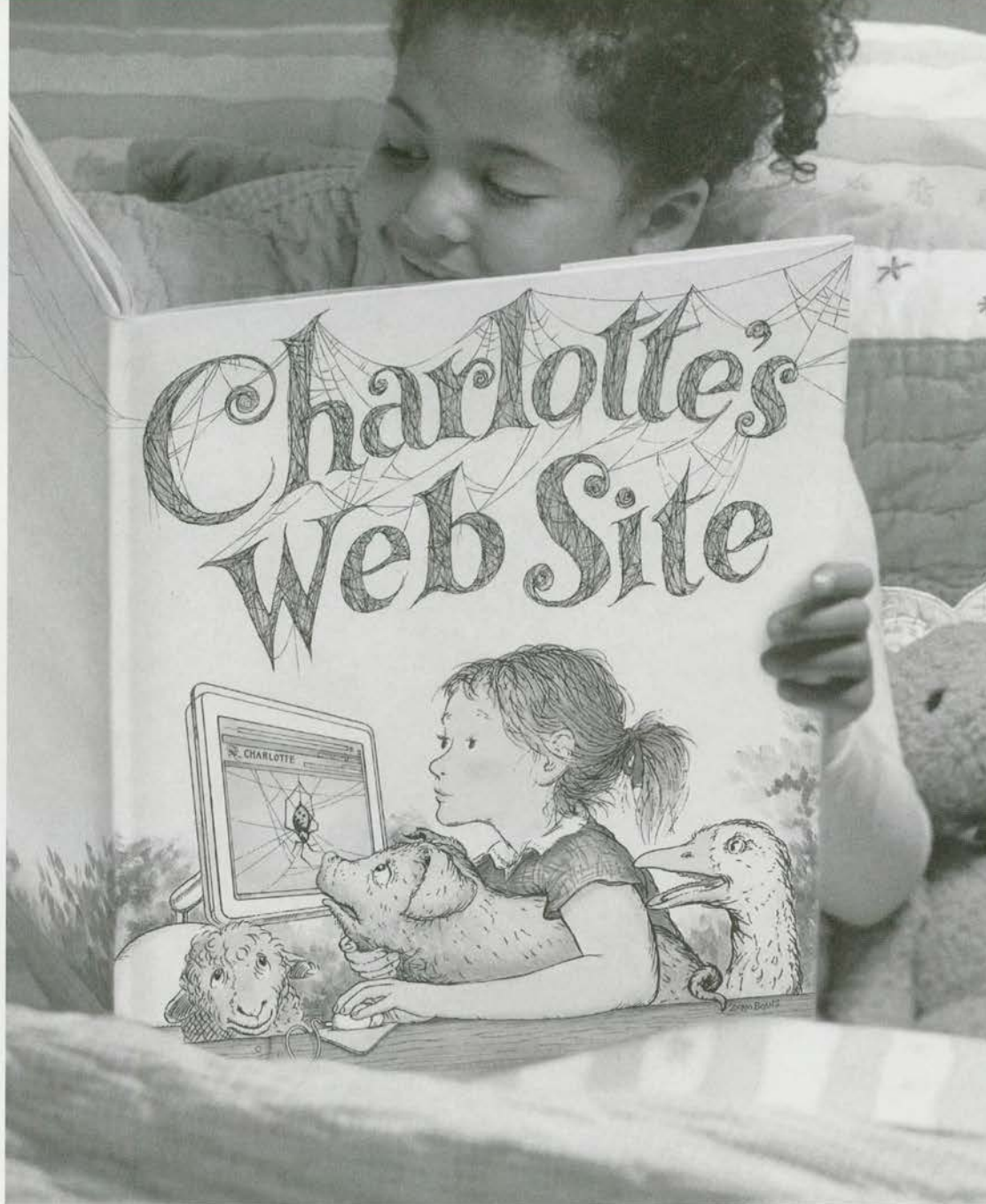
AMERICAN FEDERATION OF TEACHERS  
FALL 2004

## Preventing Early Reading Failure— and Its Devastating Downward Spiral

We now have  
the tools to help  
our weakest readers

Middle-School Science  
Women's Rights For All?  
Punctuation Sticklers





By 6th grade, an alarming number of **girls** lose interest in math, science & technology.

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have to keep their interest alive, in every way we can.

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## 2 **Notebook**

- 5 **Preventive Medicine** *We get regular medical checkups for ourselves and our kids. Problems and diseases that used to maim and kill are often averted. Thanks to research on how children learn to read—and the translation of that research into classroom materials and early screening assessments—we can now screen for and avert almost all early reading failure.*

6 **Preventing Early Reading Failure—and Its Devastating Downward Spiral**

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By Joseph K. Torgesen

*The evidence is in: The children who we hoped would be “late bloomers” in reading rarely are. Their early and modest reading weakness impedes enjoyment and deters practice. Soon, their small reading problems spiral into devastating ones. But with new easy-to-use tools, we can identify children headed toward failure—and prevent it—as early as kindergarten.*

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By Azar Nafisi

*When Nafisi returned to her native Iran in 1979, the Ayatollah Khomeini was stripping Iranians, especially women, of basic human rights. Back in America, “under the name of cultural relativism or multiculturalism,” many condoned these changes as simply “their culture.”*

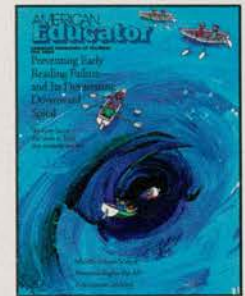
*But, she asks, if we don’t condone virginity checks or forced adolescent marriage for American women, why should we believe these practices are reasonable for Iranian women?*



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By Joy Hakim

*In her new series of science books for middle-schoolers, Joy Hakim combines science, history, geography, culture, and art to tell the story of science in a way kids love. And don’t be surprised if you learn a lot yourself.*

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By Lynne Truss

*Do mistake’s in punctuation drive you crazy? Are you losing you’re patience with peoples poor writing? You just might be a stickler; if so, Truss offers some welcome relief.*





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### Math and Science

Are you a K-12 math or science teacher with great ideas—but no funding—to improve your lessons? The Toshiba America Foundation would like to help with small grants for teacher-designed projects. Grantees must have specific, realistic, and measurable student-learning objectives and must be able to describe what changes in instruction will be made as a result of the funding. Applications from grade 7-12 teachers for projects under \$5,000 are reviewed year-round; those over \$5,000 are reviewed twice a year and are due each February 1st and August 1st. Applications from K-6 teachers are due each October 1st and may not exceed \$1,000. To learn more, visit [www.toshiba.com/taf/](http://www.toshiba.com/taf/).

### Science

In 2005, K-12 science teachers can compete for 50 grants of up to \$10,000 each and a minimum of 20 “mini-grants” of \$2,500 each from Toyota Tapestry. Their purpose is to inspire innovative instructional strategies in three areas: environmental science education, physical science applications, and literacy and science education. Among the many suggestions for proposals included in the brochure are involving at-risk or minority students, creatively using technology and equipment, and solving local community problems. Proposals are due by January 19, 2005. To learn more, visit [www.nsta.org/programs/tapestry](http://www.nsta.org/programs/tapestry).

## Reaching the Top of the Teaching Profession

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Whether you're thinking about applying or are getting ready to renew, reading *A Candidate's*

*Guide to National Board*

*Certification 2004* is a good way to begin. Jointly published by the American Federation of Teachers and the National Education Association, the guide offers strategies for preparing your portfolio (which will include examples of your teaching practice and analyses of how those practices meet the standards) and completing the assessments (which will test your knowledge of developmentally-appropriate content). The guide also explains the scoring and is filled with tips from National Board Certified teachers. The guide is online at [www.aft.org/pubs-reports/downloads/teachers/nbpts04.pdf](http://www.aft.org/pubs-reports/downloads/teachers/nbpts04.pdf).

## Photo Correction

In the Summer 2004 issue on *Brown v. Board of Education*, *American Educator* mistakenly included a photo (on page 14) of a mob about to lynch Thomas Thurmond and Jack Holmes. Many thanks to the handful of vigilant readers/historians who pointed out that Thurmond and Holmes were, in fact, white and that, although no one was convicted, charges were brought against seven of the individuals in the mob.



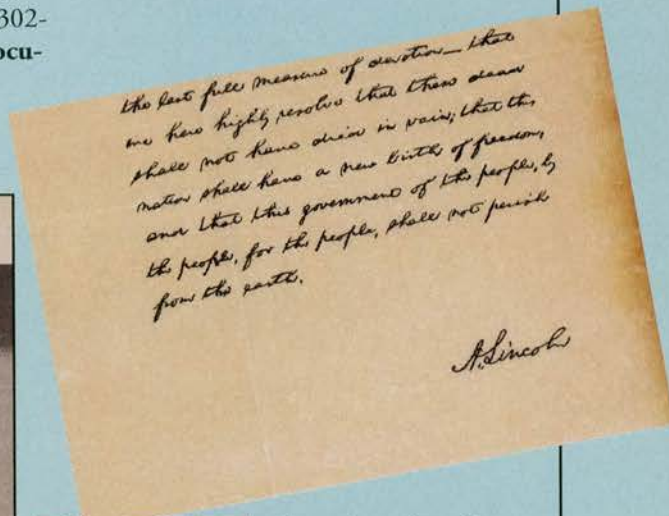
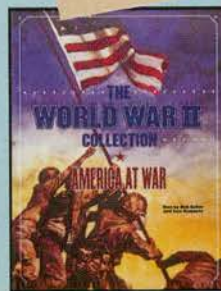
# Bring the Museum Experience to the Classroom

Trips to museums are a great way to bring history classes alive. There is something magical about smudged letters, cracked photos, and yellowing documents. The curves of a soldier's handwriting, the resolve in the eyes of a new immigrant in his passport photo, the sense of time and place present in crinkly, yellow parchment paper—these qualities can draw in even the most reluctant history students. But museum trips aren't always practical. So, Chronicle Books and the American Document Company offer the next best thing: high-quality, affordable replicas for the classroom.

Chronicle Books has developed two fascinating collections: *The Ellis Island Collection: Artifacts from the Immigrant Experience* and *The World War II Collection: America at War*. Each collection includes nearly two dozen artifacts and a booklet with an introductory essay as well as information on each of the artifacts. For younger students, the artifacts make history lessons more interesting; for older students, they are a great way to begin learning about the primary sources that make in-depth historical research so rewarding. Each collection is \$24.95; to order, call 800-722-6657 or visit [www.chroniclebooks.com](http://www.chroniclebooks.com).

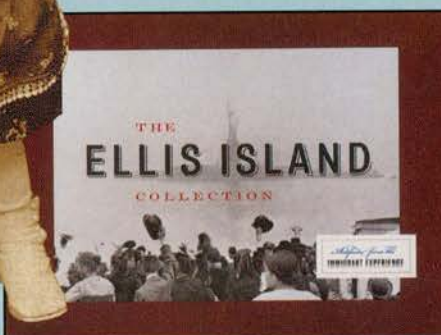
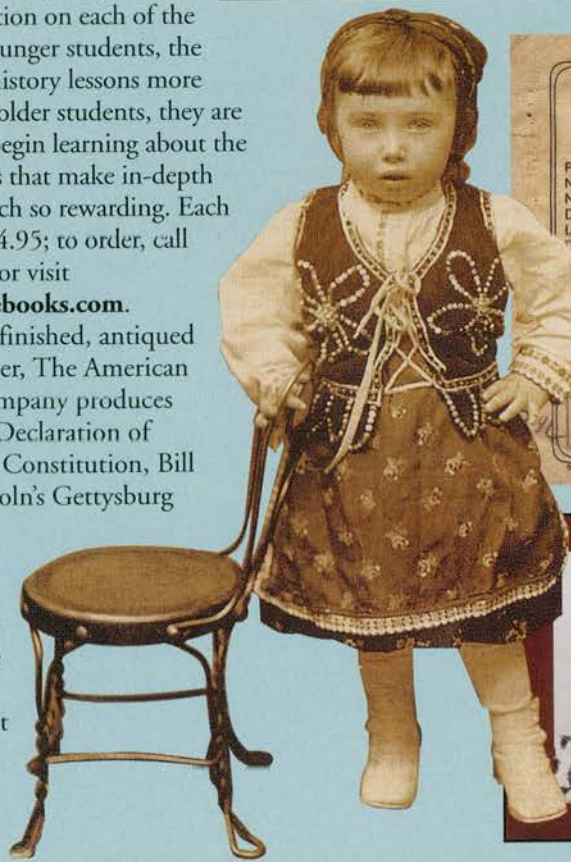
Using hand-finished, antiqued parchment paper, The American Document Company produces replicas of the Declaration of Independence, Constitution, Bill of Rights, Lincoln's Gettysburg Address, and other treasures of American history. Poster-size replicas are \$4.99; smaller versions are just \$1.99. Better yet, if you are a teacher buying replicas

for your class, the American Document Company will give you its wholesale price. To order, call 302-633-6954 or visit [www.cooldocuments.com/index.html](http://www.cooldocuments.com/index.html).



Above: A portion of Abraham Lincoln's second draft of the Gettysburg Address.

Left: Samples from the World War II Collection. Below: Samples from the Ellis Island Collection.



THERE'S NOT ENOUGH ART IN OUR SCHOOLS.

NO WONDER PEOPLE THINK  
**CARAVAGGIO**  
IS A GUY ON THE SOPRANOS.



If you're looking for Caravaggio, you're very, very cold.

It's hard to believe. Here's a 16th-century Baroque master whose bold naturalistic painting style first created a sensation, then a movement. A guy whose life was filled with the turbulence and excess of more than a dozen Mario Puzo novels.

This guy who, while troubled, ultimately found redemption and immortality in his art. But does the average kid on the street even know who Caravaggio is?

Fuhgedaboutit.

Too bad. Especially when you consider how much our children can learn from the conflicted life of a great artist like Michelangelo Caravaggio.

He grew up in less than ideal circumstances. Most of his family died in the plague. Much of his youth was misspent on the mean streets of Rome. And as a



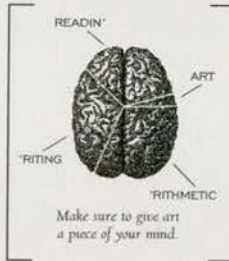
A self-portrait of Caravaggio as Bacchus. Honestly, he wouldn't last 10 minutes on *The Sopranos*.

young artist he struggled for years to make a living. He was angry. Yet the angry contrast between light and darkness in his work is the very reason why it now hangs in countless museums around the world.

If nothing else, it's a case study of the importance of having art as an outlet. Unfortunately, one we're fast removing from our kids' lives.

If the arts are indeed a vital part of your child's education (and studies show you believe they are), then you should demand his or her fair share. To find out how to help, or for more information about the benefits of arts education,

please visit us at [AmericansForTheArts.org](http://AmericansForTheArts.org). Because, as Caravaggio would tell you, life without art is torture.



**ART. ASK FOR MORE.**



For more information about the importance of arts education, contact [www.AmericansForTheArts.org](http://www.AmericansForTheArts.org).



# Preventing Early Reading Failure

**W**ould you go to a doctor who did not believe in blood tests or regular mammograms? Or a dentist who had not heard of floss? Of course not. We expect healthcare providers to keep up on new research not only in treating diseases, but in preventing them. We expect to get regular checkups to assess our health, to get tips on diet and exercise even when our overall health is good, and to get diagnostic tests if a checkup raises a red flag. Even though we don't always follow the doctor's orders, the preventive model of medicine has been wildly successful, allowing us to live longer, healthier lives.

In recent years, reading researchers have pursued a preventive model of reading instruction that could also be wildly successful. It took a lot of work on a lot of fronts: Could reading problems really be detected in their early stages? Could simple, practical assessments be developed that could be used in a classroom setting? If a reading problem was detected, could it actually be averted? And, if so, with what "treatment"?

Today, hundreds of studies later, it is possible to screen all children for weaknesses in reading development, diagnose reading problems as early as kindergarten, and deliver intensive, data-driven treatments such that 94 to 98 percent of early elementary children can reach reading levels in the average range for their grade, creating the foundation for more advanced reading.

The articles that follow provide a glimpse of the research undergirding this preventive model of reading instruction. They also discuss the new "technologies" (especially preventive screening assessments and strong curriculum materials) now available to teachers that translate this research into useable classroom materials and strategies.

It should go without saying, but nonetheless needs to be said clearly:

The research and materials discussed here focus mainly on the early reading skills that produce accurate, fluent reading—and are fundamental to later comprehension. But while these early skills are absolutely necessary to reading comprehension, they are not sufficient to propel the high level of reading comprehension and enjoyment that is the goal of reading instruction. Reaching that goal requires, additionally, strong background knowledge and vocabulary, as well as comprehension skills. For a fuller discussion of reading comprehension and the knowledge that undergirds it, see the Spring 2003 issue of *American Educator*, which is available online at [www.aft.org/pubs-reports/american\\_educator/spring2003/index.html](http://www.aft.org/pubs-reports/american_educator/spring2003/index.html).

In any debate on reading instruction that counterposes a focus on skills with a focus on enjoyment—or that pits phonological skills against the knowledge necessary to comprehend grade-level material—there is only one good answer: Kids need both. Schools that drop history and science from their curriculum to "make room" for more reading instruction—or who fail to incorporate strong content in their core reading program—do so at the expense of their students' long-term reading comprehension.

Fluent decoding is not the entirety of reading instruction. But, without it, all else falters; and the knowledge exists to teach it well. If we put that knowledge into practice in our early-grade classrooms, our current discussions about whether or not to retain third-graders who still aren't reading would be less constant, less necessary, and less freighted. We have the tools to teach reading right the first time, so let's do it.

—EDITORS



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# Avoiding the Devastating Downward Spiral

## *The Evidence that Early Intervention Prevents Reading Failure*

By Joseph K. Torgesen

Children who are destined to be poor readers in fourth grade almost invariably have difficulties in kindergarten and first grade with critical phonological skills: their knowledge of letter names, their phonemic awareness (ability to hear, distinguish, and blend individual sounds), their ability to match sound to print, and their other skills in using the alphabetic principle are weak. These weak phonological skills, in turn, mean it is difficult for these children to identify (decode) unknown words, and their efforts to do so produce many errors. Naturally, these children find it difficult, even unpleasant, to read independently.

Their problems then spiral. Their ability to become fluent readers is compromised because the development of fluent word reading depends heavily on learning to identify large numbers of words by sight (Schwanenflugel, Hamilton, Kuhn, Wisenbaker, and Stahl, 2004; Torgesen, Rashotte, and Alexander, 2001). Because words do not become sight words until they are read accurately a number of times, both inaccurate reading and diminished reading practice cause slow growth of fluent word-identification skills. Furthermore, the strongest current theories of reading growth link together phonemic and sight word-reading skills by showing how good phonemic decoding skills are necessary in the formation of accurate memory for the spelling patterns that are the basis of sight word recognition (Ehri, 1998).

The terrible spiral then spins even more strongly. We know, for example, that delayed development of reading skills affects vocabulary growth (Cunningham and Stanovich, 1998), alters children's attitudes and motivation

to read (Oka and Paris, 1986), and leads to missed opportunities to develop comprehension strategies (Brown, Palincsar, and Purcell, 1986). If children fall seriously behind in the growth of critical early reading skills, they have fewer opportunities to practice reading. Recent evidence (Torgesen, Rashotte, and Alexander, 2001) suggests that these lost practice opportunities make it extremely difficult for children who remain poor readers during the first three years of elementary school to ever acquire average levels of reading fluency. All of this explains the very sobering fact obtained from several longitudinal studies: Children who are poor readers at the end of first grade almost never acquire average-level reading skills by the end of elementary school (Francis, Shaywitz, Stuebing, Shaywitz, and Fletcher, 1996; Juel, 1988; Shaywitz et al., 1999; Torgesen and Burgess, 1998). (See "Waiting Rarely Works," p. 10.)

That's the bad news. The good news is we now have tools to reliably identify the children who are likely destined for this early reading failure. (See "Early Screening Is at the Heart of Prevention," page 14). Most importantly, given the results of a number of intervention studies, we can say with confidence that if we intervene early, intensively, and appropriately, we can provide these children with the early reading skills that can prevent almost all of them from ever entering the nasty downward spiral just described.

In this article, I want to lay out two sets of findings: (1) what we know about the kind of instruction that weak readers need in kindergarten through second grade to prevent them from ever entering the downward spiral, and (2) what we know about the effectiveness of interventions that make use of this knowledge.

Before setting forth the case for early intervention, an important point needs to be clarified. Most children who enter school at risk for reading difficulties fall into one of two broad groups. Children in the first group enter school with adequate

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*Joseph K. Torgesen is professor of psychology and education at Florida State University and director of the Florida Center for Reading Research. He is author of roughly 100 research articles and several books, including A Basic Guide to Understanding, Assessing, and Teaching Phonological Awareness.*





oral language ability but have weaknesses in the phonological domain. Their primary problem in learning to read involves learning to read words accurately and fluently (Torgesen, 1999). In contrast, the second group of children, coming largely from families of lower socioeconomic or minority status, enters school with significant weaknesses in a much broader range of prereading skills (Whitehurst and Lonigan, 1998; Hart and Risley, 1995; Hecht, Burgess, Torgesen, Wagner, and Rashotte, 2000). Not only are their phonological skills and print-related knowledge weak, they have weaker vocabularies, less experience with complicated syntax, and less general background knowledge—all of which are vital for strong reading comprehension at third grade and beyond. Children with these general oral language weaknesses on top of phonological weaknesses require a broader range of instructional support and interventions than those who come to school with impairments only in phonological ability. However, both groups require special support in the growth of early word-reading skills if they are to make adequate progress in learning to read; and, with that support, both can achieve word-reading skills within the average range.\*

It is these early word-reading skills—and specifically how to help our weakest readers attain them—that are the focus of this article. Why make word-reading skills the focus when the ultimate goal is reading for comprehension and enjoyment? For several reasons: First, new discoveries about reading have produced a consensus belief that strong word-reading skills are central to fluent, accurate reading (Rayner, Foorman, Perfetti, Pesetsky, and Seidenberg 2001). Second, there is very strong evidence, as common sense would suggest, of both an empirical (Good, Simmons, and Kame'enui, 2001) and theoretical (Chall, 1996; Rayner, et al, 2001) nature that accurate and fluent word-reading skills are important for good reading comprehension. Third, we know how to prevent the emergence of early word-reading difficulties. Thus, if our end goal is strong comprehension, one important goal of early intervention should be to prevent the emergence of early word-reading difficulties. While strong word-reading skills don't fully equip students for advanced comprehension of texts beyond a third-grade level, they are absolutely necessary for it. (For a lengthy discussion of how to build the broader language skills and knowledge that are vital to later reading comprehension, see the Spring 2003 issue of *American Educator*, available at [www.aft.org/pubs-reports/american\\_educator/spring2003/index.html](http://www.aft.org/pubs-reports/american_educator/spring2003/index.html).)

## I. What Weak Readers Need To Diminish Early Reading Failure

Too many children are leaving elementary school with reading skills inadequate for the next level of instruction. According to the National Assessment of Educational Progress (NCES, 2003), 37 percent of fourth-graders have “below

\* In this article, the average range is defined as the 30th percentile or above and refers to current national norms. Once strong core curricula and early interventions are widespread, average levels of achievement will increase. Eventually, we will have to stop relying on percentile ranking and establish a benchmark for adequate reading ability that virtually all students ought to meet.

basic” reading skills. Once this was inevitable, but no more. We now have the knowledge and the tools to bring this percentage down to a single digit.

To accomplish this, we must change the way we teach reading in three ways. First, we must ensure that core classroom instruction in kindergarten through grade three is skillfully delivered with a balanced emphasis on word-level skills (phonemic awareness, decoding, etc.) and reading comprehension (including the intensive build-up of content knowledge). Second, we must have procedures in place to accurately identify children who fall behind in early reading growth, even when they are provided strong classroom instruction. Third, we must provide these children who are behind with reading instruction that is more intensive, more explicit, and more supportive than can be provided by one teacher with a class of 20 or 30 children—and we should provide that extra support early, preferably in kindergarten and first grade.

### A. Strong Core Classroom Instruction

Six years ago, in a major national consensus report, the National Research Council (Snow et al., 1998) concluded that the most efficient way to prevent reading difficulties from developing was to ensure that every child received appropriate high-quality reading instruction in grades K-3. That report and the more recent report of the National Reading Panel (2000) identified the critical components of early reading instruction as including explicit teaching to build: phonemic awareness and phonemic decoding skills, fluency in word recognition and text processing, reading comprehension strategies, oral language vocabulary, spelling, and writing skills. Instruction that includes these elements and is delivered in a consistent and skillful way is consistently more effective than instruction that does not contain these components.

Since the speed and ease with which students attain these different skills will vary, good classroom instruction needs to make regular use of small instructional groups composed of children with comparable skill levels and needs. Many children enter school with excellent phonological processing skills and a strong beginning understanding of the alphabetic principle. These children can discover, during interactions with print, most of the knowledge that must be acquired to become a skilled reader.

One frequent argument against increasing the amount and explicitness of phonics instruction in early elementary school classrooms is that not all children need the same level of instruction in this area. This is true. But, by making use of small groups within the classroom, weak readers can receive the explicit phonics instruction they need, while other readers can focus on other elements of language arts. Keep in mind, however, that research suggests that initial explicit instruction in phonics is useful for all children (Snow, Burns, and Griffin, 1998; Foorman, Francis, Fletcher, Schatschneider, and Mehta, 1998).

For children who enter first grade with less than average ability or reading readiness, explicit instruction in, and practice with, phonemic awareness and decoding skills are par-

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Because they identify who needs special help, these screening assessments enable teachers and schools to target extra resources to the small group of children that needs the most help.



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ticularly important. Both Foorman et al. (1998) and Jul and Minden-Cupp (2000) found that explicit instruction and opportunities for extended practice with phonemically decodable texts were particularly beneficial for children at risk for reading failure. In the former study, the most phonemically explicit instruction produced the strongest reading growth for all children, but the effects were particularly striking for children whose phonological skills were weakest when they entered first grade.

Phonemic awareness tasks require children to identify or manipulate the phonemes in words that are presented orally. For example, a simple task in this domain would ask children to say which of three words (*bat, car, fork*) begins with the same sound as *bike*. A more difficult task might ask the child to pronounce the first sound in the word *bike*, and a still more difficult task might ask the child to say what word was left when the word *card* was pronounced without saying the /d/ sound. Both conscious awareness of the phonemes in words and the ability to accurately identify them within words are necessary in learning to phonemically decode words in print (Ehri, 2002; Ehri, et al., 2001; Wagner et al., 1997). Children who are delayed in the development of phonemic awareness have a very difficult time making sense out of “phonics” instruction, and they certainly have little chance to notice the phonemic patterns in written words on their own. A simple way to say this is that for individual children, phonemic

awareness is what makes phonics instruction meaningful. If a child has little awareness that even simple words like *cat* and *car* are composed of small “chunks” that are combined in different ways to make words, our alphabetic way of writing makes no sense.

### **B. Screening to Identify Children at Risk of Reading Failure**

In recent years, a “technology” of early screening has developed that allows teachers, with a very brief assessment, to identify which children in their classes are at risk of failing to develop their early reading skills on time. In the beginning, the assessment covers such early reading skills as letter-name knowledge, phonemic awareness, letter-sound knowledge, and vocabulary. After reading instruction begins in first grade, the best way to identify children who are falling behind in the ability to read words accurately and fluently is to measure that skill directly. Therefore, by the end of first grade, the assessments should also be measuring oral reading fluency.

In second and third grade, the development of word-level reading ability should continue to be monitored using direct assessments to identify children who are falling behind their peers. At this point, group- or individually-administered measures of reading comprehension may prove useful in identifying children who can continue to profit from more intensive work to build vocabulary and reading comprehension strategies.

These screening assessments are administered individually and should not be confused with group-administered standardized tests, to which they bear no likeness. Screening assessments are typically very brief, often just 5-10 minutes per child and, with proper training, can be administered by the teacher, aides, or specialists in reading or special education, with one or more adults screening the children while the teacher or others conduct the class. These screening and progress-monitoring measures are usually administered several times a year, beginning in kindergarten and going through third grade. Because they identify who needs special help, these screens enable teachers and schools to target extra resources to the small group of children that needs the most help. They can also aid teachers in forming small instructional groups of children with similar skill development needs. For a fuller discussion of these assessments, see “Early Screening Is at the Heart of Prevention” on page 14. For an account of how one school made use of such assessments to provide appropriate, effective instruction to its weakest readers, see “Practicing Prevention” on page 20.

### **C. Appropriate—and Extra—Instruction that Matches At-Risk Students’ Needs**

Kindergarten through third-grade classrooms typically include children with widely different preparation and talent for learning to read. For example, Hart and Risley (1995) documented enormous differences in opportunities to acquire oral language vocabulary at home among toddlers from different socioeconomic strata. We also know that there are very significant differences among entering school children in their knowledge about letters, print conventions, and phonological sensitivity

*(Continued on page 12)*

# Waiting Rarely Works: “Late Bloomers” Usually Just Wilt

For thirty years, up until about a decade ago, the idea of “late bloomers” was widely believed among researchers and educators alike. “Late bloomer” was the endearing term for a child who was slower than his peers in learning to read. The idea, so well captured in the term, was that these children would bloom in their reading—they would just do it a bit later than their peers. This common view, known among researchers as the “developmental lag” theory, was the reasonable basis for teachers’ patience with students who didn’t catch on to reading quickly—and it justified the common practice of delaying the diagnosis of reading problems until they were quite severe (Lyon et al., 2001).

But more recently, long after many teachers ended their formal education training, researchers have been able to put the developmental lag theory to rest. It has been replaced by an alternate theory of early reading weakness that defines the problem as a skill deficit. The main difference between the two theories is that the developmental lag theory posited that difficulties in learning to read would fade as the brain matured—early, urgent intervention was not necessary. In contrast, the skill deficit theory claimed that waiting wouldn’t work; children wouldn’t pick up these skills unless they were taught directly and intensively. In fact, waiting would be harmful, as it condemned children to falling further behind.

Three longitudinal studies (Juel, 1988; Francis et al., 1996; Shaywitz et al., 1999) have put the weight of research squarely behind the skill deficit theory and against the developmental lag theory. Each study tracked the reading development of children beginning in first grade.

In the simplest terms, these studies ask: Do struggling readers catch up? The data from the studies are clear: Late bloomers are rare; skill deficits are almost always what prevent children from blooming as readers. This research

may be counter-intuitive to elementary teachers who have seen late-bloomers in their own classes or heard about them from colleagues. But statistically speaking, such students are rare. (Actually, as we’ll see, there is nearly a 90 percent chance that a poor reader in first grade will remain a poor reader.)

The first study (Juel 1988) tracked 54 children at a school in Austin, Texas, from the beginning of first grade through the end of fourth grade using a variety of standardized tests of phonemic awareness, decoding, word recognition, listening comprehension, and reading comprehension. To see if those who are behind in learning to read do or do not catch up, Juel split the students into two groups based on their scores at the end of first grade on the ITBS Reading Comprehension subtest. Those who scored in the bottom quartile (based on national norms) were labeled “poor readers.” Those in the top three quartiles were labeled “average or good readers.”

Over the next three years, the poor readers, on average, never caught up to the average and good readers on any measure of reading ability. Consider, for example, the two groups’ grade-level equivalents on the ITBS Reading Comprehension subtest at the end of first grade and at the end of fourth grade. The poor readers’ mean score increased from K6 (a mid-kindergarten level) to 3.5 (a mid-third grade level). But the average and good readers’ mean score increased from a 2.4 to a 5.9.

Of course, group averages don’t reveal individual results. Were there some late bloomers hidden behind these means? Not many. On the ITBS Reading Comprehension subtest, students who score in the bottom quartile at the end of first grade are, in terms of grade-level equivalents, at least six months behind. So Juel examined the individual results at the end of fourth grade to see how many students were still at least six months behind. Of the 24 students who were poor readers in first grade, 21

of them were still at least six months behind in reading. Similarly, of the 30 students who were average or good readers at the end of first grade, only four had fallen six or more months behind. Juel summarized her findings as follows:

The probability that a child would remain a poor reader at the end of fourth grade, if the child was a poor reader at the end of first grade, was .88; the probability that a child would become a poor reader in fourth grade if he or she had at least average reading skills in first grade was .12. The probability that a child would remain an average reader in fourth grade if the child had average reading ability in first grade was .87; the probability that a child would become an average reader in the fourth grade if he or she was a poor reader in first grade was only .13. The evidence in this sample of children indicates that the poor first-grade reader almost invariably remains a poor reader by the end of fourth grade. (Juel, 1988)

Furthermore, Juel found that the poor readers lacked a critical skill: phonemic awareness. The poor readers entered first grade with little phonemic awareness and they did not approach the ceiling on the phonemic awareness test until the end of third grade. In contrast, average and good readers approached the ceiling on that test two years earlier, at the end of first grade. She concluded that it was trouble with decoding, rooted in poor phonemic awareness, that appeared to keep the poor readers from improving. With this finding, Juel did much to boost the case of researchers who believed that students who are behind in reading actually have a skill deficit—not a developmental lag. (And, as we see in the article by Joseph Torgesen, she gave researchers a great clue as to how to intervene with struggling readers.)

The study that finally put to rest the developmental lag theory among researchers tracked 403 students from 12 communities in Connecticut from grades one to nine (Francis et al., 1996). The primary measure of reading

development was the reading cluster score from the Woodcock-Johnson Psychoeducational Test Battery. This score is comprised of scores from the Battery's Word Identification, Word Attack, and Passage Comprehension subtests. In addition, students' IQs were measured in grades 1, 3, 5, 7, and 9 using the Wechsler Intelligence Scale for Children—Revised (and students with IQ scores below 80 in third grade were excluded from the study). Once they reached third grade, students were designated “low achieving,” “reading disabled-discrepant,” or “not reading impaired,” depending on their scores. The low-achieving group consisted of students whose reading scores were below the 25th percentile. The reading disabled-discrepant group consisted of students whose reading scores were well below (at least 1.5 standard errors below) what their IQ scores predicted. (For example, if a student's predicted score was at the 50th percentile, his actual score would have to be at about the 7th percentile to be placed in the reading disabled-discrepant group.) Students who met the criteria for both of these groups were designated reading disabled-discrepant. The “not reading-impaired” group consisted of the remaining students.

With students broken into these groups, the researchers analyzed the reading scores from grades one to nine looking for evidence of either a developmental lag or a skill deficit. If the developmental lag theory was correct, students who were behind would eventually catch up; if the deficit theory was correct, students would not catch up. But the data clearly demonstrated that, on average, neither the low-achieving nor the reading disabled-discrepant students ever caught up to their peers who were not reading impaired. All students' reading improved quickly in grades one to six, but then the rate of improvement slowed. (This quick, early im-

*The editors thank reading researcher Louisa Moats for her help in preparing this section's sidebars. Moats, the author of AFT publication Teaching Reading Is Rocket Science, is currently the Advisor on Literacy Research and Professional Development for Sopris West Educational Services.*

The probability that a child would remain a poor reader at the end of fourth grade, if the child was a poor reader at the end of first grade, was .88.



provement displayed even by weak readers has probably fueled classroom teachers' optimism that these children would eventually bloom as readers.) Apparently, the normal and behind readers reached two different plateaus.

Researchers also analyzed the scores of individual students to determine whether the average scores could, as they sometimes do, be masking different achievement patterns among individual students. That is, could the average scores be hiding the fact that many low scorers in first grade actually went on to be fine readers, while many high scorers in first grade went on to be poor readers? The researchers determined

that no masking was happening; rather, they determined that the group averages depicted in the figure closely reflected what was happening with the vast majority of the individual students.

But what about those last few years in high school? Did the struggling readers catch up? In the late 1990s, the study of Connecticut youth was extended to grade 12 (Shaywitz et al., 1999). On average, students who were behind in reading in elementary school never caught up to their peers. As in the previous study (Francis et al., 1996), all of the students improved quickly in elementary school, but then improved very little after sixth grade. Throughout elementary and secondary school, the gap between struggling readers and their peers remained quite steady.

It's important to note that in each of these studies, the poor readers' failure to catch up only indicates (1) that there is no evidence for the developmental lag theory, and (2) that the special services these students received were not effective. None of these studies indicates that it is impossible to intervene with these students.

The upshot of the research: The problem is not a developmental lag; it is a skill deficit. And, as Joseph Torgesen explains in the main article, the skill deficit between average and below-average readers can be largely erased with appropriate early intervention.

—EDITORS

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(Whitehurst and Lonigan, 1998). For schools and teachers, one of the biggest challenges is to provide, within the regular classroom, a range of instructional opportunities in reading that matches this huge diversity in children's talent and preparation for learning to read. As noted, this inevitably requires that a great deal of reading instruction be provided in small groups comprised of children working to develop similar skills. For those children at risk of reading failure, the instruction must be more explicit, more intensive, and more supportive than instruction typically is.

**Instruction for at-risk children must be more explicit than for other children.** Children who enter first grade with weaknesses in their knowledge about letters, letter-sound correspondences, and phonological awareness require explicit and systematic instruction to help them acquire the knowledge and strategies necessary for decoding print. As Gaskins, Ehri, Cress, O'Hara, and Donnelly (1997) pointed out, "first-graders who are at risk for failure in learning to read do not discover what teachers leave unsaid about the complexities of word learning. As a result, it is important to teach them procedures for learning words" (p. 325).

Explicit instruction is instruction that does not leave anything to chance and does not make assumptions about skills and knowledge that children will acquire on their own. For example, explicit instruction requires teachers to directly make connections between the letters in print and the sounds in words, and it requires that these relationships be taught in a comprehensive fashion. Evidence for this is found in a recent study of preventive instruction given to a group of highly at-risk children during kindergarten, first grade, and second grade (Torgesen, Wagner, Rashotte, Rose, et al., 1999). Of three interventions that were tested on children with phonological weaknesses, the most phonemically explicit one produced the strongest growth in word-reading ability. In fact, of the three interventions tested, *only* the most explicit intervention produced a reliable increase in the growth of word-reading ability over children who were not provided any special interventions. Other studies (Brown and Felton, 1990; Hatcher, Hulme, and Ellis, 1994; Iversen and Tunmer, 1993) combine with this one to suggest that schools must be prepared to provide very explicit and systematic instruction in beginning word-reading skills to some of their students if they expect virtually all children to acquire word-reading skills at grade level by third grade.

Further, explicit instruction also requires that the meanings of words be directly taught and be explicitly practiced so that they are accessible when children are reading text (Beck, McKeown, and Kucan, 2002). Finally, it requires not only direct practice to build fluency (Mercer, Campbell, Miller, Mercer, and Lane, 2000), but also careful, sequential instruction and practice in the use of comprehension strategies to help construct meaning (Mastropieri and Scruggs, 1997).

Intervention researchers currently have a good understanding of the kinds of knowledge and skills that must be taught and they know that such instruction must be explicit and systematic. However, the exact mix of instructional activities that is most effective almost certainly varies depending on the individual needs of each struggling reader. Furthermore, the range of instructional methods that can be used to effectively teach spe-

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If at-risk children do not receive more teaching/learning opportunities per day than other children, it is highly likely that they will be pulled into the downward spiral.



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cific skills to struggling readers may also be quite broad. For example, in one remedial study (Torgesen, Alexander et al., 2001), my colleagues and I found that two methods that both taught phonics explicitly, but that used quite different methods and distributed instructional activities quite differently, produced essentially the same long-term outcomes on reading growth for a sample of children with severe reading disabilities. Richard Olson and his colleagues at the University of Colorado (Olson, Wise, Johnson, and Ring, 1997; Wise, Ring, and Olson, 1999) also demonstrated that a variety of explicit instructional methods are equally effective in accelerating reading growth for children with reading disabilities in second through fifth grades.

**Instruction for at-risk children must be more intensive than for other children.** If at-risk children do not receive more teaching/learning opportunities per day than other children, it is highly likely that their reading skills will develop too slowly and thus they will be pulled into the downward spiral outlined in the beginning of this article. Some children are at risk because they learn more slowly than other children; they will thus require more repetition in order to solidly establish critical word-reading and comprehension skills. Other children are at risk because of a lack of instructional opportunities before they started school. Such children may learn at

average rates, but they have much more to learn than children who come to school with typical levels of preparation (Hart and Risley, 1995) and thus must be given more learning opportunities in order to catch up to their peers.

There are essentially two ways to increase intensity of reading instruction in elementary school: either instructional time can be increased or instruction can be provided individually or in small groups. While increasing whole-class instructional time in reading helps many children with mild risk status, the most practical method for increasing instructional intensity for smaller numbers of highly at-risk students is to provide small-group instruction. There can be no question that children with reading difficulties, or children at risk for these difficulties, will learn more rapidly under conditions of greater instructional intensity than they learn in typical classroom settings. Meta-analyses consistently show positive effects of reducing instructional group size (Elbaum, Vaughn, Hughes, and Moody, 1999). Further, the intensive small group work must be frequent; in the studies my colleagues and I have reviewed, success has been produced when groups met 20 to 45 minutes per day, 4 to 5 days per week.

There are a number of practical and feasible ways to provide small group instruction to at-risk students during the school day. The most common way is for the classroom teacher to devote part of the daily reading period to work with small groups of children with similar instructional needs. While the teacher is providing intensive and focused instruction to one group of four or five children, the other children are working independently on academically engaging literacy activities. The biggest challenge for teachers in this arrangement is the development of productive activities for independent practice and management of student behavior during independent center activities. Another option is to use special education or reading resource teachers to provide intervention instruction during the small group time of the reading period. The regular classroom teacher might work with one group, the resource teacher another, while two more groups were engaged in independent literacy activities. Well-trained and supervised paraprofessionals may also be used effectively to help guide small group instructional and practice sessions (Grek, Mathes, and Torgesen, 2003).

Peer tutoring is another effective strategy for increasing instructional intensity. For example, Doug and Lynn Fuchs and others (1997) reported success in using peer assisted learning strategies to improve reading skills in mid-elementary school, and Mathes and colleagues (Mathes, Torgesen, and Allor, 2001) have reported similar success with students in early elementary school.

**Instruction for at-risk children must be more supportive than for other children.** The needs of at-risk children for more positive emotional support in the form of encouragement, feedback, and positive reinforcement are widely understood. However, their potential need for more cognitive support, in the form of carefully "scaffolded" instruction, is less widely appreciated. Instruction for at-risk children should involve two types of scaffolding. One type of scaffolding involves careful sequencing so that skills build very gradually: The child is always systematically taught and given opportunities to practice the skills required for any task he/she

is asked to do (Swanson, 1999). This type of scaffolding is typically provided in well-designed, systematic instructional programs for students with learning disabilities. Another type of scaffolding involves teacher-student dialogue that directly shows the child what kind of processing or thinking needs to be done in order to complete the task successfully. This type of scaffolding in instruction usually involves four elements: (1) the student is presented with a task such as reading or spelling a word (i.e., tries to spell the word "flat"); (2) the student makes a response that is incorrect in some way, or indicates that he/she doesn't know how to proceed (i.e., spells it "fat"); (3) the teacher asks a question that focuses the child's attention on a first step in the solution process, or that draws attention to a required piece of information ("If you read that word, what does it say?" Child responds, "fat." "So, what do you need to add to make it say flat?" No answer. "When you say *flat*, what do you hear coming right after the beginning sound /f/?"); and (4) another response from the child ("I hear the /ll/ sound."). This kind of interaction between teacher and child continues until the child had been led to successfully accomplish the task. The point of this type of instructional interaction is that the child is led to discover the information or strategies that are critical to accomplishing the task, rather than simply being told what to do. As Juel (1996) showed, the ability to offer scaffolded support while children are acquiring reading skills may have increasing importance as the severity of the child's disability increases.

I have described three broad ways in which instruction for children who are at risk for reading failure needs to be different from the instruction that is typically provided to all children in the classroom. Ensuring that all three of these elements are part of the instruction for our most at-risk children represents an enormous challenge for our schools. The requirement for more explicit and supportive instruction demands a higher level of training and skill for teachers than is usually provided at present (Moats, 1994). The requirement for more intensive instruction for at-risk children must involve a reallocation of resources to make more teacher time available for preventive instruction and, in many cases, will probably require entirely new resources to adequately meet the instructional needs of all children who are at risk for reading failure.

## II. How Effective Is Early Intervention in Preventing Early Reading Failure?

The obvious questions are: Will all these changes, as sketched above, be worth it? Is instruction that makes use of the ideas above actually effective in preventing reading difficulties in most children?

In order to answer questions about effectiveness, we must first decide what outcome measure should be used to measure success, and what level of performance constitutes success for a preventive intervention. As a nation, we have (through many state laws and the No Child Left Behind Act) identified the end of third grade as the point at which all students should be reading adequately. Although we do not have a universal performance standard in place at this point, states

*(Continued on page 17)*

# Early Screening Is at the Heart of Prevention

Early intervention works. Because it is also expensive, it's important to be able to identify the kids who are most at risk of reading failure. Thanks to a new generation of screening assessments, we can identify these students as early as kindergarten—and then invest in inter-

ventions for them. The new assessments are brief, trustworthy, and easy to administer. They can be administered to all kindergartners through third-graders a few times a year, allowing teachers to identify which students need extra help. They take only five to ten minutes per child to ad-

minister and can typically be given by classroom, reading, or special education teachers or aides. Once identified, these students can receive the assistance they need, and the downward spiral that results from weak early reading skills can be averted.

## Selecting Assessments for Your School

Today, schools actually have more than two dozen individually administered early screening assessments to choose from that are appropriate for kindergarten through third grade. These assessments cover a variety of reading skills—phonemic awareness, phonics, fluency, vocabulary, and reading comprehension—as well as a variety of assessment purposes: screening, diagnosis, and progress monitoring. (There are also outcomes assessments that educators should be aware of if they plan to conduct studies of the effectiveness of their reading programs.) As an introduction to the kind of information that teachers can glean from early reading assessments, examples from TPRI and Dynamic Indicators of Basic Early Literacy Skills (DIBELS) are included here. The figure (immediate right) shows some items from the TPRI Screening Section for children at the beginning of the first grade. The figure on page 15 shows how a kindergarten student's progress is monitored using DIBELS.

Fortunately, a team of researchers has reviewed the current crop of assessments, identified which have sufficient reliability and validity, and developed a Web site for educators that clearly indicates which assessments are appropriate for differing grades, skills, and purposes (available at <http://idea.uoregon.edu/assessment/>).

Most currently available assessments identify children using national norms. So, for example, schools can decide to intervene with all children who score in the bottom 10 to 20 percent nationally. Of course, just how many students this will be varies greatly by school. A few assessments have established benchmarks, or cut scores, that represent evidence-based thresholds indicating the likelihood of reading success (or failure), and recommend that schools intervene with all students who fall below the benchmark.

A key issue that has arisen during the instrument-development research is creating accurate instruments that are not too long. Assessment developers have been grappling with the fact that longer assessments provide more detailed data, but shorter assessments are more practical for the

classroom. This led to differentiating between screening and diagnostic assessments. Typically, screening instruments tend to be short, taking as little as five to 10 minutes per child, and they identify which students are at risk or behind, as well as some information on which skills the

Screening 2 Word reading		Screening 3 Blending phonemes	
1.	become	[Remember, pronounce letter sounds, not letter names, and say the word silently to yourself first.]	
2.	school	1.	/m/ /a/ /ss/
3.	queen	2.	/b/ /oo/ /m/
4.	great	3.	/w/ /a/ /s/ /p/
5.	summer	4.	/s/ /t/ /r/ /ee/ /t/
6.	honey	5.	/ph/ /o/ /ne/
7.	push	6.	/b/ /l/ /u/ /n/ /t/
8.	asked		
Screening 1	Graphophonemic Knowledge Letter sound	8 or higher: Go to Screening 2 7 or lower: Still Developing	
Screening 2	Word Reading	3 or higher: Developed 2 or lower: Still Developing	
Screening 3	Phonemic Awareness Blending phonemes	5 or higher: Developed 4 or lower: Still Developing	
Overall Screening		8 or higher on Screening 1 AND 3 or higher on Screening 2 OR 5 or higher on Screening 3: Developed 7 or lower on Screening 1 AND 2 or lower on Screening 2 OR 4 or lower on Screening 3: Still Developing	

*Shown above are assessments and benchmarks from the Screening Section of the TPRI, the first early reading assessment to be used throughout a state. These two Screenings are used at the beginning of first grade along with a 10-item screening of children's knowledge of letter names and sounds. As you can see, the TPRI provides empirically derived criteria to indicate if students have developed adequate knowledge and skills. When students do not meet those criteria, the teacher moves directly into more in-depth assessments from the Inventory Section of the TPRI. Therefore, the amount of assessment is individualized: Students who are "developed" on the Screenings will be done in just five minutes; students lacking skills will continue through the Inventory assessments until the skills that need to be developed are identified—a process that can take an experienced teacher anywhere from 10 to 25 minutes. (For more information on the TPRI, see [www.tpri.org](http://www.tpri.org).)*



## How Do They Work?

The key to our new ability to predict which children are likely to have problems in learning to read is the research finding that almost all struggling readers have problems with phonemic awareness—identifying and being able

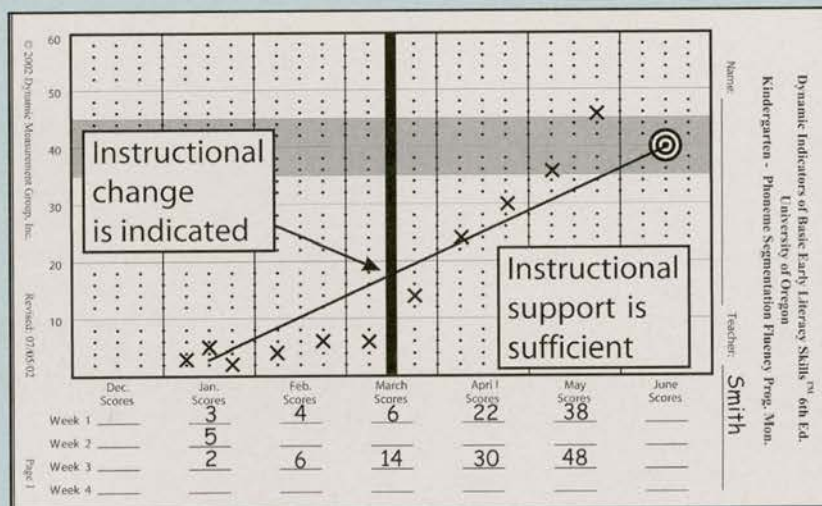
to manipulate the sounds in words (Torgesen, 1998). Not surprisingly, given their troubles with the phonological features of language, these children also have difficulty grasping the alphabetic principle and are slow to build up a “sight vocabulary,” meaning words

that they can read automatically without sounding them out. Building on these highly consistent findings, researchers have found that by midway through kindergarten (assuming pre-reading skills are being taught), knowledge of letter names predicts future

students are lacking. Diagnostic instruments—used only for the smaller group of students deemed at risk in the screening—tend to be longer, taking roughly 20 to 45 minutes per child, and they offer a much more thorough look at students’ strengths and weaknesses. (These time estimates are for teachers who are experienced in using these assessments. More time will be needed while teachers become accustomed to using those tools.) Sometimes assess-

ments have both screening and diagnostic components. For example, the TPRI has “Screening” and “Inventory” sections. When children don’t meet criteria in the Screening Section, the teacher can immediately switch to a more in-depth assessment from the Inventory Section to pinpoint the knowledge and skills that the child still needs to develop. Teachers can also use Inventory data to match instruction with specific student needs.

A third type of assessment is for progress monitoring. These instruments typically come in short, multiple forms so that students’ skills can be assessed every two weeks (or even more frequently) to quickly determine if an intervention is sufficiently effective. If not, the intervention can be altered (by changing the instructional content, methods, and/or intensity), the child may be given a diagnostic assessment, or the child may be referred for special education. For example, DIBELS is a widely used screening and progress-monitoring assessment. DIBELS measures take just a few minutes each and usually come in 20 alternate forms for frequent checkups. The figure (left) shows how a kindergarten student’s progress is



monitored using DIBELS.

While screening instruments are used with all students, diagnostic instruments are only necessary for students whose screenings reveal serious skill deficits and/or whose progress monitoring indicates that they are not responding to the intervention. Ideally, all K-3 students should be screened three times per year starting in mid-kindergarten; diagnostic and progress monitoring assessments can be done as needed, with progress monitoring of children in an intervention being quite frequent to make sure that interventions are as effective as possible.

Source for the DIBELS figure: Good, R.H., Gruba, J., and Kaminski, R.A. (2002). Using Dynamic Indicators of Basic Early Literacy Skills (DIBELS) in an Outcomes-Driven Model. In A. Thomas and J. Grimes (Eds.), *Best Practices in School Psychology IV* (pp. 679-700). Washington, D.C.: National Association of School Psychologists.

*This chart shows one kindergarten student’s improvement based on a progress monitoring assessment from January to June. Using alternate forms of the DIBELS measure of Phoneme Segmentation Fluency (PSF), the teacher screened this child three times in January to be sure that he really needed an intervention. As noted by the horizontal line in the chart, all students should score at or above 40 on PSF by the end of kindergarten. Drawing a line from the student’s initial scores to that benchmark creates clear goals for the rest of the year and allows the teacher to judge the success of his intervention. Initially, the intervention was not sufficient. The teacher made his intervention more intense by providing additional modeling, examples, and practice—and the student reached the PSF benchmark by the end of May. (To learn more about DIBELS, visit <http://dibels.uoregon.edu/> and [www.dibelsassessment.com](http://www.dibelsassessment.com).)*

reading ability. And by first grade, letter-sound knowledge is highly predictive. (For more on this topic, see "Catch Them Before They Fall: Identification and Assessment To Prevent Reading Failure in Young Children" from the Spring/Summer 1998 issue of *American Educator*; it is available online at [www.aft.org/pubs-reports/american\\_educator/spring\\_sum98/torgesen.pdf](http://www.aft.org/pubs-reports/american_educator/spring_sum98/torgesen.pdf).)

## How Accurate Are They?

Just how accurate are these early assessments? Accuracy varies by instrument. Rather than reviewing several assessments, let's look at the average predictive power of assessing kindergartners' letter identification skills (Snow et al., 1998). A meta-analysis of 20 studies that measured 11 different possible predictors of reading difficulties (including receptive vocabulary, expressive language, concepts of print, and verbal memory of stories or sentences) found that letter identification was the strongest single indicator of future reading. The mean correlation between letter identification in kindergarten and reading scores in grades one through three was .52. In fact, letter identification was almost as good a predictor by itself as an entire reading-readiness test (which includes a whole host of reading skills). But what does a moderately strong correlation like this mean when it comes to designating children at risk or not? Another study (Snow et al., 1998) used 1,000 kindergartners' letter identification skills to find out. The researchers considered their predictions accurate if the children who were designated at risk in kindergarten were then in the bottom 20 percent on teachers' ratings in first grade.

To begin with, the researchers tested a strict letter-identification cutoff; they designated students at risk only if they fell in the bottom 10 percent. According to the first-grade teachers' ratings, this strict cutoff correctly identified 83.2 percent of children. Since there were 1,000 children in the study and the bottom 10 percent were designated at risk, 100 children were so designated. Of these, 63 were correctly identified (meaning they were in the bottom 20 percent according to teachers' ratings in first grade), but 37 were false alarms (meaning they were not in the bottom 20 percent). Of the

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To minimize under-identification, schools are encouraged to screen all children—three times per year—starting with mid-K. To minimize over-identification, assessments often come with multiple forms so that teachers can confirm the results.

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900 children designated not at risk, 769 were correctly identified, but 131 were misidentified (meaning they were in the bottom 20 percent in first grade).

Believing that too many children who did end up having reading difficulties were missed with the strict cutoff, the researchers also examined a more lenient letter-identification cutoff. In this second analysis, they designated the bottom 25 percent of kindergartners at risk. Of these 250 children, 118 were correctly identified, but 132 were false alarms. Of the 750 children designated not at risk, 677 were correctly identified, but 73 were not. Overall, the more lenient cutoff meant that the overall accuracy of the prediction was reduced slightly (79.5 percent of children were correctly identified)—but the percentage of struggling readers who were missed dropped from 15 to 11.

Obviously, educators have to make a conscious choice when they decide what percentage of children to intervene with. Intervening with the bottom 10 percent means that many at-risk children will not be appropriately

served. And intervening with the bottom 25 percent means that many not-at-risk children will be served.

No assessment can completely overcome these potential errors in identifying at-risk children. Even with the best assessment, some children who will have reading problems are not identified and some who will not are. But there are strategies to greatly reduce the errors in identification. To minimize under-identification, schools are encouraged to screen all children—three times per year—starting with mid-K. (Assessments at the very beginning of kindergarten tend to be unreliable because students may lack skills simply because they haven't been taught, not because they will have trouble with the concepts once they have been presented in the regular classroom setting.) To minimize over-identification, assessments often come with multiple forms so that teachers can confirm the results (and be sure that the child was not just having a bad day) before the intervention begins. Given the importance of addressing skill deficits, over-identification of children may be the best policy. For not-at-risk students, the intervention will simply reinforce their skills, acting like an "insurance policy" against future problems with reading. And, with adequate progress monitoring, such students will test out of the intervention quickly.

Fortunately, predictions of which students are at risk for reading failure become even more accurate by the end of first grade. This is what one would expect given that, starting at the end of first grade, students' word-reading ability can be assessed directly instead of indirectly through such pre-reading skills as letter naming and phoneme segmentation. While it is clearly true that early word reading ability is a strong predictor of later word reading ability, very brief measures of oral reading fluency are also a strong predictor, and thus a good screening measure, for difficulties in reading comprehension. In fact, Fuchs, Fuchs, Hosp, and Jenkins (2001) reported evidence that a very brief measure of oral reading fluency was a better predictor of performance on a reading comprehension outcome measure than was a brief measure of reading comprehension itself. In this

*(Continued on page 48)*

## Avoiding the Downward Spiral

(Continued from page 13)

have typically adopted group administered measures of reading comprehension as the most efficient and thorough way to assess whether students have met their standards for reading proficiency.

The use of reading comprehension measures to assess third-grade standards is appropriate, since the ultimate goal of all reading instruction is to ensure that students have the knowledge and skills they need to gain meaning from text. However, most studies that have focused on the prevention of early reading difficulties do not report scores for their participants on third-grade reading comprehension measures. More typically, they report student growth in early word-level reading skills and, as noted earlier, those skills are a necessary, though not sufficient, ingredient for strong comprehension. Thus, in this discussion of effectiveness, I have also adopted word-reading ability as the primary outcome measure. As a reasonable goal for early intervention, I have adopted as the performance standard that children should not fall below the 30th percentile (which is the low end of the average range) on critical word-reading skills at any time during their early elementary years. While this cannot be considered the ultimate standard for the effectiveness of early preventive instruction (which should involve proficient performance on a reliable and valid measure of reading comprehension at the end of third grade), it is one that can be examined in current research. Further, it does represent one important goal of early intervention, which is to establish a firm foundation for future reading growth through mastery of the alphabetic principle and attainment of high levels of accuracy in reading text. I also recognize, as noted earlier, that any standard involving a percentile score is unstable in an environment in which reading scores are generally improving. The data provided in Table 1 are only meant to show what can be accomplished relative to current norms for reading achievement. If reading achievement in this country gradually improves, then achievement at the 30th percentile would obviously mean something different, in terms of absolute level of performance, than it does at this time.

Table 1 provides data from six early intervention studies in which it was possible to identify the percentage of children who obtained scores above or below the 30th percentile on measures of word-reading ability at the end of the intervention. The children who received the preventive instruction were selected because they were at risk for reading failure on the basis of either weak phonological processing skills or weak development of early word-reading ability. In most of the studies, the children had to have IQ scores of 75 or above to be included, though in some cases there was no IQ cut-off, and in one case, the cut-off was 85. The preventive instruction was provided at some point during kindergarten, first grade, or second grade. The number of hours of special instruction varied between 340 hours of first- and second-grade instruction delivered to groups of eight (Brown and Felton, 1990), and 35-65 hours of one-on-one instruction delivered in the second semester of first grade and the first semester of second grade (Vellutino et al., 1996).\* These studies all con-

tained at least one instructional condition that offered skilled delivery of explicit and systematic instruction in phonemic awareness, phonemic decoding, and fluent text reading.

As Table 1 shows, while the exact effects of the interventions varied, they all were successful in bringing most students (56 percent to 92 percent) to well within the average range of reading ability. Nonetheless, from eight percent to 44 percent of the children in these studies still had word-reading skills below the 30th percentile, even after the intervention. In reflecting on these numbers, keep in mind that the children in these studies represented the 12 percent to 18 percent of children most at risk for reading failure—they were not a random sample of all children.

So what if the instructional approaches used in these six studies were implemented across the country? How many students would still be struggling with reading? To use each study's failure rate to estimate a failure rate for the whole population, we can multiply the percentage of students who failed to reach the 30th percentile by the percentage of at-risk students they represent. Taking the first study in Table 1 (Foorman et al., 1998) as an example, the students who received the intervention came from the 18 percent most at risk for reading failure. At the conclusion of the intervention, 35 percent of this bottom 18 percent remained weak readers. Multiplying .18 by .35 yields a population failure rate of six percent. In Table 1, these population failure estimates are reported in the column on the far right.

Although there are a number of important caveats to the estimation of population failure rates reported in Table 1 (Torgesen, 2000), one point is well established. Intervention research

**Table 1: How Many Children Remain Below Average Readers After Intervention?**

Study	Amount of instruction (hours)	Teacher-student ratio	Sample failure rate	Population failure rate
Foorman et al., 1998	174	Whole class divided into small groups	35%	6%
Brown & Felton, 1990	340	1:8	29%	5%
Vellutino et al., 1996	35-65	1:1	44%	6%
Torgesen et al., 1999	88	1:1	34%	4%
Torgesen, Rashotte, Wagner, et al., 2003	80	1:3	11%	2%
Torgesen, Rashotte, Mathes, et al., 2003	91	1:3 or 1:5	8%	1.6%
Using six early intervention studies with good instructional practices, this chart shows the percentage of intervention students who fail to reach the 30th percentile in word-reading ability and estimates the percentage of all students who would fail to reach the 30th percentile if the early intervention was universally provided to weak readers. Source: Torgesen, 2004.				

\* In Table 1 (above) and Table 2 (p. 19), information on the amount of instruction and teacher-student ratio is provided as a glimpse of each intervention, not as an indication of which type of intervention might be most effective. Comparing the effectiveness of the various interventions would require a meta-analysis of a much larger set of studies.

has not yet discovered the conditions that need to be in place to enable every child to acquire adequate word-level reading skills in early elementary school. However, research has clearly shown how to sharply reduce the number of children who leave first and second grades with weak skills. Most of the estimates reported in Table 1 suggest that between four and six percent of those children with general learning ability in the broadly normal range (above an IQ of 75) would still have weak word reading skills even if they were exposed to the effective interventions reported here.

As a counterpoint to this estimate of population failure rates, Scanlon, Vellutino, Small, and Fanuele (2000) recently reported a study in which the failure rate was essentially zero in the most effective condition. This condition involved a combination of small group intervention in kindergarten and one-on-one instruction in first grade, and it suggests that it may be possible to improve on past results with multilayered

interventions in the early grades.

On the other hand, my colleagues and I have some data from one study reported in Table 1 (Torgesen, Rashotte, Mathes, et al., 2003) that these estimates of 94-98 percent success may be a bit optimistic in projecting the percentage of children who would reach grade level on a group-administered reading comprehension test at the end of third grade. In this study, we provided intensive instruction to the 20 percent of first-grade children most at risk for reading failure from five suburban schools in which effective classroom instruction was also provided to all children. Children received systematic and highly explicit supplemental instruction in groups of three or five for 45 minutes a day from October through May. Whereas all children in the intervention groups began the intervention with scores on a word-reading accuracy measure below the 25th percentile, only 8 percent had scores below the 30th percentile on the same measure at

## Best Bets: Core Reading Programs and Interventions

A strong, core reading curriculum is essential for all students. As explained in the main article, all students benefit from direct instruction in key areas such as the alphabetic principle, phonemic awareness and decoding, vocabulary and general knowledge development, reading comprehension, word-recognition fluency, spelling, and writing. Tying all these together into a coherent curriculum that carefully builds students' knowledge and skills during elementary school is complex. Fortunately, teachers do not have to build a core reading curriculum from scratch. Several of the commercially available programs cover most of the key areas that are necessary in order to effectively teach most children to read. Because they must cover such a broad range of knowledge and skills, selecting the program that is right for your school is complicated. One useful tool for examining programs' strengths and weaknesses is *A Consumer's Guide to Evaluating a Core Reading Program, Grades K-3: A Critical Elements Analysis* (see [http://reading.uoregon.edu/curricula/con\\_guide.php](http://reading.uoregon.edu/curricula/con_guide.php)). For a review of nine core reading programs based on the Guide's criteria, visit the Oregon Reading First Center's Web site at [http://reading.uoregon.edu/curricula/or\\_rfc\\_review\\_2.php](http://reading.uoregon.edu/curricula/or_rfc_review_2.php).

Unfortunately, at least as of two years ago, most widely used basal read-

ing programs were weak in promoting the background knowledge that children need to advance beyond a basic reading level. For more on this, see Kate Walsh's review of basal readers in the Spring 2003 *American Educator* at [www.aft.org/pubs-reports/american\\_educator/spring2003/Basal\\_readers.pdf](http://www.aft.org/pubs-reports/american_educator/spring2003/Basal_readers.pdf). To fill this major gap, we recommend Core Knowledge ([www.coreknowledge.org](http://www.coreknowledge.org)), a program that systematically builds students' background knowledge from preschool to eighth grade with a curriculum sequence, classroom materials, and professional development.

Intervention instruction is different from the core reading program in that it needs to be tailored to address individual students' skill deficits. Using the students' screening and/or diagnostic assessment scores as a guide, teachers identify which skills need to be re-taught and then calibrate the explicitness, intensity, and supportiveness of the intervention to match the deficits. Whether it takes just a few weeks or the whole school year, students must reach the average range in all reading skills. With the results of a screening assessment in hand, it may be tempting to develop an intervention that teaches narrowly to the assessment items on which the student did not do well. But, such narrow teaching would corrupt the accuracy

of the subsequent progress-monitoring assessment. Students with skill deficits need consistent, systematic instruction and practice that go well beyond what can be done by teaching to the test.

With all of the tailoring that has to happen, it isn't always possible to select one early intervention program and use it—start to finish—with all struggling students. But instead of developing intervention lessons from scratch, teachers can use a complete intervention program for students with severe skill deficits and selected lessons from that program for students with just a few, smaller gaps in their reading skills. To address the full range of skill deficits that students have, teachers may prefer to keep a few intervention programs on hand, each dealing with a different set of skills. Reviews of early intervention programs are available online from the Florida Center for Reading Research ([www.fcrr.org/pmrn/tier3/tier3interventions.htm](http://www.fcrr.org/pmrn/tier3/tier3interventions.htm)) and the Oregon Reading First Center (<http://oregonreadingfirst.uoregon.edu/SIreport.php#newprograms>).

The What Works Clearinghouse is currently investigating K-3 interventions to determine which are the most effective for different types of students and skill deficits. More information is available at [www.w-w-c.org/comingsoon/reading.html](http://www.w-w-c.org/comingsoon/reading.html).

—EDITORS

the end of first grade. Using the same technique as before, we can estimate the population failure rate for word-level reading skills in this study at 1.6 percent (.2 x .08).

These same children were then followed through to the end of second grade (with no further intervention from us), and our estimation of the population failure rate for the word-reading measure was the same for second grade as for first grade (Torgesen,

Rashotte, Mathes, et al., 2003). However, when the outcome measure was a group-administered measure of silent reading comprehension at the end of second grade, the population failure rate (the estimated percentage of the total population remaining below the 30th percentile) was 4.1 percent rather than 1.6 percent. I project that this failure rate will be even higher for a comprehensive measure of reading comprehension at the end of third grade for the simple reason that as reading material becomes more complex (with increasing vocabulary demands and more difficult concepts), the role of broad verbal ability and knowledge in accounting for reading comprehension difficulties becomes larger (Adams, 1990; Hirsch, 2003).\*

**How effective is intervention with older students? It works—but not as well or as efficiently as when we intervene with younger students.** I've also reviewed the results of interventions conducted with older children (ages 9-12) who were provided 50-100 hours of relatively intense (one-to-one or small group), phonemically explicit, systematic instruction. In some ways the results are promising: These older students made substantial progress in the essential skills of phonemic decoding, reading accuracy, and reading comprehension. But only students with very mild reading problems made any real progress in fluency. Table 2 shows the results of intensive, remedial interventions conducted with five samples of nine- to 12-year-olds who had mild,

\* Forty-six percent of the children in our intervention sample had estimated verbal intelligence below the 30th percentile. Thus, although our intervention students were doing better on a measure of reading comprehension in second grade than would be predicted by an estimate of their broad verbal ability, we would expect verbal ability to play an increasingly important role as reading material becomes more complex. Although research has shown how to prevent word-level reading difficulties for almost all children, specific methods for substantially and permanently increasing relative verbal ability (i.e., verbal intelligence) once children enter elementary school remain to be discovered (Lee, Brooks-Gunn, Schnur, and Liaw, 1990).

**Table 2: How Effective Are Interventions With Older Students?**

Sample	Amount of instruction (Hours)	Instructional type (teacher-student ratio)	Post-intervention percentile scores				
			Phonemic decoding	Text reading accuracy	Reading comprehension	Reading fluency	
Mild impairment (roughly normal intelligence, word reading accuracy around 30th percentile, fluency around 2nd percentile)	60	small group	82	80	70	48	
Moderate impairment (intelligence around 30th percentile, word reading accuracy around 10th percentile, fluency below 1st percentile)	Group 1	50	small group	55	25	35	7
	Group 2	100	small group	77	39	39	8
Severe impairment (intelligence around 30th percentile, word reading accuracy around 2nd percentile)	Group 1	67.5	1:1 and 1:2	39	23	27	5
	Group 2 (which appeared to have even more severe impairments than group 1)	133	1:1 and 1:2	39	16	19	5

Results of intensive remedial interventions with five samples of children aged nine to 12. Source: Torgesen, 2004.

moderate, or severe reading impairments. Even an intervention that made use of the most effective strategy known to increase fluency (repeated reading of words, phrases, and passages) had very little impact on the relative reading fluency of students with severe impairments (Torgesen, Rashotte, Alexander, Alexander, and MacPhee, 2003). It is important to understand that all of these older students in the studies in Table 2 increased in reading fluency in *absolute* terms (they were able to read passages of equivalent difficulty more fluently after the intervention than prior to the intervention). However, for students with moderate to severe problems with word-level fluency, their increased fluency on low-level passages did not produce a significant "closing of the gap" in fluency compared to peers who were reading at average levels for their age.

These studies reflect one of the consistent findings in our research on interventions with late elementary children: If children's impairments in word-reading ability have reached moderate or severe levels, our current interventions cannot typically bring their reading fluency rates to the average range. Although the gap in reading accuracy and comprehension can be substantially or completely closed by current interventions even with these older children, the gap in fluency has remained much less tractable to intervention for moderately and seriously impaired older children. (Fortunately, preventive studies with younger children have not found such problems with later fluency.)

My colleagues and I have proposed elsewhere (Torgesen, Rashotte et al., 2001) several possible explanations for this troubling fact. The most important factor appears to be the difficulty in making up for the huge deficits in reading practice the older children have accumulated by the time they reach late elementary school. These differences in reading practice emerge during the earliest stages of reading instruction (Allington, 1984; Beimiller, 1977-1978) and they become more pronounced as the children advance across the grades in elementary school. For example, in a previous issue of *American Educator*, Cunningham and Stanovich (1998) re-

(Continued on page 45)

# Practicing Prevention

## *How One School District Helps Students Avoid Reading Failure*

By Catherine Paglin

Brandon is a busy and capable kindergartner. One morning before Christmas, he kept right up with his classmates at Clear Lake Elementary as he counted the 67 days of school he's attended so far, recited a poem about the five little Santas, and made a construction-paper wreath. When his work was done, he settled on the floor to play with trucks and blocks.

Brandon also knows quite a few letter sounds. "That one says /b/ and that one says /a/," he tells a visitor, pointing at the large letter cards hanging over the blackboard. As he speaks, he gets up from the rug. "I have to stand up to do it," he explains. Demonstrating his expertise in the alphabetic principle, it seems, takes Brandon's full concentration. "That one's /r/ and that one says /ff/," he continues. "And that one is /p/. And /s/," he announces proudly with a prolonged, snakelike hiss.

Brandon is on target to become a reader. But if he'd been in school seven years ago, he might well have been on track for special education instead. That's because he started kindergarten showing clear signs of reading difficulties. An assessment found that he was having trouble with such tasks as identifying letters and recognizing or reproducing the initial sounds in spoken words. Most telling, he was making little or no progress after a few weeks in school. The school's old approach wasn't geared to dealing with reading problems quickly and systematically. A learning disability label and a referral to special education might have been the outcome for this bright boy.

But luckily for Brandon, an innovative approach adopted by the Bethel School District in Eugene, Ore., several years ago rapidly intervened with strategies tailored to his needs. The results district-wide have been stunning. Today, only two percent of kids leave first grade as nonreaders\*—phenomenal for any district, and especially so given the low so-

cioeconomic status and high mobility rates of Bethel students.

Before the initiative, the numbers were discouraging. In those days, 15 percent of kids left first grade unable to read. Second-grade special education referral rates were soaring—hitting 17 percent at one school in 1996-97. Worried, the district began analyzing its approach to reading. Recalls Carl Cole, special services director, "We were concerned about the high number of kids identified as learning disabled, and when you're talking about kids who are learning disabled, you're almost exclusively talking about kids with reading disabilities."

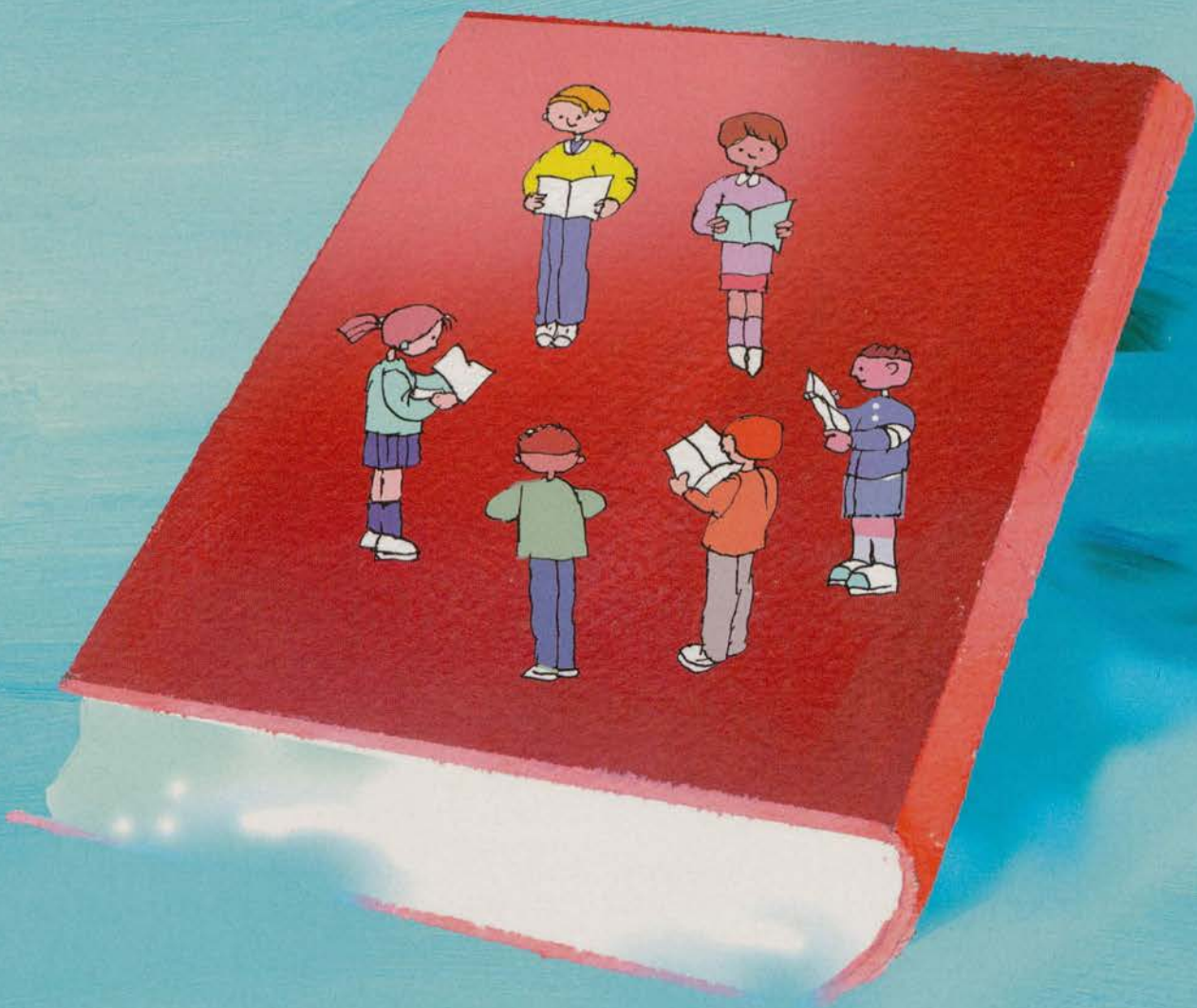
Looking into the matter, the district found that the problem was not with the assessments and identifications of the referred students. They were accurate. But assessments of kids were not tied to what was happening in the classroom instructionally. Sometimes the evaluation team referred kids to special education to make sure students would get instruction of a kind not available in the regular classroom. "When it was discovered that kids were discrepant readers, we didn't use that information to say, 'What are we doing instructionally that's causing this?'" Cole recalls.

What they were doing instructionally was, as in many districts across the country, "a recipe for disaster," says Cole, particularly for a student population in this low-income community where transient hotels and homeless shelters are plentiful. Because the district had a site-based approach—allowing each school to choose its own reading program—there was no consistency from school-to-school, grade-to-grade, room-to-room. Different textbooks were in use across schools, within schools, and even within grade levels at the same school.

Also, the district's half-day kindergarten was mainly a social-readiness program, not an instructional program. Had Brandon entered a Bethel kindergarten back in the old days, he would not have been tested and monitored regularly on indicators of progress toward reading. His exposure to letters

\* At the end of first grade, Bethel's nonreaders are defined as those students who can read less than 15 words per minute on the DIBELS measure of Oral Reading Fluency. According to the DIBELS Administration and Scoring Guide, students should attain a score of at least 40 words per minute at the end of first grade; those who obtain a score of 20 or below are considered at risk for reading difficulties and those who score below 10 are in need of intensive instructional support.

*Catherine Paglin is a freelance journalist who frequently writes for the Northwest Regional Educational Laboratory (NWREL). This article is updated and reprinted with permission from "Double Dose: Bethel School District's intensive reading program adds beefed-up instruction for at-risk readers from Day One" in NWREL's Northwest Education Magazine, Vol. 8, No. 3.*



and letter sounds would have been incidental, not direct. If he didn't seem to be catching on—if, for instance, he had nothing to contribute when his teacher asked the class to brainstorm for words that start with a *b*—his teacher would have concluded that he was just “not ready for reading.”

District administrators became convinced that most kids identified as learning disabled are actually “instructionally disabled,” meaning they hadn't received the instruction appropriate for their needs. So they set out to build a reading program that would be effective for all students. They joined forces with University of Oregon's Institute for Development of Educational Achievement, directed by nationally known reading researchers Drs. Edward Kame'enui and Deborah Simmons. A four-year, \$700,000 grant from the U.S. Office of Special Education Programs was committed to the development, implementation, and evaluation of Bethel's reading initiative.

“The amount of support we had was phenomenal,” says Cole. Besides bringing in the expertise of Kame'enui and Simmons, the grant paid for staff development and a new position—reading coordinator.

Today, Bethel's approach to reading is more than an instructional model—it's also a prevention model, designed to head off many learning disabilities at the pass. The model includes:

- Measurable district goals for each grade level;
- Regular and frequent assessment and monitoring;
- Research-based reading curricula that involve direct, explicit, and systematic instruction;
- Protected time for reading instruction;
- Instruction in small groups at each child's skill level;
- Leadership role for principals; and,
- Training for all teachers and educational assistants in using the curricula and assessment measures.

**R**esearch shows that the “wait-and-see” attitude toward reading problems—common at many schools—is a mistake. Instead, Bethel takes an “as-early-as-possible” approach. In the second week of school, a building assessment team (typically, the Title I and special education teachers, plus educational assistants) tests kindergartners for initial-sound fluency and letter-naming fluency using a set of indicators and benchmarks developed at the University of Oregon. The DIBELS (Dynamic Indicators of Basic Early Literacy Skills), each of which takes about three minutes per student to administer, are reliable predictors of later reading performance, according to research findings. Based on these assessments, as well as subsequent teacher observations, students are placed in small groups in one of three categories: “benchmark,” which means on track to meet district goals and ultimately state standards; “strategic,” meaning progressing but behind; and “intensive,” meaning at risk of failing to meet goals.

By the beginning of October, the at-risk kindergartners are getting an extra 30 minutes per day of reading instruction. They also get progress monitoring with DIBELS twice a month—twice as often as their classmates. The extra instruction is not a pullout but an add-on. At Clear Lake, the additional time is sandwiched between morning and afternoon kindergarten. A van collects and delivers the afternoon

extended-day kids early, and takes the morning group home half an hour later than their classmates.

The curriculum for this extended kindergarten (playfully named the “Reading Raccoons”) is Early Reading Intervention (ERI), developed by Kame'enui and Simmons and field-tested in the Bethel district before being published recently by Scott Foresman. During the half-hour lesson, the instructors—teachers and educational assistants—move almost seamlessly from one activity to the next, hardly wasting a breath. Speaking smoothly and sometimes rhythmically, they deal out and sweep up manipulatives such as letter tiles, erasable white boards, alphabet and picture cards, tracing cards, game boards, pencils, and paper. As they do, they model and test children on very specific phonological skills, for instance, the ability to isolate particular initial and final sounds.

Teacher Jane Sterett's group of five Reading Raccoons is all attention as she passes out yellow plastic letter tiles—clink, clink—*p, t, s, m,* and *l* to each child. In front of each child is a laminated strip printed with a row of three squares. The teacher holds up a picture card.

“This is *cat*,” she says, then asks, “What is this?”

“*Cat*,” they chorus.

Then, following her instructions, the students move their index fingers along the strip, pointing to each square as Sterett slowly says each sound: */k/, /aa/, /t/*.

“Where is */t/*?” she asks. The students point to the last square. “That's right, */t/* is the last sound in *cat*. Now find the letter for the sound */t/* and put it in the last square.” The plastic tiles clink as each child finds the “*t*” and places it on the strip.

Each daily lesson offers many chances for children to respond individually and as a group. Though ERI is highly scripted, experienced teachers often fit in even more opportunities for responses, while still delivering the program as intended, says district reading coordinator Rhonda Wolter. The 126 ERI lessons take students along a skills continuum—from learning letters and sounds to segmenting and blending phonemes in sequence to reading words and, finally, to reading sentences and storybooks. Each lesson includes writing and spelling activities as well as activities for phonological awareness and alphabetic understanding.

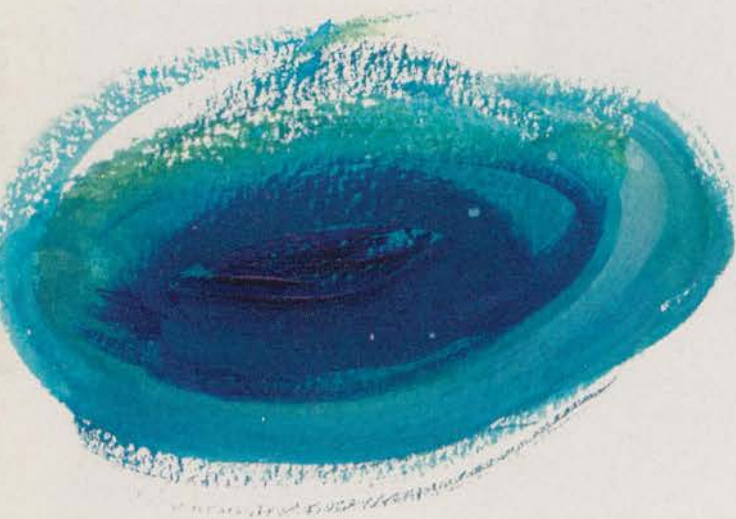
Another research-based curriculum, Open Court, is the core reading program at Clear Lake and most of the district's seven elementary schools, where it is used for daily class instruction, K-3. Each day, following the whole class instruction, students break into small groups. In those groups, which last about 30 minutes, three educational assistants join the teachers to provide instruction geared to the kids' skill levels. The “strategic” group (progressing but behind), gets ERI. The “benchmark” group (readers who are on track) might read decodable or leveled books. And the “intensive” group gets a “double dose” of reading with different materials, a reinforcement of ERI material they have already encountered in Reading Raccoons.

The extra instruction for at-risk readers, as well as the small daily groups for all students, continues through the primary grades. “Part of what has been really successful with our model is that for kids who need interventions like this,



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The extra instruction for at-risk readers, as well as the small daily groups for all students, continues through the primary grades.



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we always try to make it *in addition* to the regular program,” says curriculum director Drew Braun. “In the past, it was ‘instead of.’ For example, when you broke into reading groups, if you were Title I, you went to Title I. Now Title I and other services are a second dose for those kids—not instead of—because kids are not going to get caught up unless we give them extra.”

Another “extra” is the district’s five-week summer school for students who are not meeting benchmarks or who are in danger of losing ground over the break. “They’re kids that we’re not sure how much support they’re going to get over the summer, whether anybody’s going to get them to the library, so we give them the opportunity to continue practicing their skills,” says Wolter.

The district’s commitment to reading is paying off. For children who have been in the Bethel reading program since kindergarten, second-grade special education referrals are now between four and six percent, even though students are actually entering school with lower prereading skills than before. And, despite the fact that the proportion of children eligible for free or reduced-price lunch has increased in recent years from 37 to 48 percent, the proportion of third-graders meeting state standards in reading has also increased—from 79 percent in the 1998-99 school year to 92 percent in the 2003-04 school year. Results like these are just what Bethel’s educators were hoping for when they began using DIBELS in 1998-99 and ERI in 1999-2000.

“I think one kind of kid we catch is a kid who has trouble paying attention,” says Wolter. “We have a lot of those kinds of kids. In a big group, they start losing out on what’s going on. By doing our small groups, we’ve been able to capture those kids, keep them in a structured setting, and work with them.”

Some kids, despite the research-based core classroom curricula, the twice-monthly progress monitoring assessment, and the early and extra intervention, still don’t make progress. In that case, says Wolter, “a whole series of checks” happens. “Has the student been absent a lot, does the student have health problems, has their vision been checked, their hearing?” Wolter says. “Maybe it’s in the instruction. Maybe the instructor’s been shaving off five minutes because the kids have been coming in late. Are they in a group too large? Is the program being used with fidelity?”

Going down this checklist usually roots out the problem. Sometimes, it’s found in surprising places—literally. Two years ago, a doctor turned up foreign objects—a bead and a twisted piece of aluminum foil—in the ears of a boy whose progress in extended kindergarten had stalled.

### Flip of a Switch

The reading initiative has wrought changes on a lot of levels. At the district level, it broke down a dividing line between regular and special education. These days, Cole—the special education expert—might run a general curriculum meeting, while Braun—the generalist—might facilitate a special education meeting. “It’s just a continuum,” says Braun. “We’ve taken a lot of the bags of tricks of special education and put them in the regular classroom because they work really well.”

Kindergarten teachers were resistant at first to the new instructional methods and assessments when the program began to phase in spring of 1999.

“It was very, very difficult—I got my phone unlisted,” Cole jokes.

Clear Lake Principal Betsy Fernandez also recalls some tension. “Some of the teachers in my building were pretty outspoken in the questions they asked—‘What about the pressure that’s being put on kids academically? What about the whole developmental approach to teaching kindergarten?’” she says. “They were tough questions. Now, kindergarten teachers are some of the most dedicated to the

*(Continued on page 44)*

# Women's Rights— Not Just for Westerners

By Azar Nafisi

I went back to my country in 1979 after I finished my studies. Actually, two days after I finished my dissertation at Oklahoma University, I was on the plane back to Iran. For almost two decades after I left Iran at the age of 13, I imagined what home would be. I imagined that as a woman and a writer and a teacher, I would go back to that home and serve. I went back to Iran at the end of the summer of 1979. What I found, thanks to the revolution led by the Ayatollah Khomeini, was fundamentalism, terror, and the war with Iraq. (See the box on page 26 for more details.)

I discovered two things when I went back home. One, that home was not home anymore. But home should not really be home; it should not make us comfortable; it should not make us smug. I always remember Theodore Adorno saying that the highest form of morality is not to feel at home in your own home. Rather, we must be constantly vigilant and questioning in regards to our own actions and words. So for that I would like to thank the Islamic Republic for not making me feel at home in my own home.

The second thing I discovered was that as a woman, as a human being, as a teacher and a writer, the way I looked, the way I felt, the way I talked, the values I cherished, they were all now called “alien.” A group of people came to my country in the name of my country, in the name of my traditions, in the name of my religion, telling me that people like me—millions of people like me in my country—were

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*Author and human rights advocate Azar Nafisi addresses the American Federation of Teachers at its 2004 convention. This article is adapted from her remarks.*

agents of a Western imperialist alien power. Because of that, millions of Iranians, and I among them, had to ask ourselves, was this true? That group came in the name of religion and in the name of Islam.

When I came back to this other home in 1997—the United States—it was so surprising to me to find out that with good intentions and under the name of cultural relativism or multiculturalism, many of the mythologies that those Islamists created in my country were now accepted by many here. People would tell me, “It is their culture.” I would be called, and categorized as, a “Western” woman.

The truth is that Islamic fundamentalism is a totalitarian system. It confiscates a religion and uses it as an ideology for power. Its targets, like all totalitarian regimes' targets, are basic individual rights, civil rights, and human rights. Alongside of that, it has to target thought and imagination—what

we call culture—in order for it to survive.

As soon as the Islamists came to power (eight months before they ratified a new constitution, created a new parliament, or had a new president), they cancelled the family protection law that gave women rights both at home and at work. Then they imposed the Sharia laws on Iran; the Sharia laws, whether in Iran, Afghanistan, or Saudi Arabia, are basically the same laws.

The first targets of Sharia laws, again, were women and individual rights. For example, they lowered the age of marriage for girls from 18 to 9. Now, I would like to ask those who say it's “their culture,” how many 9-year-old girls have free choice to say that they would like to marry a man twice or three times their age? The Islamists also implemented the punishment of stoning to death for what they called adultery and prostitution. Meanwhile, they made polygamy legal, where a man could have not only four official wives, but could contract, or rent, as many women as he wanted



Now, I would like to ask those who say it's "their culture," how many 9-year-old girls have free choice to say that they would like to marry a man twice or three times their age?

for a period of five minutes to 99 years. Legally, they considered women as half men. So, for example, on the witness stand, testimony by two women would have the same weight as testimony by one man. They disrobed women judges because they said women did not have the ability to think clearly, so they could not be judges. Another example is that if a woman is killed by a man, the family of the woman has to pay the family of the man (if you can put a price on life) half the blood money in order for that man to be punished.\* These were the laws that they brought to my

\* "Blood Money" is the value of a person's life in Iran. A woman in Iran is always worth half of a man; therefore, men are worth double the amount of "blood money." The Islamic Penal Code in Iran states that if a Muslim man commits first-degree murder against a Muslim woman, the woman's family must pay half of the value of the culprit's life to his family before retribution is allowed.



© EARL & NAZIMA KOWALL/CORBIS

*Shown here are photos of Iranian women from the mid 1980s. Azar Nafisi returned home to Iran in 1979 to teach literature. She endured nearly 20 years under Sharia laws and fled to the United States in 1997.*

country in the name of my religion.

Now, I ask you, if this were our Iranian culture, if this were what we chose, would you say that the Salem witch trials were the real culture in Massachusetts and not Thoreau or Emerson or Hawthorne? Would you say that slavery was the real culture in America and not Zora Neale Hurston or William Faulkner or Carson McCullers or Tony Morrison or Richard Wright? Would you say that Europe's Middle Ages inquisition was its real culture, and not St. Augustine or St. Thomas Aquinas?

Every country in the world today, every people has a stain upon their history. If we remember and cherish America today because of the highest achievements of its culture, if we cherish this country, or if we cherish countries we call democratic, we cherish them because of the way they treat that stain. We cherish democratic countries when they give the people the right to change: the right to change what is unacceptable, and the right to preserve the highest achievements of mankind—namely its works of science, its works of thought, and its works of imagination.

If you allow those things to *your* people, then I think you should allow them to *my* people. And, you should believe that no woman, in any part of the world, no matter how much she believes in her culture and tradition and religion, would like to be flogged, stoned to death, or genitally mutilated. No person in the world today (in their sane mind, of course) would reject life, liberty, and pursuit of happiness—and I especially love pursuit of happiness. It is not happi-

ness, it is not the dream, it is the search for it that is the whole purpose of life.

Now, who does not want to be happy? Why is it that life, liberty, and pursuit of happiness should be geographically or culturally determined? It is not an imposition upon other cultures when you create a genuinely critical dialogue with others. You would have wanted Europe to be for those who were anti-slavery. Today, we want you to be for those who are anti-totalitarianism in my part of the world.

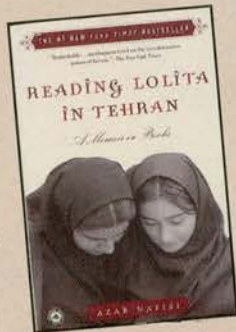
Alongside the confiscation of reality, there is one other thing that every totalitarian regime does—it confiscates people's imagination because imagination is always irreverent, always wayward, always playful. Remember Salman Rushdie? The essence of Salman Rushdie, as Carlos Fuentes says, is not that he wrote a novel insulting Islam, it is that he wrote a novel that was playful and irreverent of reality. And at the core of fiction, at the core of the modern novel, is a celebration of individual rights and of democracy.

The greatest of our novelists are those who give voice—multi-voices—to people with whom they do not even agree. That is the essence of the novel, and that is what the Ayatollahs were afraid of. When we talk about that, we should remember that in the Soviet Union, and in Hitler's Germany, works of writers like Camus or Sartre or Hemingway were all condemned as decadent and bourgeois. The celebration of individual rights in films and in public was also considered decadent and bourgeois.

Totalitarian regimes attack movie houses; they attack the

## Struggling to Keep Imagination Alive

In 1979, as the Islamic revolution swept Iran, Azar Nafisi returned to her home in Iran to teach literature at the prestigious University of Tehran. She had just earned a doctorate from Oklahoma University and was excited to share her love of literature, Eastern and Western, with fellow Iranians. But reality soon interfered with her dreams. The Ayatollah Ruhollah Khomeini became supreme leader-for-life and created an Islamic republic in which all laws had to be authorized by a council of religious scholars. As the revolution progressed in the 1980s, Nafisi fought restrictions on Western classics, struggled to show pro-revolution students the merits of books like *The Great Gatsby*, and was expelled from the University of Tehran for refusing to wear the veil. She found other teaching positions at the Free Is-



lamic University and Allameh Tabatabai University, but by 1995 she found the university setting too oppressive to meaningfully continue teaching. The more books were banned, the more Nafisi became convinced that reading and appreciating them were acts of insubordination: They offered an escape, an alternative to the everyday horrors of life in a totalitarian state. Great works of art are great works of the imagination—and that's exactly what the government could not tolerate.

Though she resigned her official post in 1995, it was then that Nafisi was able to do her best teaching; she held secret classes in her home with a handful of her top female students (having male students join them would have been too dangerous). Watching them come and go every

week, Nafisi became keenly aware of how the mandated veil did not protect them as it was supposedly designed to do. Rather, it masked them, taking away their individuality and imagination.

Nafisi tells the story of the revolution, her classes, and her students in *Reading Lolita in Tehran*, which she wrote after fleeing to the United States in 1997. To read an excerpt, see "Glimpses of Tyranny and Resistance" in the Fall 2003 issue of *American Educator*, available online at [www.aft.org/pubs-reports/american\\_educator/fall2003/glimpses.html](http://www.aft.org/pubs-reports/american_educator/fall2003/glimpses.html). And to learn about Iran since 1997, see the rating of Iran in *Freedom in the World*, Freedom House's annual assessment of the state of freedom, available online at [www.freedomhouse.org/research/freeworld/2003/countryratings/iran.htm](http://www.freedomhouse.org/research/freeworld/2003/countryratings/iran.htm).

—EDITORS

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You should believe that no woman, in any part of the world, no matter how much she believes in her culture and tradition and religion, would like to be flogged, stoned to death, or genitally mutilated.

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novel; they ban music; they ban women from dancing; and women's voices become dangerous. For example, from the Russian version of *Hamlet*, they took out most of Ophelia's scenes. From the Sir Laurence Olivier version of *Othello*, they took out most of the scenes with Desdemona, and they took out the suicide scene at the end because they said that the masses would be depressed when they look at somebody killing himself on the screen. Apparently the masses do not get depressed when they are stoned to death; they say, "Oh, that's our culture," but they hate to see Sir Laurence Olivier dying on the screen.

Remember when the Soviet Union took the death of the swan out of *Swan Lake* so that the masses would not become depressed? In the Islamic Republic, children's book illustrators put scarves on female chickens so that the male chickens won't go all wild and do something devastatingly terrible to the female chickens. Don't ask me how they could differentiate between the female and the male chickens, but understand that this sort of mockery is also a mockery of religion. The kind of man who becomes so obsessed sexually with a strand of my hair that he does not know what to do with himself should not be on the streets.

The point is, the issue we are facing today is not the issue of religion, it is a confiscation, in fact, of religious rights. The issue in the West that comes constantly to our attention is the veil. People say that many Muslim women choose to wear the veil, and that is true. Many Muslim women do; my own grandmother never took off the veil her entire life. My mother, who considered herself a Muslim and went to pilgrimage, to Hajj, never wore the veil. Who is to say which woman is more Muslim? No government, no state, has the right to interfere with the way an individual woman or man worships or does not worship his or her God.

In Iran, it is not only the Jewish, the Christians, the atheists, the Buddhists, the Bahais, or the Zoroastrians who are being deprived of their religious rights, but also the Muslims, because the veil has become a political issue. A Muslim woman should have the right to wear the veil if she wants to. No one can argue with someone's faith, no one can tell someone how to wear, or whether to wear, something. But imagine if tomorrow your government told you that this was a Christian-majority country and all Americans would, therefore, have to practice the President's form of Christianity. And further, starting tomorrow, all Americans would

have to wear a cross. Would the cross mean anything anymore? The interpretation of Islam that is given to us today in Iran is only one interpretation. Why should the veil mean anything anymore?

The veil in Iran today plays the same role that the Mao jackets played in Communist China. It is the same uniform; it is a call for uniformity by a mindset that cannot and will not tolerate multiplicity and multi-vocality.

So this is the main issue that we are dealing with today. The issue is not just political, it is existential. A totalitarian system takes away your sense of dignity and your sense of individuality. The best way to resist it is to reclaim and retrieve that sense of individuality and dignity. That is why people in concentration camps, like Primo Levi or Mandelstam or in the Soviet Union, people like Akhmatova, or Brodsky, or Solzhenitsyn, turn to the highest achievements of mankind, namely the works of imagination.

For 25 years, Iranian people resisted the regime by coming out into the streets and using "weapons of mass destruction," like lipstick, a strand of hair, holding hands, listening to music. By being themselves they would be flogged; 76 lashes is the punishment for showing hair or wearing lipstick. They would be flogged, jailed, given virginity tests. They would go out the next day into the streets and do it again, for 25 years. When women were deprived of becoming judges, like Shirin Ebadi, the Nobel Peace Laureate, did they stay at home? They came out and became lawyers for human, women's, and children's rights. They did not allow that sense of dignity and integrity to be taken away from them.

Today in the streets of Tehran, it is the morality squads that have retreated, not the women. The American media was completely silent about this, but July was the anniversary of the student uprising in 1999, and there are still prisoners who are on strike.\* The students, the children of revolution in Iran today, are the ones who are reading Jane Austen and Saul Bellow. They know more about de Tocqueville and the Declaration of Independence than some of my American students do.

When I came here I always remembered Saul Bellow saying that the sufferings of freedom must be taken into consideration. People might survive the ordeal of Holocaust, but how do we deal with the ordeal of freedom?

We, in those other countries, take away from you these values that are universal: life, liberty, and the pursuit of happiness. We, in return, give you back new interpretations of these values by shouting them in the streets of Tehran or Kabul—or hopefully Baghdad. We will bring them back home to you and remind you that you cannot feel too much at home. We remind you that democracy and human rights, as well as terror and fundamentalism, are universal. In order to safeguard those values that you have fought for in this country, you have to safeguard the values that people all over the world now are fighting for. □

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\* In 1999 there was the largest student uprising in 20 years. It began with a small, peaceful demonstration protesting the closing of a moderate newspaper. After police reacted harshly, beating and detaining students, students across the country engaged in demonstrations for five days calling for reforms, including freedom of the press.

# Fantastic Journey

## *How Scientists Figured Out the Shape and Size of the Earth— Written for Kids*

By Joy Hakim

There is something I want to be sure you understand before you finish this article. It's this: Science is not about certainty; it's about uncertainty. Does that sound weird? Well, it's true. Science is all about trying ideas, discarding those that don't work, and building on those that do. It never stops.

As you know, scientifically minded serious thinkers once "proved" that the Earth was flat. They walked around and observed carefully and made that judgment. It helped them plan their lives. Then someone came along and "proved" the Earth is a globe in the center of the universe. And that worked. And then someone else came along and "proved" that the Sun is in the center of the universe, and that worked, until someone else came along and "proved" that the universe has no center, and....

Well, you get the point. Those people in the past who had wrong ideas weren't dummies. They were doing the best they could, given the knowledge of their times. We do the same thing today. And you can be sure that people in the future will look back and wonder why we believe some of the things we do. Good scientists know that. They learn to be humble. Does that make science unimportant? After all, if some of our scientific theories are going to be proved false, why bother studying them?

Because uncertainty is the most interesting of all places to be. If you believe something is an absolute truth, you can just memorize it and get on with your life. There's nothing to discuss.

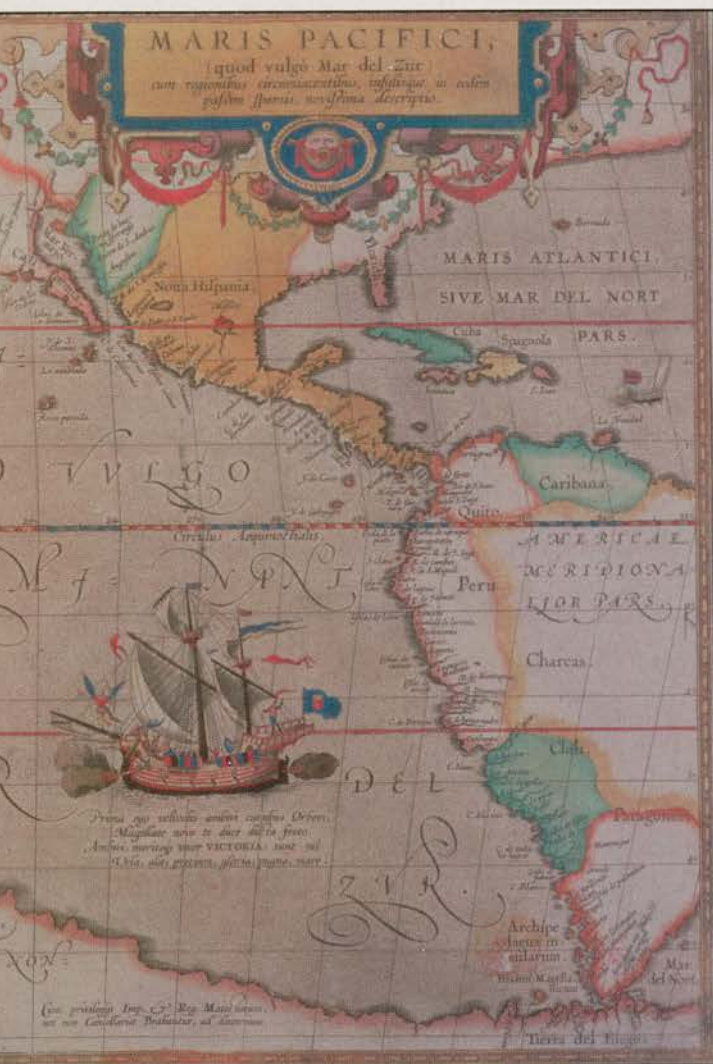
Science isn't like that at all. Scientists—the good ones—are always questioning and questing. Yes, there are scientific ideas, often called principles or theories, that have proved themselves over time. Then they get called facts, or laws. By

*Joy Hakim, former teacher, reporter, and editor, writes nonfiction for children. Her latest project is a six-volume series called The Story of Science, from which this article is excerpted with permission. ©2004 The Story of Science, Smithsonian Books. Her 10-volume series, A History of US, won the Michener Prize in Writing and was made into a PBS special called "Freedom." For a larger excerpt, see the Spring 2002 American Educator at [www.aft.org/pubs-reports/american\\_educator/spring2002/Atom.pdf](http://www.aft.org/pubs-reports/american_educator/spring2002/Atom.pdf). To purchase the new books, see box on p. 36.*



using those laws, modern science has achieved incredible things. But nothing is beyond question to the scientific mind—even those laws. So no good scientist will laugh at you for asking questions—because sometimes the silliest seeming questions have led to the most profound answers.

To better understand how science progresses, let's begin with the Sumerians' thoughts on the Earth and then take a look at the roughly 2,000 years in which scholars debated whether the Earth is round or flat, big or little.



Round or flat, big or little? As late as 1589, this map by Flemish geographer Abraham Ortelius showed the Pacific Ocean far smaller than it really is. The quest to understand the shape and size of our planet has been underway for millennia. Joy Hakim's new set of science books walks kids through the scientific journey—filled with intellectual adventure, great stories, and beautiful art—that has produced accurate maps and our current understanding of a round earth.

The universe was called *an-ki*, which meant “sky-earth.” The wise ones, who were deep thinkers and observers, said the sky was like an upside-down soup dish—solid and bowl shaped. Some called it a heavenly vault. Perhaps it was fashioned of tin, although more than a few thought it was made of the beautiful blue gemstone lapis lazuli. Others said there were three layers of translucent crystal. Stars, which were celestial fires, shone through holes in that glorious roof. Water was stored between the layers, they said. When a hole got unplugged, it rained.

And the Earth? It was a flat disk set in a surrounding ocean.

Below Earth was the vast underworld. Each night it was visited by the Sun. Once a month, the Moon made the same journey to the lower region.

From where did life come? From the ocean—which was eternal; out of it had come everything living.

These were the thoughts of the Sumerians, who, 5,000 years ago, created what may have been the world's first great civilization. Their ancient myths were important, they were part of a process that would stretch minds. But science was still an infant, just taking baby steps out of the cradle. It would take another 2,000 years for star gazers to start trying to answer the big questions of the universe in a scientific way.

\* \* \*

Along the Aegean Sea, Mother Earth is no shy flower. There, though spectacularly beautiful, she is also boisterous and hard to tame. Crops grow poorly. Earthquakes and volcanoes terrify and leave scars. The sea swallows its victims. The Greek-speaking people, who settled sea-washed Turkey, Greece, and the islands between, needed sharp minds to survive, and they developed them. About 3,000 years ago, some of them began using their minds in new ways. It was a time when superstition and fear still guided most thought and action. Rulers who claimed godly powers told subjects what to think. But in Ionia, on the Turkish coast, there were no god-kings. There, cities thrived. Traders and travelers brought new ideas. Ordinary people were free to think for them-

BRIDGEMAN ART LIBRARY

selves. A few, who examined the world with clear, unfrightened minds, drew conclusions from what they observed.

“But,” writes astronomer Carl Sagan, “in Ionia, a new concept developed, one of the great ideas of the human species. The universe is knowable, the ancient Ionians argued.... There are regularities in Nature that permit its secrets to be uncovered. Nature is not entirely unpredictable; there are rules even she must obey.”

Thales (THAY-leez), a sixth-century B.C.E. Ionian living in the prosperous port of Miletus, is said to be the world’s first philosopher-scientist-mathematician; the first to look for explanations in observed facts, not myths; the first scientist to leave his name on his ideas.

A road went from Thales’ home in Miletus to the fabled city of Babylon, where the savvy ruler Nebuchadnezzar (neb-uh-kuhd-NEZ-uhr) had a stable of astronomers at work. (Babylonia had succeeded Sumer as the leading culture in Mesopotamia.) From Babylon, traders and scholars went to India and Mongolia and China, learned of those cultures, and brought home goods that dazzled. Back in Ionia, they were joined by soldiers, returned from the Persian Wars. The soldiers bragged of their army’s engineers, who had built marvels. Some were now working in the Ionian ports.

Given all this intellectual ferment, Thales may have been exasperated by the fickle gods worshiped by most people of his time. Perhaps he realized the importance of a fresh start that turned away from myths toward observation and thought. He would use no gods to explain nature. Rather, he would use his senses and his intelligence and teach others to do the same. It was the beginning of the scientific approach.

## Is the Earth Flat or Round?

Thales did a new kind of thinking, but it might not have gone anywhere if he hadn’t been a teacher. Anaximander (ca. 611-ca. 547 B.C.E.), who was a pupil of Thales, is often called the Founder of Astronomy. That’s not quite true. Peo-

ple had been looking at the stars from the earliest of times. But Anaximander did do something new. He tried to picture the whole Earth and understand its place in the cosmos. He figured out that the Earth’s surface must be curved (that explains the changing position of stars when one travels). And, in a breakthrough thought, he described the sky as a transparent sphere that moves and carries the Sun and stars; it was not just an arch over the Earth.

But Anaximander’s Earth wasn’t a sphere. It was a kind of pudgy cylinder with a top that had a north-south curve. Earth stood all day by itself in the middle of the universe. Nothing was holding it, said Anaximander. That idea of an unsupported Earth was hard for most people to imagine; it took a big intellectual leap. Once it was made, it wasn’t difficult to go from a freestanding cylinder to a free-floating globe, as Pythagoras (pi-THAG-uh-ruhs) did just a few decades later.

Pythagoras, who was born in ca. 582 B.C.E., is often called the world’s first great mathematician. He was lucky in the time and place of his growing up. His home was on the island of Samos, just a mile’s swim in the Aegean Sea from the coast of Turkey.

When Pythagoras was a boy, Samos was a big-time prosperous port. Ships carrying new ideas seemed to blow in on almost every breeze. The Greek historian Herodotus tells us that the people of Samos “are responsible for three of the greatest building and engineering feats in the Greek world.” If we take ourselves to Samos in the sixth century B.C.E., you can see those engineering marvels: a spectacular tunnel channeling water pipes through a big hill, a man-made harbor, and the largest of all known Greek temples.

It is an age of ferment—and genius. Besides Thales and Anaximander in Ionia, there are Confucius (kuhn-FYOO-shuhs) and Lao-tzu (rhymes with “now-duh”) in China, the Pharaoh Necho (NEE-ko) in Egypt, Zoroaster (ZOR-oh-aster) in Persia, the Jewish prophets in Israel, and Gautama Buddha in India. Pythagoras has a mind that can hold its own with any of them.

Samos was part of Ionia, but no one considers Pythagoras as an Ionian because he didn’t think like the other Ionian scientists. He stands alone.

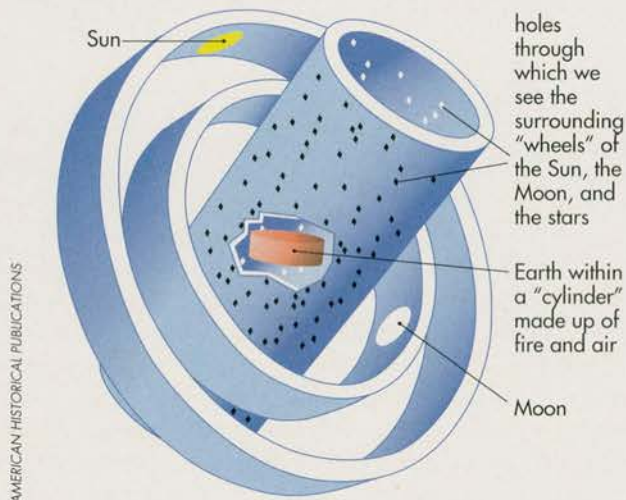
How do you make sense of the universe? Do you do it by considering mountains of information—observing this, observing that—adding one block of knowledge to another? Believe that, and you’re an Ionian-style scientist.

Or, is it an orderly, perfect creation that can be understood through mathematical formulas and headwork? Believe that, and you’re thinking like Pythagoras.

Actually, today’s scientific method combines both approaches, pure thinking along with observation, as well as something essential to modern science—experimentation that leads to proofs. But it took a long time to get that method working. The Greeks didn’t do much experimenting.

For Pythagoras, the way to understand the universe was by searching for things that are absolutely true, and numbers seemed perfect for that quest. “All is number,” he said. And he meant it. Everything in the world, he believed, could be explained through mathematics. He went still further: He thought numbers were divine, an expression of God’s mind.

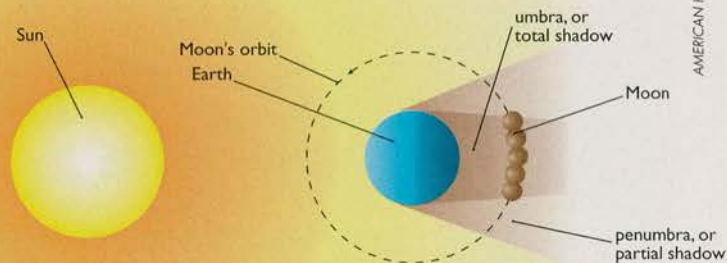
### An Artist's Interpretation of Anaximander's Universe





The Earth's shadow doesn't fall on the Moon any old time. A lunar eclipse happens only during a full moon, when Earth is directly between the Sun and the Moon. The ancient Greeks watched without telescopes as this shadow passed over the full moon (it happens in minutes) and saw that the edge was slightly curved. They concluded that Earth, like its shadow, must be curved, too.

(IF THIS DIAGRAM WERE TO SCALE, EARTH WOULD BE JUST TO THE LEFT OF PAGE 30. THE SUN WOULD BE ONE AND A HALF FOOTBALL FIELDS BEYOND THAT AND HAVE ALMOST A 5-FOOT DIAMETER.)



© 2004 by FRED ESPENAK, www.MrEclipse.com



This series of photos shows the total lunar eclipse of January 21, 2000, which lasted for 1 hour and 18 minutes. The photos were snapped at 20-minute intervals. The Moon is in

full phase throughout; the shifting darkness on its surface is the Earth's shadow. The umbra (the darkest part of the shadow) doesn't obscure the Moon completely, because some

sunlight reflects off the Earth onto the Moon's surface. As light passes through the atmosphere, the blue wavelengths scatter, so the eclipsed Moon appears orange.

We don't have any books or papers or words that Pythagoras actually wrote. All of his work has been lost. But we know enough from the writings of others, who tell of him and his achievements, to realize he was one of the most influential people of all time.

There is an exactness to the world, an orderliness, and it follows rules that can be understood with numbers: that's what Pythagoras told us, and it has been confirmed again and again.

If all this isn't enough, Pythagoras is thought to be the first person to teach that the Earth is a sphere. (He took the next step after Anaximander's squatty cylinder.)

What an astonishing feat, to understand that Earth is a big ball (a slightly out-of-shape ball, as we now know). Would you have figured out its spherical shape if you hadn't been told? And that still isn't all: Pythagoras understood that Earth moves!

Anaximander had explained the motion of the Sun and stars by saying that they are all attached to a heavenly sphere that rotates, carrying them in its grip. Pythagoras accepted that idea, but in his cosmology, the Earth, the Sun, and the planets are not attached to the same heavenly sphere as the stars: they follow different paths; some, like Earth, are circling a great celestial fireball. Take note of that fireball—Earth is not in the center in this universe.

Something else: Pythagoras introduced the idea of multiple spheres. For way more than 1,000 years afterward, astronomers would worry about separate spheres for the Sun and planets. (Finally, modern science came up with gravity, smashing those crystal spheres.)

This astonishing thinker and observer understood that the structure and relationships of the universe can be described with mathematical formulas. He made mathematics the language of Western science. No one has done more.

**W**ithin 200 years after Pythagoras, Greek thinkers seem to have agreed that the Earth is round. Sky gazers had figured out that the round shape on the Moon during a lunar eclipse is our planet's shadow. Since those sky gazers were apt to be the wisest of scholars, it was a heavy nail in the flat-Earth coffin.

There were others. The Greeks traveled widely in the Mediterranean lands. They knew that the North Star is lower in the sky in southern Egypt than it is in northern Greece. A round Earth explains that. And they also knew that the first one sees of a ship coming over the horizon is its sail; only later does the hull come into view. That seemed to confirm the round-world theory. But knowing the shape of the Earth wasn't enough. Scholars also wanted to know how big the Earth is. That was a question for Eratosthenes.

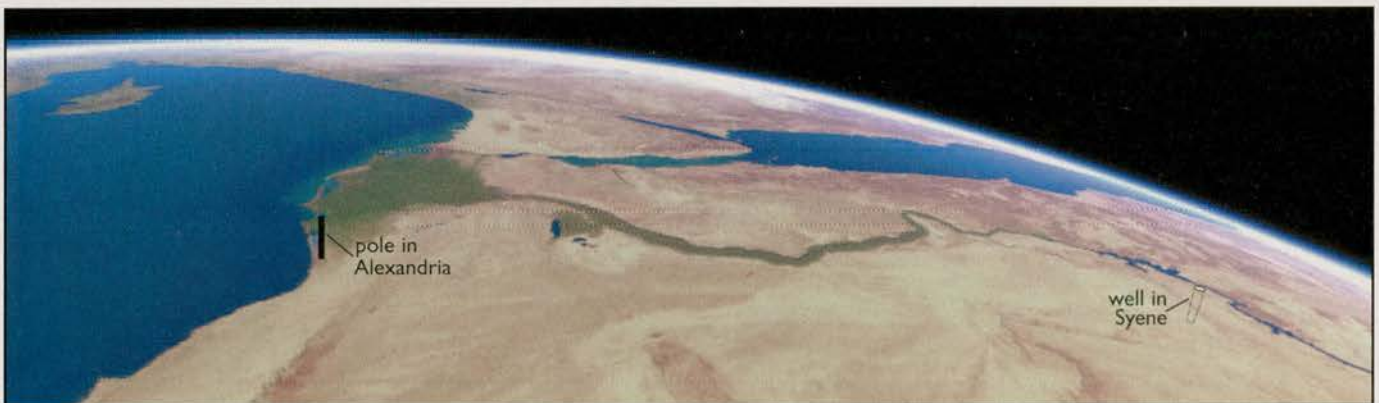
### Is the Earth Big or Small?

Eratosthenes (ca. 275-ca 195 B.C.E.), who was born in coastal North Africa (now Libya), went to school in Athens and then was called to Egypt by Ptolemy III, who asked him to become director of the library/museum/university at Alexandria. He was the perfect person for that job. Eratosthenes (er-uh-TOS-thuh-nee-z) was a great scholar himself, and he energized others. His nickname was "Beta," which is the second letter in the Greek alphabet. Some people



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It's exactly noon in the city of Aswân (formerly Syene) in southern Egypt. How can you tell? Noon on the summer solstice (June 20 or 21) is the only time the Sun is directly overhead and its rays can reach the bottom of this very deep well. Aswân is near the tropic of Cancer (which is 23.5° N), the latitude line that defines the northern limit of Earth's Tropical Zone.



PLANETARY VISIONS/AHP

It's not a straight line from Alexandria to ancient Syene. Though the cities aren't far apart, the span of the Earth between them is curved. Because of that curve, sunlight strikes the cities at slightly different angles.

thought him second only to Aristotle in broad talent. Today Eratosthenes is remembered mostly because of some measuring he did.

Eratosthenes discovered that at noon on the summer solstice (the longest day of the year), at Syene (an Egyptian city near modern Aswân on the southern Nile), the Sun's rays lit the very bottom of a deep well, and a stick cast no shadow at all.

That wasn't true at Alexandria, on the northern mouth of the Nile, where at the same time on the same day, the Sun's rays did cast a shadow.

Eratosthenes must have asked himself, "Why a shadow at Alexandria and no shadow at Syene?" Then he figured out that the Sun might be right overhead at Syene but not quite overhead at Alexandria, and he realized that he had hit upon valuable information. He saw it as yet another indication that the Earth is curved and as an opportunity to find out the circumference of the Earth.

Eratosthenes is said to have put a stick in the ground in Alexandria and measured the angle of its shadow. It was

7.2°, which is  $\frac{1}{50}$  of a circle. If the Earth is truly a globe—as he believed—then the distance between Alexandria and Syene is  $\frac{1}{50}$  of that globe. To find the size of the whole globe, all he had to do was measure the distance between the two cities. So he paid someone to walk from Alexandria to Syene, counting his steps, and then he multiplied that distance by 50. The answer was very close to the best modern measurements of the circumference of the Earth. That was more than two millennia ago, and the only equipment Eratosthenes used was a stick in the ground, his brain, and a hired walker.

Given what he found to be the large size of the Earth and the small size of the known land, Eratosthenes surmised that there was a huge interconnected ocean. (That would be verified by the voyage of Magellan 18 centuries later.)

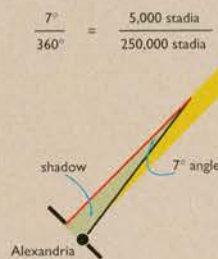
Most of Eratosthenes' works, like those of most of the ancient thinkers, have been lost. Much of what we know of him and his accomplishments comes from the written comments of others. And they tell us that he was a geographer, historian, and literary critic, as well as an astronomer. He

# How Did Eratosthenes Come So Close?

Syene, near modern Aswân, Egypt, is close to the tropic of Cancer (23.5° N). At that line of latitude, at noon on the summer solstice (June 20 or 21), the Sun is directly overhead. Stand there and you'll have no shadow. Alexandria is farther north, so there the noon Sun is not quite overhead on the solstice. You, or a stick, will cast a shadow that's at about a 7° angle.

Both cities lie near the same meridian, or longitude line, which is a north-south great circle (a circumference, really) around the Earth. Like all circles, the meridian has 360°. Since 7° is about 1/50 of 360°, the distance between the two cities (5,000 stadia) must be 1/50 of the distance around the meridian. By multiplying 5,000 by 50, Eratosthenes estimated Earth's circumference at 250,000 stadia. Then, since he was aiming for an easy-to-use number, he added 2,000 stadia and got 252,000. (It's evenly divisible by 60 and 360.)

So, you might be wondering by now, just how long was a stadium (singular for stadia)? The experts aren't quite sure, but they say it's



$$\frac{7^\circ}{360^\circ} = \frac{5,000 \text{ stadia}}{250,000 \text{ stadia}}$$

between 150 and 158 meters (164 and 173 yards). At 157 meters (172 yards), a popular choice, Eratosthenes figured Earth's circumference at about 39,250 kilometers (24,390 miles). That's amazingly close to today's measures of the north-south circumference, which is about 40,000 kilometers (24,855 miles).

—J.H.

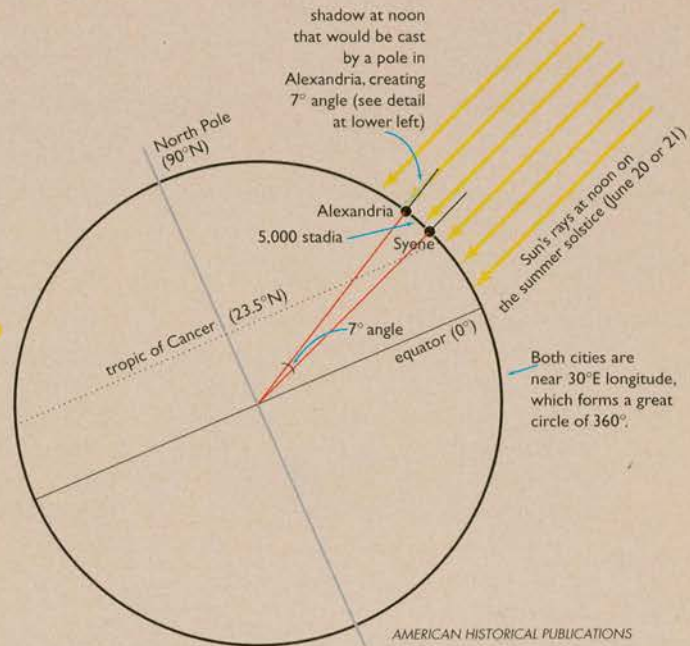
## Why Was It So Tough?

Today's satellites can map and measure the Earth within inches of accuracy. It wasn't that easy for Eratosthenes. He had no way to measure long distances well, and even very careful step-counting is an uneven thing. The round number 5,000 stadia is a clue that Eratosthenes knew the result was an estimate.

Also, Alexandria isn't exactly due north of Aswân/Syene. It's a couple of degrees west of it. Aswân/Syene isn't on the tropic of Cancer. It's a little north of it. Eratosthenes couldn't know about those slightly off-kilter positions, which threw off his result a bit.

There's one more thing no one knew back then: Earth bulges at the middle and is a little flattened at the poles. That makes the meridians (the north-south great circles) a little shorter than the east-west Equator, which is 40,075 kilometers (24,901 miles) long.

Those tiny quirks probably wouldn't have mattered to Eratosthenes. He fudged by tacking on extra stadia to make the math easier, which shows he wasn't aiming for perfection. He just wanted a close estimate, and he did incredibly well.



# A Serendipitous Step Backward

Claudius Ptolemy (TOL-uh-mee) was known as the world's greatest astronomer, geographer, and mathematician. In the second century C.E., everyone in the Alexandrian world believed that. There would be a long interlude when Ptolemy was forgotten, but then he would bounce back stronger than ever. During the Middle Ages and the Renaissance, Ptolemy was revered. People believed he was the greatest in 1492, when Columbus sailed the ocean blue and happened upon what was to him the New World. So put Ptolemy in your head as another of the most influential authors of all time. He wrote huge books that organized all the known math, geography, and astronomy of the day.

This Ptolemy was not an emperor or a general, as were the Ptolemys who ruled Egypt. We hardly know anything about his personal life. We do know that he was born in



*Ptolemy studies an armillary sphere (a model of the sky as it appears from Earth) in this wood panel painted by Flemish artist Joos van Ghent (ca. 1435 - ca. 1480). The panel is part of a series commissioned for the palace of the duke of Urbino, in Italy.*

North Africa and was part of the Greek-speaking Hellenistic world. Most authorities believe that he was Greek, but a few think he may have been Egyptian. He lived and studied in Alexandria more than three centuries after Eratosthenes.

But unlike Eratosthenes, he believed that Earth is mostly dry land rather than ocean. (That was an idea that went back to Aristotle.) He thought the stars and planets orbited in perfect circles. (That was Plato's idea.) And he thought Earth much smaller than it actually is. When Ptolemy calculated, Earth came out 30 percent smaller than what Eratosthenes had figured it to be—and what it really is.

Besides that, Ptolemy made Asia huge, stretching it far beyond where it actually is. (Later, all those errors would make Christopher Columbus think that Asia was just across an ocean that wasn't terribly big.)

Ptolemy wasn't much of an original theorist, but he was a solid thinker who compiled and organized and extended the work of the past and left a base for future scientific study. His great contribution was in explaining the world mathematically. Those who followed would be compelled to do the same thing.

Ptolemy wrote massive volumes on science, geography, and mathematics.

And his ideas seemed to work. With his model and his mathematics, you could predict the motions of the Sun, stars, and planets. You'd be close enough so that farmers, sailors, and teachers could use the results—which they did. Today we're apt to look back at Ptolemy and forget how important he was for centuries. Those who turned to Ptolemy were rejecting superstition and magic and using a solid work of scholarship.

His monumental book was called *Megale mathematike syntaxis* ("Great Mathematical Composition"). Sometimes it was just called *Megiste* or *Almagest* ("The Greatest"). In addition to making a significant contribution to trigonometry, it mapped and charted the visible stars. Ptolemy's star charts became enormously helpful to anyone trying to navigate a ship at sea.

In fact, Christopher Columbus relied on his copy of *Almagest* when he set out to find a new route to Asia by sailing west. Columbus read Eratosthenes, too, but he believed Ptolemy. That means he thought the Earth was smaller than it actually is and Asia, larger. When he reached the Caribbean Islands, he was sure he was near Asia (and he would have been if Ptolemy had been right).

Now consider this: If Columbus had paid attention to Eratosthenes—and if he had known how big the world really is—he might not have dared sail west. Where would we be now?

—J.H.

was the first man, of whom we know, who was concerned with accurate dating. He set up a chronology that began history with the Trojan War. But it was when he came up with that close-to-accurate measurement of the Earth that he demonstrated that the universe is understandable. Given some brainpower, we can figure out how it works. What would his contemporaries and future generations do with that insight? For a long time they just forgot all about it.

## Darkness Descends

After some impressive centuries of rule and a time of peace

and harmony unusual in human history, the vast and mighty Roman Empire was in trouble. Historians will give you a whole lot of reasons for its decline:

- poor leadership
- economic woes
- urban (city) problems connected to size and rapid growth
- nasty political fighting
- crime

Whatever the cause, when wild, uncivilized, barbaric tribes began attacking, the empire started to collapse. It did

not happen overnight; it was a long process. Those barbarians—bands of warring hoodlums—came from the north, and kept coming. They were being pushed out of their lands by still fiercer hordes who had fought on horseback all the way across Asia from Mongolia. Wherever they went, these barbarian tribes brought disaster, destruction, energy, and change.

While the Roman Empire was tumbling, a new religion was spreading like a grass fire (which means fast). The new religion was Christianity. It preached love and brotherhood and brought a vision of a world to come. It was a message of hope. And it spoke to those who were facing confusion, violence, and wrenching change in what had once been civilized, secure communities. Christianity led believers inward, to a quiet, spiritual life. At a time when the known world was often unbearably brutal, Christians focused on the world of the soul and the promise of eternal life.

In 313 C.E., Emperor Constantine made Christianity a tolerated and lawful religion of the Roman Empire. Christians, who had been struggling outcasts, began to hold political as well as spiritual power. Their ideas on science now mattered. Should priests and bishops encourage Christians to study the natural world? Or should they urge Christians to concentrate on saving their souls? Studying science and mathematics meant studying the Greeks. But the Greeks were being called pagans. If the Greeks were wrong about religion, as the Christians believed, could they be right about scientific matters? This was a serious, troubling dilemma.

Greek scientists had taught that the Earth is round. But if the world is round, then some people must be hanging upside down, said the priests. "Can anyone be so foolish as to believe that there are men whose feet are higher than their heads, or places where things may be hanging downwards, trees growing backwards, or rain falling upwards?" wrote the much-loved African priest and author Lactantius. (He was tutor to Emperor Constantine's son.) The side of the Earth opposite Europe (and below the equator) was called the antipodes (an-TIP-uh-deez). How could anyone live on the antipodes? The Bible's stories seem to make it an impossibility. Belief in a habitable round Earth was often seen as proof of heresy. (Almost no one understood that there is no top and bottom nor up and down in space.)

What happened to that round-Earth idea the Greeks had developed? A sixth-century monk named Cosmas wrote a 12-volume *Topographia Christiana*, which was meant to replace it. The first volume of his work has this title: *Against those who, while wishing to profess Christianity, think and imagine like the pagans that the heaven is spherical*. The Earth, said Cosmas, is rectangular—twice as long as it is wide—and surrounded by an ocean, which is surrounded by a second Earth: Adam's Paradise. The sky is like the roof of a tent with stars and planets pushed by angels.

Did people believe Cosmas? Yes, most did. But it didn't seem to matter much. Hardly anyone was concerned with the science of the universe. Its moment had passed. No other culture anywhere had done what the Greeks had done; but now Alexandria was becoming a forgotten town. Science and question-asking were out of fashion.

The Sumerian idea of a flat Earth returned—this time richly embroidered with descriptions of sea monsters and bizarre land creatures. It stayed around for almost 1,000 years. (To give yourself an idea of 1,000 years, it's twice as long ago as Columbus's voyage to America.)

Historians call the time between the fall of the Roman Empire (476) and the beginning of the Renaissance (early 15th century) the Middle Ages. Some divide that medieval era and call the first of it (from 476 to about 1000) the Dark Ages. Some call those years the Great Interruption. Whatever name you choose, it describes a time when most of Europe took a big step backward. Life became coarse and primitive, not just in comparison to our life today, but in contrast to other world civilizations of the time, such as the T'ang and Sung dynasties in China, the Eastern Orthodox Byzantine Empire centered in Constantinople (now Istanbul, Turkey), and the Islamic Empire (led by the culture-loving Abbasid rulers).

The tradition of scientific question-asking shifted to Arab lands, where it stayed alive for some five or six centuries and helped create a golden age of Islam.

In China, technology was making enormous strides. Astronomers and mapmakers there were way ahead of those left in Europe. They were charting regions of the Earth exactly, although they still hadn't figured out that Earth was round. Ships' rudders, the compass, wheelbarrows, canals with locks, paper, printing, gunpowder, stirrups, and harnesses—those were just a few of the ideas and inventions that were eventually carried across the Silk Road from the East to the West. But neither the Chinese nor the Japanese nor the Mayans nor any other culture anywhere matched the Greeks when it came to asking questions about the universe. Without the right questions, you don't get the right answers. You don't even get energetic discussions. These *were* dark ages for science and dreadful years for most Europeans—especially for those with intelligence and imagination.

If anyone, then, had suggested that Europe was going to develop a science-based culture that would be a beacon to most of the world—well, that hardly seemed possible. By the year 1000, the once-famous Roman Forum had become a pasture for cattle. Squatters were living in Rome's Colosseum and hanging laundry from its windows. Alexandria? You could ask anyone: Its glory days were in the mostly forgotten past.

## Light Prevails

Pope Sylvester II, who reigned during the millennial year 1000, was sometimes called the Magician Pope, for he was a versatile thinker with many talents.

As a young man, Sylvester—whose name then was Gerbert of Aurillac—went to Islamic Spain, where he studied Arabic math and science. While he was there, he read the ancient Greeks—in Arabic! When he was 39, Gerbert was the star of an all-day public debate sponsored by the German King Otto II. Scholars and students traveled from all over Europe for these events. Gerbert argued that physics is a branch of mathematics, won the debate, and was soon

# The Story of Science: A Writer's Reasons

"The sight of stars always sets me dreaming," Vincent van Gogh wrote to his brother, Theo. Somehow it consoles me to think of that tormented painter finding repose by looking heavenward. So, in a notebook I keep (don't all writers have them?), I put Vincent's words about stargazing right next to those of Huck Finn. Huck says, "We had the sky up there, all speckled with stars, and we used to lay on our backs and look up at them, and discuss about whether their was made or only just happened."

Funny thing: the Greeks asked that question, Mark Twain asked it, and we're still asking. The big questions don't seem to go away. As to stargazing, that's how science got started. Where *did* those stars come from? What are they made of? And where are they going? Those are questions for all of us, not just for the astrophysicists in our midst.

That's a conviction that led me to write a series of books on the story of science (this article is excerpted from the first of a projected six). The first three books in the series tell the story of physics and chemistry, from ancient Sumer to today's string theory. Which means they deal with the very big (the universe), the very small (atoms and particles), and the in-between as well. It is, I believe, an enthralling tale, and one that is basic to our human heritage. The next two books cover earth science and biology; the last will be a reader full of fascinating original documents. All the books are essentially reading books that tell the dramatic stories of the

discoverers of scientific knowledge. In the sidebars and asides, as well as the coordinated teaching materials developed by researchers with Johns Hopkins University's Talent Development Middle Schools, we'll get into science's specifics.

I'm convinced, and I hope to convince you, that science is not just for scientists. In the 20th century, we compartmentalized knowledge; in the information age, that doesn't make sense. Today, you can be a hermit on a mountain peak and still have access to the world's learning. For scholarship to be so available, so democratic, is unprecedented in world history. To use that opportunity well, we all need to be generalists first (then we can find specialties). And no field of knowledge is as basic or as creative as science. That ragtag notebook of mine—cluttered with thoughts from poets, artists, and philosophers—has helped me realize that the human quest to understand the universe underlies almost all other creativity. I'm also convinced that there is no better way to learn to read critically and think analytically than by reading solid subject matter. Nonfiction is the kind of reading that stretches the mind. And it doesn't have to be dull: The real world is full of incredible

stories that just happen to be true. I've tried to write vital books that will engage readers of all ages.

—J.H.

*The first book in Joy Hakim's new series, The Story of Science, is currently available. The next two books will be published in the spring of 2005 and the final three books are scheduled to come out during the 2005-2006 school year. The series is being published by,*



*and can be purchased from, Smithsonian Books (800-233-4830) and is available from the National Science Teachers Association (800-277-5300) and fine book-sellers.*

*This article is composed of excerpts, graphics, artwork, and captions from the first book in the series. The actual texts are written with middle-school students in mind; they tell the story of science in chronological order with numerous short chapters. If you are interested in the books for classroom use, please e-mail Janey Tannenbaum at [tannenbaumj@sipress.si.edu](mailto:tannenbaumj@sipress.si.edu).*

court mathematician and advisor to the powerful Otto. So, along with a high-powered mind, he now had political influence.

He was already a controversial figure. When he came home from Spain, he told friends and colleagues about Arabic mathematics and about Greek thinkers. A few other Christian scholars set off for Spain—although outsiders weren't welcomed. They were more likely to bring trouble than anything else. Most Spaniards thought they had little

to learn from other European peoples.

Around 1110, an English philosopher named Adelard of Bath disguises himself as a Muslim student and heads for Spain. Adelard has studied and taught in France and traveled to Italy, Syria, and Palestine. He speaks Arabic, so he has no problem pretending to be a Muslim. He is anxious to learn all he can in Spain's great schools. One of the first books he encounters is Euclid's comprehensive treatment of geometry called *The Elements*.

In a world where hardly anyone can multiply or divide big numbers, Euclid is astonishing. Adelard is swept away by *The Elements*; it makes numbers clear and useful.

Adelard translates Euclid from Arabic into Latin, giving Europe an enormous gift. He helps make it the most influential book on mathematics ever. (It will be the basis of almost all thinking about geometry until the 19th century.)

Thanks to the influential Roman philosopher Boethius, Aristotle's writings on logic have been known for centuries. Now, with the Dark Ages receding, his works on science get translated and begin to be studied by a few Christian scholars. At the same time, three philosophers from the Arabic world write commentaries on Aristotle—clarifying and extending his thinking. They are Maimonides, who is Jewish; Avicenna, who is Persian; and Averroës, who is Spanish. Their observations give thinkers much to discuss. After centuries of intellectual stagnation, this is all astonishing. Imagine living in the dark and suddenly lights are turned on.

Some say much of the ferment can be traced to the new schools and universities. One of the first of them is built in the 12th century at Chartres (SHAR-truh), France. The great cathedral houses a school where professors begin to teach about nature and science. Universities are soon founded in most large towns across Europe.

Professors need books to teach, which leads to a demand for scholarly works. Scribes are put to work copying the new translations of the ancient works. Some scholars actually begin thinking for themselves. Still, ideas change slowly.

When it comes to geography, European maps show Earth with three continents: Africa, Europe, Asia. All the world's known land—those three continents—is surrounded by the "Ocean Sea." That ocean is terrifying because no one has sailed across it and told the tale; sea monsters are thought to abound.

Aristotle's round world is being taken seriously at most of

the universities, but no one with a ship is dealing with the idea. Around the year 1000, Leif Eriksson, a Viking explorer, sailed west from Greenland and discovered a new land that he thought promising for growing grapes. He called it Vinland. But, even a century later, hardly anyone elsewhere knows of that voyage, and no one understands its significance.

## Proof: A Grueling, Three-Year "Experiment" at Sea

On September 4, 1522, a battered, worm-infested ship is sighted heading for Seville on Spain's Guadalquivir (gwah-tuhl-kee-VEER) River. No one has expected it; it is as if a ghost ship has appeared.

The ship's crew—a pitiful band of 18 Europeans and four East Indians—are living skeletons. The 18 Europeans are all that remain of a hopeful expedition of 270 that set sail three years earlier. The families of the men think them dead.

The ship limps slowly up the river, but word of its appearance spreads rapidly. By September 6, when it reaches Seville, the whole city is consumed with curiosity. Where has this ship been?

The story begins on this same river with an armada of five ships. The ships are not particularly impressive, but the *capitán-general* is. His name is Ferdinand Magellan, and he has checked, rechecked, and strengthened every timber, every sail, every length of rope.

Magellan is preparing for a two-year expedition. His food supplies include several tons of pickled pork, almost as much honey, and 200 barrels of anchovies. In case they must fight, there are thousands of lances, shields, and helmets. To keep the ships in repair, they pack 40 loads of lumber, pitch, and tar. And there are mirrors, scissors, colored glass beads, and kerchiefs to trade with unknown natives. (Later he will discover that he has been cheated; much that he ordered and paid for is stolen on the docks and not loaded on the ships.)

Some people say Magellan is a fanatic or, at best, a dreamer. Actually, he is a bit of both, as achievers must be. Short and muscular with a bushy black beard and a limp—a battle wound—he has an idea; and it consumes him. He believes he can do what Columbus has not done—reach Asia and its fabled Moluccas (Spice Islands) by sailing west. He expects to find the Moluccas, load his ships with cloves and other spices, and then turn around and sail back, thus pioneering a new trading route. Spices, especially cloves, nutmeg, mace, cinnamon, and ginger, are worth their weight in gold and sometimes more than gold.

European monarchs, merchants, adventurers, and scholars, in search of power, wealth, and knowledge, are trying to find new ways around the world. Magellan is convinced that sailing west to reach the East will be faster and safer. If he is right, he will become rich and famous. And if he reaches his destination, he knows it will prove once and for all that the Earth is a round globe.

The trick will be to find a passageway through the American land. That land is like a giant jigsaw puzzle, and most of the pieces are still missing. Like other mariners, Magellan believes the land Columbus discovered is skinny. Perhaps it

(Continued on page 43)



Sea monsters and other strange creatures inhabit *Cosmographia universalis* ("Universal Cosmography," 1544), a geography book by Sebastian Münster, an influential German geographer and religious scholar.

# Eats, Shoots & Leaves

By Lynne Truss

*A panda walks into a café. He orders a sandwich, eats it, then draws a gun and fires two shots in the air.*

*"Why?" asks the confused waiter, as the panda makes towards the exit. The panda produces a badly punctuated wildlife manual and tosses it over his shoulder.*

*"I'm a panda," he says, at the door. "Look it up."*

*The waiter turns to the relevant entry and, sure enough, finds an explanation.*

*"Panda. Large black-and-white bear-like mammal, native to China. Eats, shoots and leaves."*

Either this will ring bells for you, or it won't. A printed banner has appeared on the concourse of a petrol station near to where I live. "Come inside," it says, "for CD's, VIDEO's, DVD's, and BOOK's."

If this satanic sprinkling of redundant apostrophes causes no little gasp of horror or quickening of the pulse, you should probably put down this article at once. By all means congratulate yourself that you are not a pedant or even a stickler; that you are happily equipped to live in a world of plummeting punctuation standards; but just don't bother to go any further. For any true stickler, you see, the sight of the plural word "Book's" with an apostrophe in it will trigger a ghastly private emotional process similar to the stages of bereavement, though greatly accelerated. First there is shock. Within seconds, shock gives way to disbelief, disbelief to pain, and pain to anger. Finally (and this is where the analogy breaks down), anger gives way to a righteous urge to perpetrate an act of criminal damage with the aid of a permanent marker.

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*Lynne Truss is author of several books and a book reviewer for the Sunday Times of London. Previously she hosted Cutting a Dash, a BBC Radio 4 program on punctuation. This article is excerpted from Eats, Shoots and Leaves: The Zero Tolerance Approach to Punctuation by Lynne Truss © 2003, by arrangement with Gotham Books, a division of Penguin Group (USA) Inc.*

It's tough being a stickler for punctuation these days. One almost dare not get up in the mornings. True, one occasionally hears a marvellous punctuation-fan joke about a panda who "eats, shoots, and leaves," but in general the stickler's exquisite sensibilities are assaulted from all sides, causing feelings of panic and isolation. A sign at a health club will announce, "It's party time, on Saturday 24th May we are have a disco/party night for free, it will be a ticket only evening." Advertisements offer decorative services to "wall's—ceiling's—door's ect." Meanwhile a newspaper placard announces "FAN'S FURY AT STADIUM INQUIRY," which sounds quite interesting until you look inside the paper and discover that the story concerns a quite large mob of fans, actually—not just the lone hopping-mad fan so promisingly indicated by the punctuation.

Everywhere one looks, there are signs of ignorance and indifference. What about that film *Two Weeks Notice*? Guaranteed to give sticklers a very nasty turn, that was—its posters slung along the sides of buses in letters four feet tall, with no apostrophe in sight. I remember, at the start of the *Two Weeks Notice* publicity campaign in the spring of 2003, emerging cheerfully from Victoria Station (was I whistling?) and stopping dead in my tracks with my fingers in my mouth. Where was the apostrophe? Surely there should be an apostrophe on that bus? If it were "one month's notice" there would be an apostrophe. Therefore "two weeks' notice" requires an apostrophe! Buses that I should have caught (the 73; two 38s) sailed off up Buckingham Palace Road while I communed thus at length with my inner stickler, unable to move or, indeed, regain any sense of perspective.

Part of one's despair, of course, is that the world cares nothing for the little shocks endured by the sensitive stickler. While we look in horror at a badly punctuated sign, the world carries on around us, blind to our plight. We are like the little boy in *The Sixth Sense* who can see dead people, except that we can see dead punctuation. Whisper it in petrified little-boy tones: Dead punctuation is invisible to every-





one else—yet we see it *all the time*. No one understands us seventh-sense people. They regard us as freaks. When we point out illiterate mistakes we are often aggressively instructed to “get a life” by people who interestingly, display no evidence of having lives themselves. Naturally we become timid about making our insights known, in such inhospitable conditions. Being burned as a witch is not safely enough off the agenda. A sign has gone up in a local charity-shop window which says, baldly, “Can you spare any old records” (no question mark) and I dither daily outside on the pavement. Should I go in and mention it? It does *matter* that there’s no question mark on a direct question. It is appalling ignorance. But what will I do if the elderly charity-shop lady gives me the usual disbelieving stare and then tells me to bugger off, get a life, and mind my own business?

On the other hand, I’m well aware there is little profit in asking for sympathy for sticklers. We are not the easiest people to feel sorry for. We refuse to patronize any shop with checkouts for “eight items or less” (because it should be “fewer”), and we never read a book without a pencil at hand, to correct the typographical errors. In short, we are unattractive know-all obsessives who get things out of proportion and are in continual peril of being disowned by our exasperated families.

I know precisely when my own damned stickler personality started to get the better of me. In the autumn of 2002, I was making a series of programs about punctuation for Radio 4 called *Cutting a Dash*. My producer invited John Richards of the Apostrophe Protection Society to come and talk to us. At that time, I was quite tickled by the idea of an Apostrophe Protection Society, on whose Web site could be found photographic examples of ungrammatical signs such as “The judges decision is final” and “No dog’s.” We took Mr. Richards on a trip down to Berwick Street Market to record his reaction to some green-grocers’ punctuation (“Potatoe’s” and so on), and then sat down for a chat about how exactly one goes about protecting a conventional printer’s mark that, through no fault of its own, seems to be terminally flailing in a welter of confusion.

What the APS does is write courteous letters, he said. A typical letter would explain the correct use of the apostrophe, and express the gentle wish that, should the offending “BOB,S PETS” sign (with a comma) be replaced one day, this well-meant guidance might be borne in mind. It was at this point that I felt a profound and unignorable stirring. It was the awakening of my Inner Stickler. “But that’s not enough!” I said. Suddenly I was a-buzz with ideas. What about issuing stickers printed with the words “This apostrophe is not necessary”? What about telling people to shin up ladders at dead of night with an apostrophe-shaped stencil and a tin of paint? Why did the Apostrophe Protection Society not have a militant wing? Could I start one? Where do you get balaclavas?

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Punctuation has been defined many ways. Some grammarians use the analogy of stitching: punctuation as the basting that holds the fabric of language in shape. Another writer tells us that punctuation marks are the traffic signals of language: they tell us to slow down, notice this,

take a detour, and stop. I have even seen a rather fanciful reference to the full stop (known in the United States as the period) and comma as “the invisible servants in fairy tales—the ones who bring glasses of water and pillows, not storms of weather or love.” But best of all, I think, is the simple advice given by the style book of a national newspaper: that punctuation is “a courtesy designed to help readers to understand a story without stumbling.”

Isn’t the analogy with good manners perfect? Truly good manners are invisible: they ease the way for others, without drawing attention to themselves. It is no accident that the word “punctilious” (“attentive to formality or etiquette”) comes from the same original root word as punctuation. As we shall see, the practice of “pointing” our writing has always been offered in a spirit of helpfulness, to underline meaning and prevent awkward misunderstandings between writer and reader. In 1644, a schoolmaster from Southwark, Richard Hodges, wrote in his *The English Primrose* that “great care ought to be had in writing, for the due observing of points: for, the neglect thereof will pervert the sense,” and he quoted as an example, “My Son, if sinners intise [entice] thee consent thou, not refraining thy foot from their way.” Imagine the difference to the sense, he says, if you place the comma after the word “not”: “My Son, if sinners intise thee consent thou not, refraining thy foot from their way.” This was the 1644 equivalent of Ronnie Barker in *Porridge*, reading the sign-off from a fellow lag’s letter from home, “Now I must go and get on my lover,” and then pretending to notice a comma, so hastily changing it to, “Now I must go and get on, my lover.”

To be fair, many people who couldn’t punctuate their way out of a paper bag are still interested in the way punctuation can alter the sense of a string of words. It is the basis of all “I’m sorry, I’ll read that again” jokes. Instead of “What would you with the king?” you can have someone say in Marlowe’s *Edward II*, “What? Would you? *With the king?*” The consequences of mispunctuation (and re-punctuation) have appealed to both great and little minds, and in the age of the fancy-that e-mail, a popular example is the comparison of two sentences:

A woman, without her man, is nothing.  
A woman: without her, man is nothing.

Which, I don’t know, really makes you *think*, doesn’t it?

But just to show there is nothing very original about all this, 500 years before e-mail, a similarly tiresome puzzle was going round:

Every Lady in this Land  
Hath 20 Nails on *each* Hand;  
*Five & Twenty* on Hands and Feet;  
And this is true, without deceit.

(Every lady in this land has 20 nails. On each hand, five; and 20 on hands and feet.)

So all this is quite amusing, but the reason it’s worth standing up for punctuation is not that it’s an arbitrary system of notation known only to an over-sensitive elite who have attacks of the vapors when they see it misapplied. The reason to stand up for punctuation is that without it there is

# Sticklers United

As I was preparing for my book, *Eats, Shoots and Leaves: The Zero Tolerance Approach to Punctuation*, I wrote an article for *The Daily Telegraph*, hoping to elicit a few punctuation horror stories, and it was like detonating a dam. Hundreds of e-mails and letters arrived, all of them testifying to the astonishing power of recall we sticklers have when things have annoyed us ("It was in 1987, I'll never forget, and it said 'CREAM TEA'S'"). The vast majority of letters concerned misplaced apostrophes, of course, in *potato's* and *lemon's*. But it was interesting, once I started to analyze and sort the examples, to discover that the greengrocer's apostrophe formed just one depressing category of the overall, total, mind-bogglingly depressing misuse of the apostrophe. Virtually every proper application of this humble mark utterly stumps the people who write to us officially, who paint signs, or who sell us fruits and vegetables. The following is just a tiny selection of the examples I received:

## *Singular possessive instead of simple plural:*

Trouser's reduced  
Coastguard Cottage's

Next week: nouns and apostrophe's (BBC Web site advertising a grammar course for children!)

## *Singular possessive instead of plural possessive:*

Pupil's entrance (on a very selective school, presumably)  
Adult Learner's Week (lucky him)  
Frog's Piss (French wine putting an unfair strain on single frog)  
Member's May Ball (but with whom will the member dance?)

Nude Reader's Wives (intending "Readers' Nude Wives," of course, but conjuring up an interesting picture of polygamous nude reader attended by middle-aged women in housecoats and fluffy slippers)

## *Plural possessive instead of singular possessive:*

Lands' End (mail-order company

which roundly denies anything wrong with name)

Bobs' Motors

## *No possessive where possessive is required:*

Citizens Advice Bureau  
Mens Toilets  
Britains Biggest Junction (Clapham)

## *Dangling expectations caused by incorrect pluralization:*

Pansy's ready (is she?)  
Cyclist's only (his only what?)  
Please replace the trolley's (replace the trolley's what?)

## *Unintentional sense from unmarked possessive:*

Dicks in tray (try not to think about it)  
New members welcome drink (doubtless true)

## *Someone knows an apostrophe is required ... but where, oh where?*

It need'nt be a pane (on a van advertising discount glass)  
Ladie's hairdresser  
Mens coats'  
The Peoples Princess' (on memorial mug)  
Fred's restaurant

## *Apostrophes put in place names/proper names:*

Dear Mr. Steven's  
XMA'S TREES  
Glady's (badge on salesgirl)  
Did'sbury

## *It's or Its'*

### *instead of Its:*

Hundreds of examples, many from respectable National Trust properties and big corporations, but notably:

Hot Dogs a Meal  
in Its' Self (sign in Great Yarmouth)  
Recruitment at it's best (slogan of employment agency)

"... to welcome you to the British Library, it's services and cata-

logues" (reader induction pamphlet at British Library)

## *Plain illiteracy:*

"... giving the full name and title of the person who's details are given in Section 02" (on UK passport application form)

Make our customer's live's easier (Abbey National advertisement)

Gateaux's (evidently never spelled any other way)

Your 21 today! (on birthday card)

## *Signs that have given up trying:*

Reader offer  
Author photograph  
Customer toilet

This is a mere sample of the total I received. I heard from people whose work colleagues used commas instead of apostrophes; from someone rather thoughtfully recommending a restaurant called l'Apostrophe in Reims (address on request); and from a Somerset man who had cringed regularly at a sign on a market garden until he discovered that its proprietor's name was—you couldn't make it up—R. Carrott. This explained why the sign read "Carrott's" at the top, you see, but then listed other vegetables and fruits spelled and punctuated perfectly correctly.

—L.T.



no reliable way of communicating meaning. Punctuation directs you how to read, in the way musical notation directs a musician how to play. On the page, punctuation performs its grammatical function, but in the mind of the reader it does more than that. It tells the reader how to hum the tune.

If only we hadn't started reading quietly to ourselves. Things were so simple at the start, before grammar came along and ruined things. The earliest known punctuation—credited to Aristophanes of Byzantium (librarian at Alexandria) around 200 BC—was a three-part system of dramatic notation (involving single points at different heights on the line) advising actors when to breathe in preparation for a long bit, or a not-so-long bit, or a relatively short bit. And that's all there was to it. A *comma*, at that time, was the name of the relatively short bit (the word means in Greek “a piece cut off”); and in fact when the word “comma” was adopted into English in the 16th century, it still referred to a discrete, separable group of words rather than the friendly little tadpole number-nine dot-with-a-tail that today we know and love. For a millennium and a half, punctuation's purpose was to guide actors, chanters, and readers-aloud through stretches of manuscript, indicating the pauses, accentuating matters of sense and sound, and leaving syntax mostly to look after itself. St. Jerome, who translated the Bible in the 4th century, introduced a system of punctuation of religious texts *per cola et commata* (“by phrases”), to aid accurate pausing when reading aloud. Cassiodorus, writing in the 6th century in southern Italy for the guidance of trainee scribes, included punctuation in his *Institutiones Divinarum et Saecularium Litterarum*, recommending “clear pausing in well-regulated delivery.”

Most of the marks used by those earnest scribes look bizarre to us now, of course: the *positura*, a mark like a number 7, which indicated the end of a piece of text; the sinister mark like the little gallows in a game of hangman that indicated the start of a paragraph (paragraphs weren't indented until much later); and, significantly here, the *virgula suspensiva*, which looked like our present-day *solidus* or forward slash (*/*), and was used to mark the briefest pause or hesitation. Perhaps the key thing one needs to realize about the early history of punctuation is that, in a literary culture based entirely on the slavish copying of venerated texts, it would be highly presumptuous of a mere scribe to insert helpful marks where he thought they ought to go. Punctuation developed slowly and cautiously not because it wasn't considered important, but, on the contrary, because it was such intensely powerful ju-ju. Pause in the wrong place and the sense of a religious text can alter in significant ways. For example, as Cecil Hartley pointed out in his 1818 *Principles of Punctuation: or, The Art of Pointing*, consider the difference between the following:

“Verily, I say unto thee, This day thou shalt be with me in Paradise.”

and:

“Verily I say unto thee this day, Thou shalt be with me in Paradise.”

---

Punctuation directs you how to read,  
in the way musical notation directs a  
musician how to play.



---

Now, huge doctrinal differences hang on the placing of this comma. The first version, which is how Protestants interpret the passage (Luke, xxiii, 43), lightly skips over the whole unpleasant business of Purgatory and takes the crucified thief straight to heaven with Our Lord. The second promises Paradise at some later date (to be confirmed, as it were) and leaves Purgatory nicely in the picture of the Catholics, who believe in it.

For a considerable period in Latin transcriptions, there were no gaps between words, if you can credit such madness. Texts from that benighted classical period—just capital letters in big square blocks—look to modern eyes like those word-search puzzles that you stare at for 20 minutes or so, and then (with a delighted cry) suddenly spot the word “PAPER NAPKIN” spelled diagonally and backwards. However, the *scriptio continua* system (as it was called) had its defenders at the time. One 5th-century recluse called Cassian argued that if a text was slow to offer up its meaning, this encouraged not only healthy meditation but the glorification of God—the heart lifting in praise, obviously, at the moment when the word “PAPER NAPKIN” suddenly floated to the surface, like a synaptic miracle.

Isn't this history interesting? Well, I think so—even though, for a considerable time, admittedly, not much happened. That imaginative chap Charlemagne (forward-looking Holy Roman Emperor) stirred things up in the 9th century when Alcuin of York came up with a system of *positurae* at the ends of sentences (including one of the earliest question marks), but to be honest, western systems of punctua-

tion were damned unsatisfactory for the next 500 years until one man—one fabulous Venetian printer—finally wrestled with the issue and pinned it to the mat. That man was Aldus Manutius the Elder (1450-1515), and I will happily admit I hadn't heard of him until about two years ago, but am kicking myself that I never volunteered to have his babies.

The heroic status of Aldus Manutius the Elder among historians of the printed word cannot be overstated. Who invented the italic typeface? Aldus Manutius! Who printed the first semicolon? Aldus Manutius! The rise of printing in the 14th and 15th centuries meant that a standard system of punctuation was urgently required, and Aldus Manutius was the man to do it. In *Pause and Effect* (1992), Malcolm Parkes's magisterial account of the history of punctuation in the West, facsimile examples of Aldus's groundbreaking work include a page from Pietro Bembo's *De Aetna* (1494), which features not only a very elegant roman typeface but the actual first semicolon (and believe me, this is exciting). Of course we did not get our modern system overnight, but Aldus Manutius and his grandson (conveniently of the same name) are generally credited with developing several of our modern conventional signs. They lowered the *virgule* and curved it, for a start, so that it began to look like the modern comma. They put colons and full stops at the ends of sentences. Like this. And also—less comfortably to the modern eye—like this:

Most significantly of all, however, they ignored the old marks that had aided the reader-aloud. Books were now for reading and understanding, not intoning. Moving your lips was becoming a no-no. Within the 70 years it took for Aldus Manutius the Elder to be replaced by Aldus Manutius the Younger, things changed so drastically that in 1566 Aldus Manutius the Younger was able to state that the main object of punctuation was the clarification of syntax. Forget all that stuff about the spiritual value to the reader of working out the meaning for himself; forget as well the humility of those copyists of old. I'm sure people did question whether Italian printers were quite the right people to legislate on the meaning of everything; but on the other hand, *resistance was obviously useless against a family that could invent italics.*

After journeying through the world of punctuation, and seeing what it can do, I am all the more convinced we should fight like tigers to preserve our punctuation, and we should start now. There is more at stake than the way people read and write.

If we value the way we have been trained to think by centuries of absorbing the culture of the printed word, we must not allow the language to return to the chaotic *scriptio continua* swamp from which it so bravely crawled less than 2,000 years ago. We have a language that is full of ambiguities; we have a way of expressing ourselves that is often complex and allusive, poetic and modulated; all our thoughts can be rendered with absolute clarity if we bother to put the right dots and squiggles between the words in the right places. Proper punctuation is both the sign and the cause of clear thinking. If it goes, the degree of intellectual impoverishment we face is unimaginable. □

## Fantastic Journey

(Continued from page 37)

is a long island or two.

He knows that Vasco Núñez de Balboa climbed a peak in Central America in 1513 and looked out at a sea. No one realizes that Balboa stood at the narrow waist between two giant continents—the only place where the Atlantic and Pacific Oceans are relatively close. No one knows for sure how big Earth actually is. And almost everyone believes there is only one ocean and that the new land is a minor interruption in the great Ocean Sea. Magellan studies everything that is known about the Americas. Besides that, Magellan has brought a slave, Enrique, from the Malay Islands. Enrique knows the Spice Islands region, and he has a talent for languages. With him, Magellan is as well prepared to travel to the Spice Islands as any European in his time could be.

Perhaps you know the story: of the mutiny and Magellan's strength in thwarting it. Of the discovery of a strait at the tip of South America and of the terrors and the tortuous twists of its waters. (It takes 38 days to get through it.) Of the second mutiny, when those who sail the largest of the ships turn around and head back to Spain with most of the expedition's provisions. Of the awful voyage across the enormous Pacific—99 days without fresh food. Of Magellan's leadership and example during all that harrowing time. And, finally, of the landing on an island where Enrique talks to the natives and they answer him. He is speaking their language!

Magellan realizes that Enrique has arrived home. He is the first man to sail around the world. Magellan has found the East by sailing west. But the *capitán-general* doesn't have long to celebrate. They are in the Philippine Islands, and Magellan is about to be killed in a senseless battle.

**W**hat does all this have to do with science? A whole lot: It's one thing to have a theory. It is something else to have a proof. Science depends on both.

Pythagoras believed the Earth was round. Two thousand years later, Magellan proved he was right. That knowledge electrifies the medieval world. After the surviving sailors arrive in Seville on Magellan's worn-out, worm-eaten vessel (the only ship left from the expedition), couriers (messengers) race across Europe to carry the news to the pope. Soon, everyone knows of the voyage. Their picture of Earth changes. They learn that when Magellan and his crew sailed near the antipodes—what they thought was the bottom of the Earth—they hadn't been upside down.

Magellan's voyagers had sailed around the globe and had not seen any sea monsters. That was important knowledge. And then there was Magellan's discovery of the vastness of the Pacific Ocean. This was no little sea. If all the Earth's landmasses could be dumped into the Pacific, there would still be plenty of water left for swimming. And Europeans hadn't even known that ocean existed! Can you imagine how that knowledge stretched their minds?

There was still more. The voyage was a great technological

(Continued on page 48)

## Practicing Prevention

(Continued from page 23)

program, and the results they're getting are really good."

The change, she says, came when teachers began seeing the hard data after the first half-year. "It was like the flip of a switch," she remarks.

Kindergarten teacher Elizabeth Radke notes that "having more intentional instruction and more direct instruction to their levels was helping" the strugglers.

The other thing that changed kindergarten teachers' minds, besides the data, was the depth of the district's investment in the program. "We couldn't do it without all the support," says kindergarten teacher Linda Tindal. "It wouldn't work if I had to try to run four reading groups by myself. But our district is very committed to it, and it's wonderful."

With students entering first grade more prepared, they catch on more quickly. To accommodate those stronger learners, teachers are making adjustments. Reading coordinator Wolter had to scramble for appropriate reading materials when the first wave of better-prepared students hit first grade.

"Most of the kids come in, if they've been here, knowing the majority of their letter names and sounds," says first-grade teacher Vivian Ewing. "They're really ready to take off with the reading. It's amazing to see, because it used to be that out of a class this size, a third of them knew all the letter names and sounds, a third of them knew about 10, and a third of them hadn't had any experience or they'd had experience but it wasn't consistent enough."

Wolter has seen the same effects. "Even Title I classrooms don't have as many kids in them as they used to," she says. "And the kids are doing higher skills"—not the typical Title I work. Another outcome, she says, is that many Title I first-graders are new kids moving in who haven't experienced an academic kindergarten. "So," she says, "we need to start all over with them."

A major impact of the program has been in special education classrooms. There are many fewer kids in special education; and those who are there have much more severe, hard-to-remedy reading difficulties.

"They're really challenging" says Clear Lake's special education teacher Linda Duke. Still, Duke likes the new continuity between special and regular education. For instance, she uses the same DIBELS system of progress monitoring that the regular teachers use, just more frequently. Sometimes teachers are using the same direct instruction programs with their low readers as she does in the resource room. And when she mainstreams a child, various interventions, such as an oral reading fluency lab, are available in the regular program, allowing the child to keep working on key reading skills.

"The teachers are working together and the whole system is so fluid that we can move kids in and out of programs," she says. Meanwhile, to determine how best to help the kids who are not responding adequately to the reading interventions, the district is involved in federally funded research studies with the University of Oregon.

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"It wouldn't work if I had to try to run four reading groups by myself. But our district is very committed to it, and it's wonderful."

—Linda Tindal  
Kindergarten Teacher

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## "I Can Do It"

The most dramatic changes in Bethel are in student performance. The statistics tell part of the story. Compare, for example, the first-grade oral reading fluency scores\* of kids who move to the district in the fall of first grade with scores of kids who enter in the fall of kindergarten. At the beginning of first grade, there's a significant difference between the groups, says Braun. By spring, the new kids have not caught up. They are still 10 words behind in oral reading fluency. For kids who enter the district in second grade, the end-of-year difference is 22 words per minute.

"Kids who have been here are reading 25 percent faster than kids who came in at the beginning of second grade," Braun reports. Late-entering students, in fact, are Bethel's next challenge, particularly with its high mobility rate. Between the beginning of kindergarten and the beginning of first grade, the district loses about 22 percent of its original kindergarten class and gains about 20 percent in new students in first grade.

Scores and statistics, however, don't tell the whole story. Changes have shown up, too, in student behavior. "Previously, kids were starting to misbehave because they were having difficulty with skills," says Wolter. "By putting them in a small group, by getting them right where their skill level is, we alleviate some of those problems. They start feeling good about themselves, and they don't have to act out."

Clearly, Brandon is one child who feels confident in his abilities. He likes to tell about the letters he's learned and show off how fast he can spell his name. "There's a lot of stuff I do in Reading Raccoons," he says. "We do Writer's Warm-Up, and that's hard. But," he reports with pride, "I can still do it." □

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\*The DIBELS measure of Oral Reading Fluency—the number of words a student can read correctly in one minute—is a reliable predictor of how well a student will do on later comprehension tests, such as the Oregon State Assessment.

# Avoiding the Downward Spiral

(Continued from page 19)

ported evidence suggesting enormous differences in the amount of reading done by good and poor fifth-grade readers outside of school. A child at the 90th percentile of reading ability may read as many words in two days as a child at the 10th percentile reads in an entire year outside of school. Reading practice varies directly with the severity of a child's reading disability, so children with severe reading disabilities receive only a very small fraction of the total reading practice obtained by children with typical reading skills. (To read the article, "What Reading Does for the Mind," go to [www.aft.org/pubs-reports/american\\_educator/spring\\_sum98/cunningham.pdf](http://www.aft.org/pubs-reports/american_educator/spring_sum98/cunningham.pdf).) Nevertheless, research to refine and increase the effectiveness of remedial interventions continues. An ongoing study of four different remedial programs for third- and fifth-grade students in 50 schools is designed to figure out which strategies work best with which students and which programs are most cost effective for schools to implement. Preliminary results will be available in January 2005; for more information, see [www.hann4kids.org/power4kids/](http://www.hann4kids.org/power4kids/).

The results of intervention research have several important implications for education practice. First, schools must focus powerfully on preventing the emergence of early reading weaknesses—and the enormous reading practice deficits that result from prolonged reading failure—through excellent core classroom instruction and intensive, explicit interventions for children who are identified through reliable indicators as at risk of failure. One of the most important goals of preventive instruction should be to maintain fundamental word-reading skills for at-risk children within the average range so that they can read independently and accurately—and with enjoyment. If they do, it is likely that they will experience roughly typical rates of growth in their sight word vocabularies and thus be able to maintain more nearly average levels of reading fluency as they progress through the elementary school years.

Second, schools must find a way to provide interventions for older children with reading disabilities that are appropriately focused and sufficiently intensive. The evidence presented here shows that with such instruction older students can make substantial gains. Simultaneously, our expectations about what constitutes reasonable progress in reading for older children with reading disabilities needs to be adjusted; until our methods are greatly improved, fluency is not likely to rise to average levels over any reasonable intervention period.

Providing the instruction that children at risk of reading failure need will require a great deal of staff development. As an AFT publication is titled, *Teaching Reading Is Rocket Science*—and most teachers have not been provided with the training necessary. (To read *Teaching Reading Is Rocket Science*, go to [www.aft.org/pubs-reports/downloads/teachers/rocketsci.pdf](http://www.aft.org/pubs-reports/downloads/teachers/rocketsci.pdf).) It will also require that schools incorporate into their regular life the use of early reading

screening and progress-monitoring assessments on a regular basis beginning in kindergarten. And it will require both a reallocation of staffing resources and new resources to assure that children who need an intervention get it—immediately. It will take work and it will be expensive. But we know it can be done. And we know it works. □

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## Fantastic Journey

(Continued from page 43)

feat. When Magellan's crew arrived back in Spain, according to Pigafetta, the voyage had covered 81,449 kilometers. That's 50,610 miles. Columbus sailed only about 4,100 kilometers (2,548 miles) on his first voyage. Like the first trip to the Moon, Magellan's voyage showed what human intelligence and daring can do. It energized a Western world that, after 1,000 years of semi-hibernation, was doing more than yawning. It was getting ready to wake up and run. This new information would help make that possible. For those who thought scientifically, Magellan changed everything. □

## Early Screening

(Continued from page 16)

study, with middle and junior high school students with reading disabilities, the correlation between oral reading fluency and the reading comprehension measure was a nearly perfect .91. More recently, researchers comparing third graders' performance on the Dynamic Indicators of Basic Early Literacy Skills measure of Oral Reading Fluency to their scores on state assessments of reading comprehension have found correlations of .70 with the Florida Comprehensive Assessment Test (Buck and Torgesen, 2003) and .73 with the North Carolina end-of-grade assessment (Barger, 2003).

—EDITORS

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AFT Online is proud to unveil a new look for the union's Web site. We have made it more streamlined, with easier navigation and attractive graphics.

We also moved frequently requested pages—such as hot topics and the AFT salary survey—to a regular spot on the home page to allow easier access. We can also bring more up-to-date news from the union to our members and the public.

Check us out at [www.aft.org](http://www.aft.org).

The image displays three overlapping screenshots of the AFT website. The top screenshot shows the home page with a navigation menu for teachers, higher education, paraprofessionals & school-related personnel, public employees, healthcare, retirees, and parents. A sidebar on the left lists categories like news, hot topics, and salary surveys. The middle screenshot shows the 'Teachers' page with a featured article titled 'NCLB: Its Promise, Its Promise' and a search bar. The bottom screenshot shows the 'American Educator' page, featuring a list of articles and a sidebar with contact information.

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