AMERICAN FEDERATION OF TEACHERS
SPRING 1991

# AMERICAN Educator

## Polishing the Stone

How Asian Teachers Perfect their Lessons

# Conventional wisdom says quantity. But Macintosh ha


Wagon Train 1848 *from MECC encourages cooperative learning and decision making on a simulated journey across the Old West.*


English Express *from Davidson and Associates uses multimedia technology to teach English to limited-English proficient students.*


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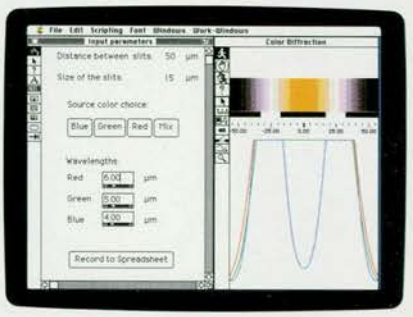


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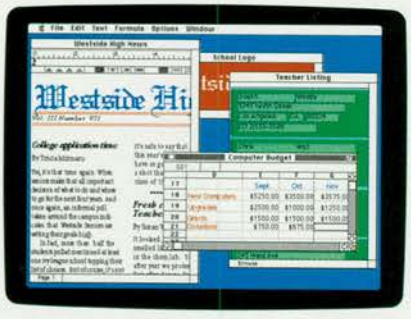


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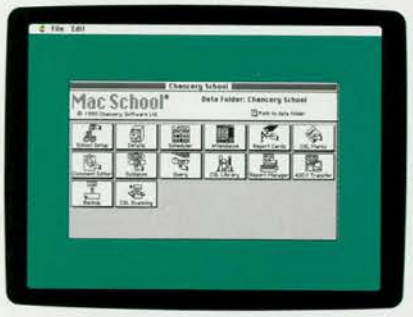


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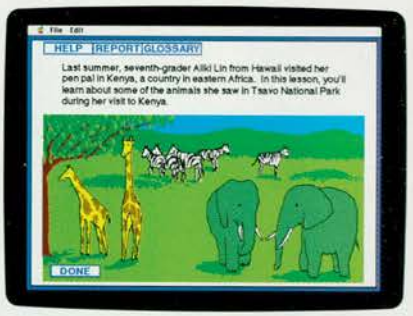


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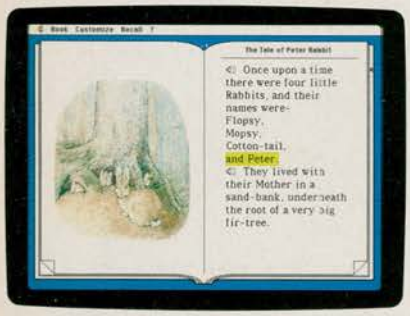


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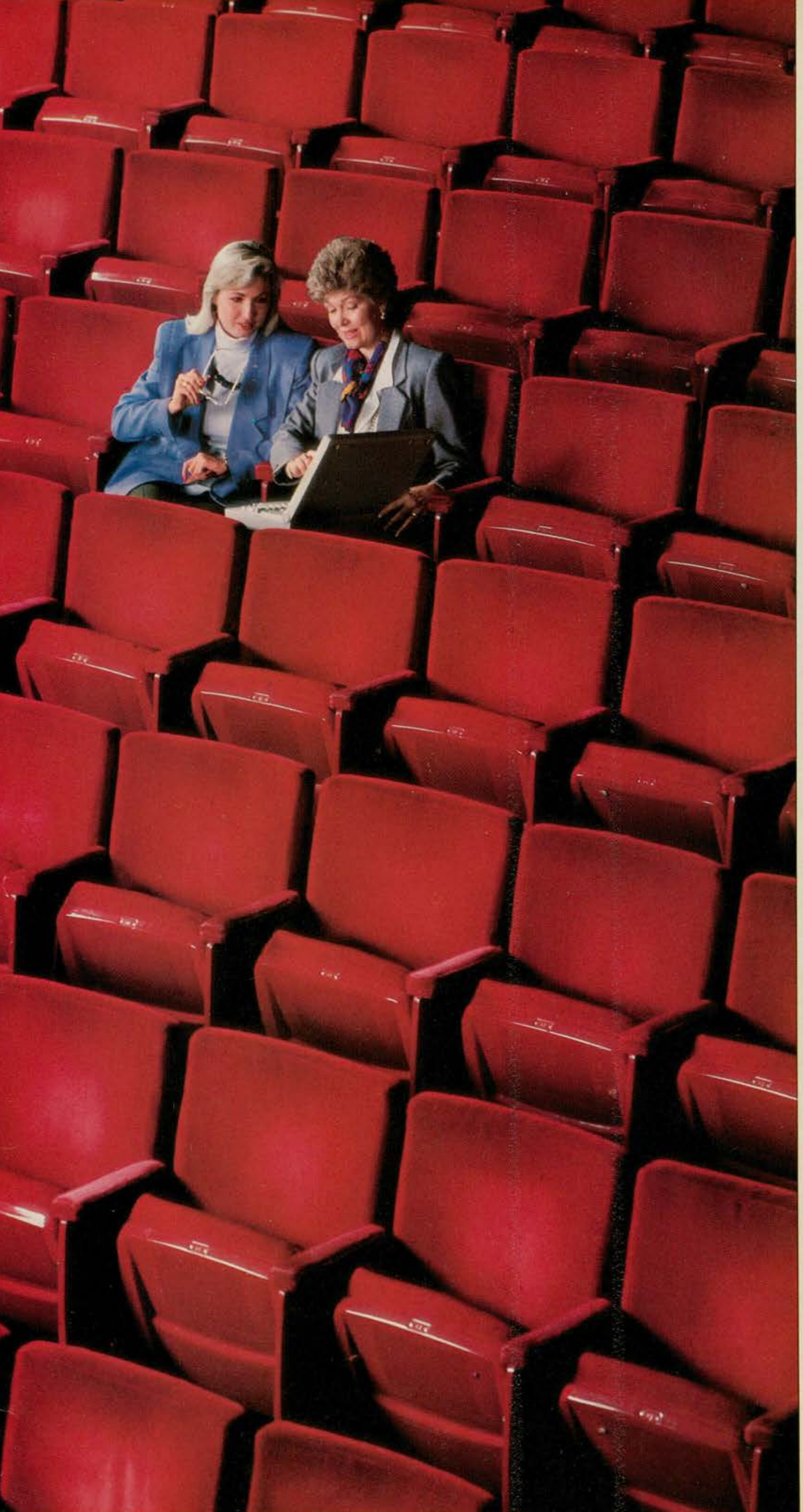

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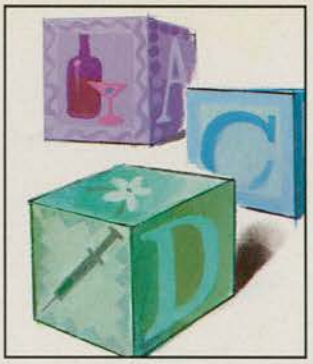

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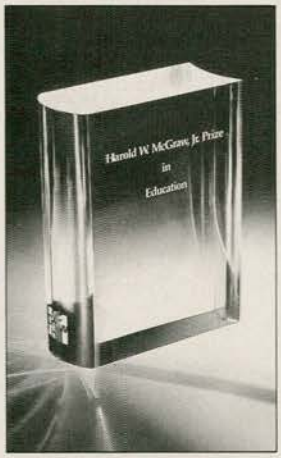
# AMERICAN Educator

# The Harold W. McGraw, Jr. Prize in Education

# Three who make a difference: Announcing the 1990 winners of the McGraw Prize in Education.




The Harold W. McGraw, Jr. prize was established in 1988, in celebration of McGraw-Hill's 100th anniversary and in honor of our chairman emeritus.

Each year, up to three $25,000 prizes are awarded to people who have made a difference in education.

For 1990, the Board of Judges selected these three individuals for distinguished contributions to the advancement of education.

***James P. Comer, M.D.***

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The 42 public schools in New Haven, Connecticut, use his methods, as do more than 100 others in eight states. The results: a better learning climate, dramatically reduced behavioral problems and climbing achievement levels.

***Clark Kerr***

Clark Kerr was a major force in the transformation of American higher education after World War II.

Dr. Kerr recognized, long before the need, the emerging educational requirements of a booming California population and a rapidly changing society. As president of the University of California from 1958-1967, Dr. Kerr created a system renowned for intellectual excellence, pioneering research and quality education at reasonable cost. Today, more than 160,000 students at the university's nine campuses are nurtured by this environment.

Great achievements cannot be attributed easily to any individual, but behind the University of California are the intelligence, resourcefulness and vision of Clark Kerr.

***Dr. Richard C. Wallace, Jr.***

Richard C. Wallace restored public confidence in Pittsburgh's public schools during the 1980s by building alliances with business and teachers, and starting programs that had a strong impact on student achievement and the dropout rate.

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As superintendent of schools, Dr. Wallace has infused the community with faith in local schools and reliance on the efficacy of educational reform.

For more information, write to The Harold W. McGraw, Jr. Prize in Education, McGraw-Hill, Inc., 1221 Avenue of the Americas, New York, NY 10020.

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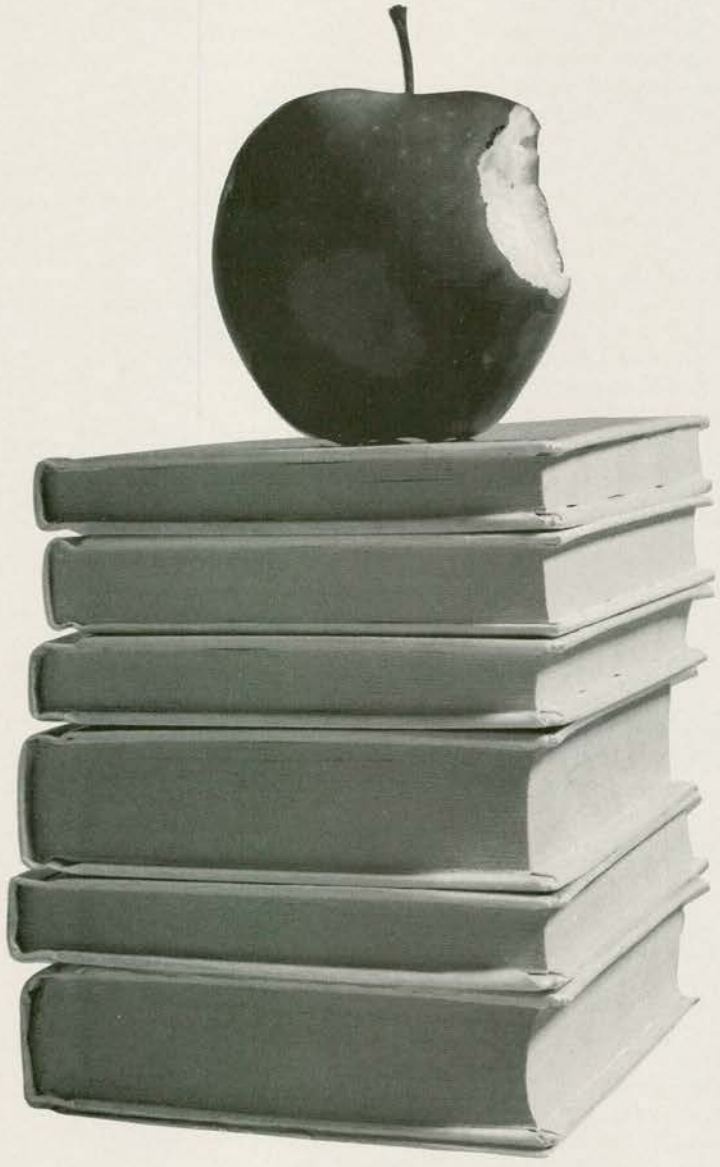

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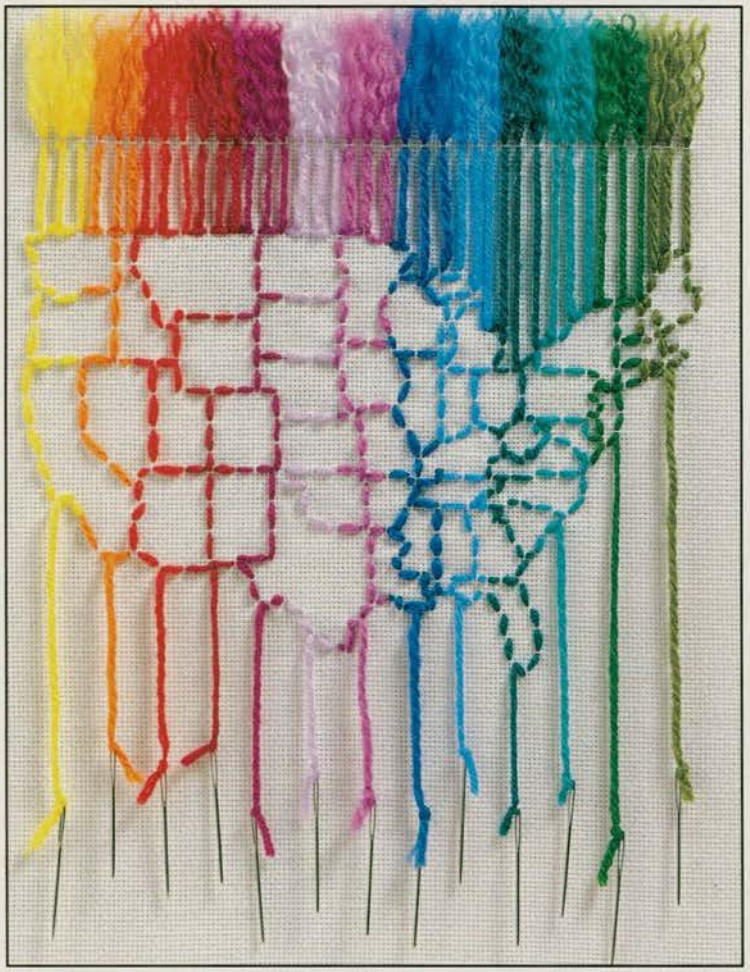
# The Universal Classroom

## Locution á la Lincoln



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By Mitzi Witkin

*As it has always been, America remains a nation of many cultures, races, languages, and religions. In the last two decades alone, over 7.8 million people journeying from over 150 different countries and speaking dozens of different languages came to make this country their new home. For children of diverse cultures, the American public school, in its long common school tradition, continues to be the most important meeting ground for the great American experiment. Here, citizens old and new come to know each other, to appreciate the vitality of diversity, and to learn of the common heritage that will bind them together.*

*We invite our readers to tell the stories of their universal classrooms, of the critical role our public schools play in forging one nation. Essays should be 750 to two thousand words, and we will pay $150 for any that we publish. Send to "The Universal Classroom,"* American Educator, *555 New Jersey Avenue, N.W., Washington, DC 20001.*

—Editor

Last year, the administration took the unusual measure of placing six foreign students with little knowledge of English in my regular eighth-grade English class scheduled during agony time—the last period of the day. The reason for the measure was expediency itself. Their English as a Second Language (ESL) teacher was a part timer, her workday ending before the last period.

Five boys and one girl, they were an international group originating from South America, Iran, and China. Polite, obedient, and nervous, at first, they remained a mute audience for some weeks while the rest of us carried on, for the most part, as actors performing our regular English program for them. When an animated debate followed a discussion of Jack London's attitude toward women as represented by Mercedes in *The Call*

*Mitzi Witkin teaches eighth-grade English at Great Neck North Middle School in Great Neck, New York. A teacher for seventeen years, she holds a Ph.D. in English literature from the City University of New York.*

*of the Wild,* they looked on with puzzled and concerned expressions. They smiled when we laughed and remained cautious the rest of the time.

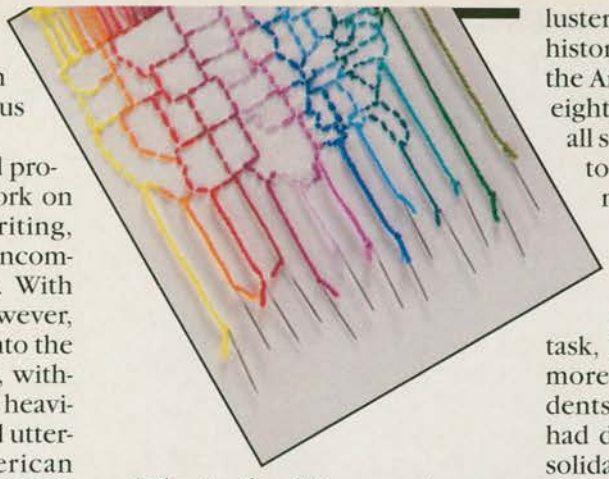
Although their ESL teacher had provided them with materials to work on while the regular class was writing, their separate position became uncomfortable, even unnatural, for us. With the help of Abraham Lincoln, however, I found a way to integrate them into the regular classroom setting so that, within a short time, their halting and heavily accented voices could be heard uttering the noblest words of American English—the Gettysburg address.

The assignment that broke the ice was a simple project to memorize Lincoln's Gettysburg address using a collaborative approach. I did not realize at the time I conceived this assignment that reciting by memory would place these foreign students on a near-equal footing with the others. After all, to most of my regular eighth graders, the Gettysburg address might have been written in a foreign language. Its simple, careful, measured style was so different from their own rambling discursiveness. They, like the foreign students, would have to focus intently on the words in order to understand them and commit them to memory.

Two weeks before Lincoln's birthday, I distributed to every student a copy of the Gettysburg address with notes on its occasion and lore.* For the first couple of days, we discussed content and historical background. I then divided the class into six groups placing one foreign student in each group of four. Since collaborative learning necessitates rules, I set down a few: First, each group had to identify itself with a name that reflected the task. Second, each group had to decide how to divide the speech so that each of four persons could memorize a section that was fair for the group and manageable for the individual. Third, everyone in the group was responsible for teaching the meaning of the address to the others and for constructively correcting elocution.

I used myself to model reading the address but also called on a few eager readers to experiment with variations of phrasing, pace, and emphasis. This helped clarify meaning and provided insight into understanding where passages might be broken for individual assignment.

The introduction of a new project in a middle school classroom, especially one that offers an opportunity for social interaction and personal performance, is invariably greeted with the enthusiasm of a Fourth of July celebration. This particular project glowed with the added luster of reliving spoken American history and included voices new to the American way of life. True to the eighth-grade spirit of camaraderie, all students rose to what they came to see as two historical epiphanies—one in Gettysburg, the other right here in their classroom. I had to close the door to contain their zeal.



***Their halting voices could be heard uttering the noblest words of American English.***

As they started their group task, I was not surprised to see the more outspoken, extroverted students dominate. Once each group had decided on its name, however, solidarity prevailed. The names provided each group with a club identity. Such names as Gettysburg Girls and The Patriots bestowed on each member a new and shared identity that included the foreign student member as well.

A few difficulties surfaced in executing the remainder of the task. These hardships, however, evolved as illuminating experiences for the children and for me. Since it was evident that the foreign student member of the group could neither memorize as long a portion as the others nor pronounce it as smoothly, the group had to decide which sentences would be, as Lincoln said, "fitting and proper." Each group decided on a different segment for the foreign student member. One group wanted the foreign student to start the address, if only through "continent," a total of thirteen words. Other groups found a sentence or phrase later in the address more suitable for their foreign member. In making these assignments, students discovered one another as well as the language of the speech. As each student selected a portion of the address based on his or her own ability to tackle it, the groups as a whole came to understand the foreign students as individuals who, like themselves, differed in ability to comprehend, memorize,and enunciate.

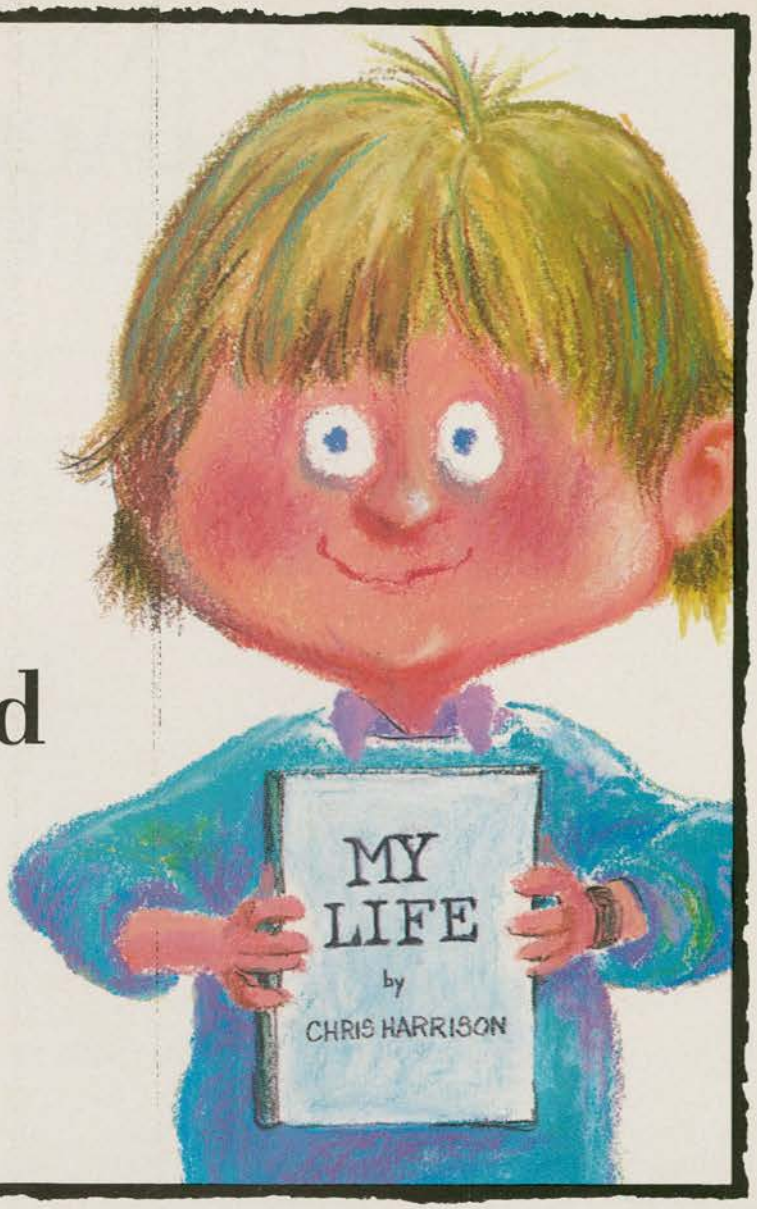
Even more important was the support they gave one another and especially to the foreign students. As Maria, Ali, Juan, Miron, Lin, and Michael struggled to enunciate their portion, the others in their groups stood behind them, listening and offering encouragement. When the foreign students would falter and finally overcome the pitfalls of articulation, they were greeted with applause and cheers. I'd never expected my classroom to resemble a sporting event.

We spent one week on preparations and another week on the actual delivery. Never was oratory so mixed. Some rushed, some declaimed, others stumbled, but all were truly eloquent.

The world will little note nor long remember what Maria, Ali, Juan, Miron, Lin, and Michael did in my class last February, but I know that they and their classmates will. □

*One remarkable fact about the Battle of Gettysburg is the number of dead. In three days, 51,000 fell. More Americans died in that battle than in the fourteen years of the Vietnam War.

# Five Year Old Writes Life Story.

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# How Asian Teachers Polish Each Lesson to Perfection

By James W. Stigler and Harold W. Stevenson

ALTHOUGH THERE is no overall difference in intelligence, the differences in mathematical achievement of American children and their Asian counterparts are staggering.[1]

Let us look first at the results of a study we conducted in 120 classrooms in three cities: Taipei (Taiwan); Sendai (Japan); and the Minneapolis metropolitan area. First and fifth graders from representative schools in these cities were given a test of mathematics that required computation and problem solving. Among the one hundred first-graders in the three locations who received the lowest scores, fifty-eight were American children; among the one hundred lowest-scoring fifth graders, sixty-seven were American children. Among the top one hundred first graders in mathematics, there were only fifteen American children. And only one American child appeared among the top one hundred fifth graders. The highest-scoring American classroom obtained an average score lower than that of the lowest-scoring Japanese classroom and of all but one of the twenty classrooms in Taipei. In whatever way we looked at the data, the poor performance of American children was evident.

These data are startling, but no more so than the results of a study that involved 40 first- and 40 fifth-grade classrooms in the metropolitan area of Chicago—a very representative sample of the city and the suburbs of Cook County—and twenty-two classes in each of these grades in metropolitan Beijing (China). In this study, children were given a battery of mathematics tasks that included diverse problems, such as estimating the distance between a tree and a hidden treasure on a map, deciding who won a race on the basis of data in a graph, trying to explain subtraction to visiting Martians, or calculating the sum of nineteen and forty-five. There was no area in which the American children were competitive with

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*This article is based on a forthcoming book by Harold W. Stevenson and James Stigler, tentatively entitled* Cultural Lessons: A New Look at the Education of American Children, *to be published by Summit Books.*

ILLUSTRATED BY DAN SHERBO

those from China. The Chinese children's superiority appeared in complex tasks involving the application of knowledge as well as in the routines of computation. When fifth graders were asked, for example, how many members of a stamp club with twenty-four members collected only foreign stamps if five-sixths of the members did so, 59 percent of Beijing children, but only 9 percent of the Chicago children produced the correct answer. On a computation test, only 2.2 percent of the Chinese fifth graders scored at or below the mean for their American counterparts. All of the twenty Chicago area schools had average scores on the fifth-grade geometry test that were below those of the Beijing schools. The results from all these tasks paint a bleak picture of American children's competencies in mathematics.[2]

The poor performance of American students compels us to try to understand the reasons why. We have written extensively elsewhere about the cultural differences in attitudes toward learning and toward the importance of effort vs. innate ability and about the substantially greater amounts of time Japanese and Chinese students devote to academic activities in general and to the study of math in particular.[3] Important as these factors are, they do not tell the whole story. For that we have to take a close look inside the classrooms of Japan, China, and the United States to see how mathematics is actually taught in the three cultures.

## Lessons Not Lectures

If we were asked briefly to characterize classes in Japan and China, we would say that they consist of coherent lessons that are presented in a thoughtful, relaxed, and nonauthoritarian manner. Teachers frequently rely on students as sources of information. Lessons are oriented toward problem solving rather than rote mastery of facts and procedures and utilize many different types of representational materials. The role assumed by the teacher is that of knowledgeable guide, rather than that of prime dispenser of information and arbiter of what is correct. There is frequent verbal interaction in the classroom as the teacher attempts to stimulate students to produce, explain, and evaluate solutions to problems. These characteristics contradict stereotypes held by most Westerners about Asian teaching practices. Lessons are not rote; they are not filled with drill. Teachers do not spend large amounts of time lecturing but attempt to lead the children in productive interactions and discussions. And the children are not the passive automata depicted in Western descriptions but active participants in the learning process.

We begin by discussing what we mean by the coherence of a lesson. One way to think of a lesson is by using the analogy of a story. A good story is highly organized; it has a beginning, a middle, and an end; and it follows a protagonist who meets challenges and resolves problems that arise along the way. Above all, a good story engages the reader's interest in a series of interconnected events, which are best understood in the context of the events that precede and follow it.

Such a concept of a lesson guides the organization of instruction in Asia. The curricula are defined in terms of coherent lessons, each carefully designed to fill a forty- to fifty-minute class period with sustained attention to the development of some concept or skill. Like a good story, the lesson has an introduction, a conclusion, and a consistent theme.

We can illustrate what we are talking about with this account of a fifth-grade Japanese mathematics class:

> The teacher walks in carrying a large paper bag full of clinking glass. Entering the classroom with a large paper bag is highly unusual, and by the time she has placed the bag on her desk the students are regarding her with rapt attention. What's in the bag? She begins to pull items out of the bag, placing them, one-by-one, on her desk. She removes a pitcher and a vase. A beer bottle evokes laughter and surprise. She soon has six containers lined up on her desk. The children continue to watch intently, glancing back and forth at each other as they seek to understand the purpose of this display.
>
> The teacher, looking thoughtfully at the containers, poses a question: "I wonder which one would hold the most water?" Hands go up, and the teacher calls on different students to give their guesses: "the pitcher," "the beer bottle," "the teapot." The teacher stands aside and ponders: "Some of you said one thing, others said something different. You don't agree with each other. There must be some way we can find out who is correct. How can we know who is correct?" Interest is high, and the discussion continues.
>
> The students soon agree that to find out how much each container holds they will need to fill the containers with something. How about water? The teacher finds some buckets and sends several children out to fill them with water. When they return, the teacher says: "Now what do we do?" Again there is a discussion, and after several minutes the children decide that they will need to use a smaller container to measure how much water fits into each of the larger containers. They decide on a drinking cup, and one of the students warns that they all have to fill each cup to the same level—otherwise the measure won't be the same for all of the groups.
>
> At this point the teacher divides the class into their groups *(han)* and gives each group one of the containers and a drinking cup. Each group fills its container, counts how many cups of water it holds, and writes the result in a notebook. When all of the groups have completed the task, the teacher calls on the leader of each group to report on the group's findings and notes the results on the blackboard. She has written the names of the containers in a column on the left and a scale from 1 to 6 along the bottom. Pitcher, 4.5 cups; vase, 3 cups; beer bottle, 1.5 cups; and so on. As each group makes its report, the teacher draws a bar representing the amount, in cups, the container holds.
>
> Finally, the teacher returns to the question she posed at the beginning of the lesson: Which container holds the most water? She reviews how they were able to solve the problem and points out that the answer is now contained in the bar graph on the board. She then arranges the containers on the table in order according to how much they hold and

***It is not uncommon for the Asian teacher to organize the entire lesson around the solution to a single problem.***

writes a rank order on each container, from 1 to 6. She ends the class with a brief review of what they have done. No definitions of ordinate and abscissa, no discussion of how to make a graph preceded the example—these all became obvious in the course of the lesson, and only at the end did the teacher mention the terms that describe the horizontal and vertical axes of the graph they had made.

With one carefully crafted problem, this Japanese teacher has guided her students to discover—and most likely to remember—several important concepts. As this article unfolds, we hope to demonstrate that this example of how well-designed Asian class lessons are is not an isolated one; to the contrary, it is the norm. And as we hope to further demonstrate, excellent class lessons do not come effortlessly or magically. Asian teachers are not born great teachers; they and the lessons they develop require careful nurturing and constant refinement. The practice of teaching in Japan and China is more uniformly perfected than it is in the United States because their systems of education are structured to encourage teaching excellence to develop and flourish. Ours is not. We will take up the question of why and what can be done about this later in the piece. But first, we present a more detailed look at what Asian lessons are like.

## Coherence Broken

Asian lessons almost always begin with a practical problem, such as the example we have just given, or with a word problem written on the blackboard. Asian teachers, to a much greater degree than American teachers, give coherence to their lessons by introducing the lesson with a word problem.

It is not uncommon for the Asian teacher to organize the entire lesson around the solution to this single problem. The teacher leads the children to recognize what is known and what is unknown and directs the students' attention to the critical parts of the problem. Teachers are careful to see that the problem is understood by all of the children, and even mechanics, such as mathematical computation, are presented in the context of solving a problem.

Before ending the lesson, the teacher reviews what has been learned and relates it to the problem she posed at the beginning of the lesson. American teachers are much less likely than Asian teachers to begin and end lessons in this way. For example, we found that fifth-grade teachers in Beijing spent eight times as long at the end of the class period summarizing the lessons as did those in the Chicago metropolitan area.

Now contrast the Japanese math lesson described above with a fifth-grade American mathematics classroom that we recently visited. Immediately after getting the students' attention, the teacher pointed out that today was Tuesday, "band day," and that all students in the band should go to the band room. "Those of you doing the news report today should meet over there in the corner," he continued. He then began the mathematics class with the remaining students by reviewing the solution to a computation problem that had been included in the previous day's homework. After this brief review, the teacher directed the students' attention to

the blackboard, where the day's assignment had been written. From this point on, the teacher spent most of the rest of the period walking about the room monitoring the children's work, talking to individual children about questions or errors, and uttering "shushes" whenever the students began talking among themselves.

This example is typical of the American classrooms we have visited, classrooms where students spend more time in transition and less in academic activities, more time working on their own and less being instructed by the teacher; where teachers spend much of their time working with individual students and attending to matters of discipline; and where the shape of a coherent lesson is often hard to discern.

American lessons are often disrupted by irrelevant interruptions. These serve to break the continuity of the lesson and add to children's difficulty in perceiving the lesson as a coherent whole. In our American observations, the teacher interrupted the flow of the lesson with an interlude of irrelevant comments or the class was interrupted by someone else in 20 percent of all first-grade lessons and 47 percent of all fifth-grade lessons. This occurred less than 10 percent of the time at both grade levels in Sendai, Taipei, and Beijing. In fact, no interruptions of either type were recorded during the eighty hours of observation in Beijing fifth-grade classrooms. The mathematics lesson in one of the American classrooms we visited was interrupted every morning by a woman from the cafeteria who polled the children about their lunch plans and collected money from those who planned to eat the hot lunch. Interruptions, as well as inefficient transitions from one activity to another, make it difficult to sustain a coherent lesson throughout the class period.

Coherence is also disrupted when teachers shift frequently from one topic to another. This occurred often in the American classrooms we observed. The teacher might begin with a segment on measurement, then proceed to a segment on simple addition, then to a segment on telling time, and then to a second segment on addition. These segments constitute a math class, but they are hardly a coherent lesson. Such changes in topic were responsible for 21 percent of the changes in segments that we observed in American classrooms but accounted for only 4 percent of the changes in segments in Japanese classrooms.

Teachers frequently capitalize on variety as a means of capturing children's interest. This may explain why American teachers shift topics so frequently within the lesson. Asian teachers also seek variety, but they tend to introduce new activities instead of new topics. Shifts in materials do not necessarily pose a threat to coherence. For example, the coherence of a lesson does not dimin-

***No one was leading instruction 9 percent of the time in Taiwan, 26 percent in Japan, and an astonishing 51 percent of the time in the United States.***

### Video Available

A thirty-four-minute cassette depicting Japanese and Chinese classroom scenes that illustrate the techniques described in this article is available for $35. Called *The Polished Stones*, it can be ordered from Catherine A. Smith, 300 North Ingalls, 10th floor, University of Michigan, Ann Arbor, Michigan 48109. Checks should be made payable to the university.

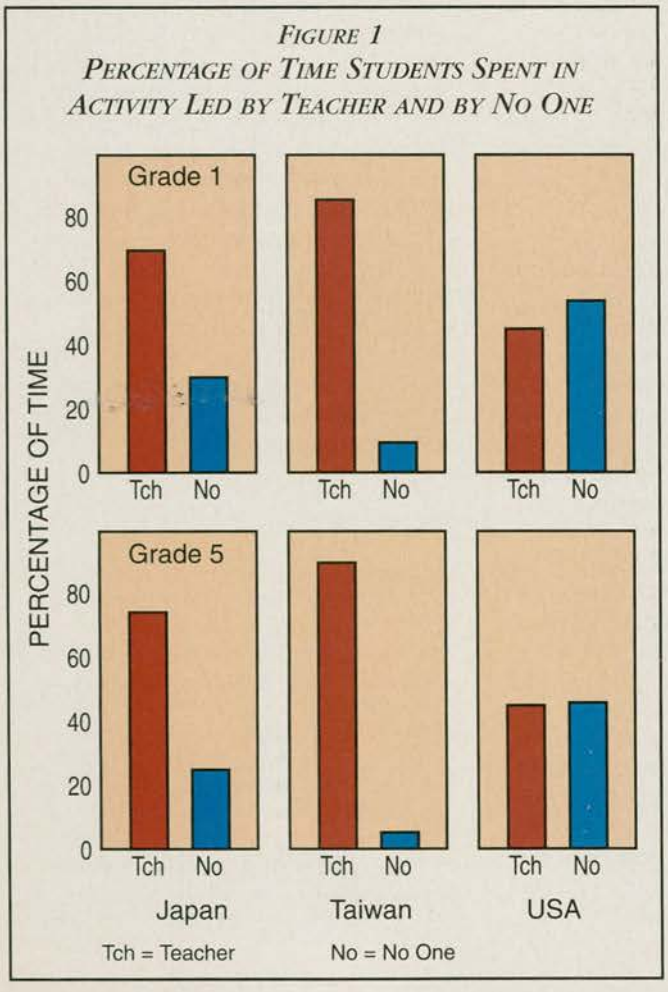
ish when the teacher shifts from working with numerals to working with concrete objects, if both are used to represent the same subtraction problem. Shifting the topic, on the other hand, introduces variety, but at the risk of destroying the coherence of the lesson.

## Classroom Organization

Elementary school classrooms are typically organized in one of three ways: the whole class is working as a unit; the class is divided into a number of small groups; or children work individually. In our observations, we noted when the child was receiving instruction or assistance from the teacher and when the student was working on his own. The child was considered to be receiving instruction whenever the teacher was the leader of the activity, whether it involved the whole class, a small group, or only the individual child.

Looking at the classroom in this manner led us to one of our most pronounced findings: Although the number of children in Asian classes is significantly greater than the number in American classes, Asian students received much more instruction from their teachers than American students. In Taiwan, the teacher was the leader of the child's activity 90 percent of the time, as opposed to 74 percent in Japan, and only 46 percent in the United States. No one was leading instruction 9 percent of the time in Taiwan, 26 percent in Japan, and an astonishing 51 percent of the time in the United States (see Figure 1).

*Figure 1*
*Percentage of Time Students Spent in Activity Led by Teacher and by No One*




Even American first graders actually spent more time on their own than they did participating in an activity led by the teacher.

One of the reasons American children received less instruction is that American teachers spent 13 percent of their time in the mathematics classes not working with any students, something that happened only 6 percent of the time in Japan and 9 percent in Taiwan. (As we will see later, American teachers have to steal class time to attend to the multitude of chores involving preparation, assessment, and administration because so little non-teaching time is available for them during the day.)

A much more critical factor in the erosion of instructional time was the amount of time American teachers were involved with individuals or small groups. American children spend 10 percent of their time in small groups and 47 percent of their time working individually. Much of the 87 percent of the time American teachers were working with their students was spent with these individual students or small groups, rather than with the class as a whole. When teachers provide individual instruction, they must leave the rest of the class unattended, so instructional time for all remaining children is reduced.

Children can learn without a teacher. Nevertheless, it seems likely that they could profit from having their teacher as the leader of their activities more than half of the time they are in the classroom. It is the incredibly large amounts of time that American children are left unassisted and the effect that unattended time has on the coherence of the larger lesson that is the problem.

When children must work alone for long periods of time without guidance or reaction from the teacher, they begin to lose focus on the purpose of their activity. Asian teachers not only assign less seatwork than American teachers, they also use seatwork differently. Chinese and Japanese teachers tend to use short, frequent periods of seatwork, alternating between group discussion of problems and time for children to work problems on their own. Seatwork is thereby embedded into the lesson. After they work individually or in small groups on a problem, Asian students are called upon to present and defend the solutions they came up with. Thus, instruction, practice, and evaluation are tightly interwoven into a coherent whole. In contrast, the average length of seatwork in American fifth-grade classrooms was almost twice as long as it was in Asian classrooms. And, instead of embedding seatwork into the ongoing back and forth of the lesson, American teachers tend to relegate it to one long period at the end of the class, where it becomes little more than a time for repetitious practice. In Chicago, 59 percent of all fifth-grade lessons ended with a period of seatwork, compared with 23 percent in Sendai and 14 percent in Taipei. American teachers often do not discuss the work or its connection to the goal of the lesson, or even evaluate its accuracy. Seatwork was never evaluated or discussed in 48 percent of all American fifth-grade classes we observed, compared to less than 3 percent of Japanese classes and 6 percent of Taiwan classes.

Since Asian students spend so much of their time in whole-group work, we need to say a word about that format. Whole-class instruction in the United States has gotten a somewhat bad reputation. It has become associated with too much teacher talk and too many passive,

tuned-out students. But as we will see in more detail as we continue our description of Asian classrooms, whole-class instruction in Japan and China is a very lively, engaging enterprise. Asian teachers do not spend large amounts of time lecturing. They present interesting problems; they pose provocative questions; they probe and guide. The students work hard, generating multiple approaches to a solution, explaining the rationale behind their methods, and making good use of wrong answers.

## Handling Diversity

The organization of American elementary school classrooms is based on the assumption that whole-group instruction cannot accommodate students' diverse abilities and levels of achievement; thus, large amounts of whole-class time are given up so that the teacher can work individually with students. Asian educators are more comfortable in the belief that all children, with proper effort, can take advantage of a uniform educational experience, and so they are able to focus on providing the same high-quality experience to all students. Our results suggest that American educators need to question their long-held assumption that an individualized learning experience is inherently a higher-quality, more effective experience than is a whole-class learning experience. Although it may be true that an equal amount of time with a teacher may be more effective in a one-on-one situation than in a large-group situation, we must realize that the result of individualized instruction, given realistic financial constraints, is to drastically reduce the amount of teacher instruction every child receives.

Japanese and Chinese teachers recognize individual differences among students, but they handle that diversity in a very different way. First, as we will see in more detail later, they have much greater amounts of non-teaching time than do American teachers, and part of that time is available for working with individual students. They may spend extra time with slower students or ask faster students to assist them, but they focus their lesson on teaching all children regardless of apparent differences in ability or developmental readiness. Before we discuss how they do that in a whole-group setting, we

## *How We Made Sure We Were Looking at Representative Schools*

FREQUENT REPORTS on television and in books and newspapers purport to depict what happens inside Japanese and Chinese classrooms. These reports usually are based on impressions gathered during brief visits to classrooms—most likely classrooms that the visitor's contacts in Asia have preselected. As a result, it is difficult to gauge the generality of what was seen and reported. Without observing large, representative samples of schools and teachers, it is impossible to characterize the teaching practices of any culture.

The descriptions that we present are based on two large observational studies of first- and fifth-grade classrooms that we conducted in Japan, Taiwan, China, and the United States. In contrast to informal observations, the strength of formal studies such as ours is that the observations are made according to consistent rules about where, when, and what to observe.

In the first study, our observers were in classrooms for a total of over four thousand hours—over a thousand class periods in 20 first- and fifth-grade classrooms in each of three cities: Sendai, Japan; Taipei, Taiwan; and Minneapolis, Minnesota.[1] Our second study took place in two hundred classrooms, forty each in Sendai and Taipei, plus forty in Beijing, China, and eighty in the Chicago metropolitan area of the United States.[2] Care was taken to choose schools that were representative. Our Chicago metropolitan area sample—the urban and suburban areas that make up Cook County—included schools that are predominantly white, black, Hispanic, and ethnically mixed; schools that draw from upper, middle, and lower socioeconomic groups; schools that are public and private; and schools that are urban and suburban.

Observers visited each classroom four times over a one- to two-week period, yielding a total of eight hundred hours of observations. The observers, who were residents of each city, wrote down as much as they could about what transpired during each mathematics class. Tape recordings made during the classes assisted the observers in filling in any missing information. These detailed narrative accounts of what transpired in the classrooms yielded even richer information than we obtained in the first study, where the observers followed predefined categories for coding behavior during the course of observations.

After the narrative records had been translated into English, we divided each observation into segments, which we defined as beginning each time there was a change in topic, materials, or activity. For example, a segment began when students put away their textbooks and began working on a worksheet or when the teacher stopped lecturing and asked some of the students to write their solutions to a problem on the blackboard.

Both studies focused on mathematics classes rather than on classes in subjects such as reading, where cultural differences in teaching practices may be more strongly determined by the content of what is being taught. For example, it is likely that the processes of teaching and learning about the multiplication of fractions transcend cultural differences, whereas teaching children how to read Chinese characters may require different approaches from those used to teach children to read an alphabetic language. □

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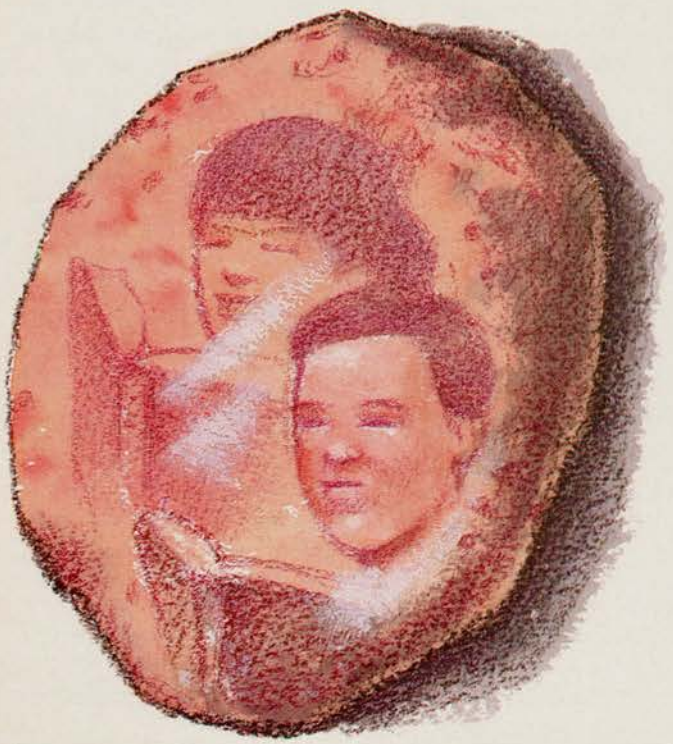
***Tracking does not exist in Asian elementary schools. This egalitarian philosophy carries over to organization within the classroom.***



need to first address the question of whether American classrooms are more diverse than Asian ones, thus potentially rendering whole-class instruction more difficult.

Whenever we discuss our research on teaching practices, someone in the audience inevitably reminds us that Japan and China are nations with relatively homogeneous populations while the United States is the melting pot of the world. How could we expect that practices used in Asian societies could possibly be relevant for the American context, where diversity is the rule in race, ethnicity, language, and social class?

What impedes teaching is the uneven preparation of children for the academic tasks that must be accomplished. It is diversity in children's educational backgrounds, not in their social and cultural backgrounds, that poses the greatest problems in teaching. Although the United States is culturally more diverse than Japan or China, we have found no more diversity at the classroom level in the educational level of American than of Asian students. The key factor is that, in the United States, educational and cultural diversity are positively related, leading some persons to the inappropriate conclusion that it is ethnic and cultural diversity, rather than educational diversity, that leads to the difficulties faced by American teachers.

It is true, for example, that there is greater variability in mathematics achievement among American than among Japanese children, but this does not mean that the differences are evident in any particular classroom. Variability in the United States exists to a large extent across neighborhoods and schools (rather than within them). Within individual classrooms, the variability in levels of academic achievement differs little between the United States and Japan, Taiwan, or China. It is wrong to argue that diversity within classrooms is an American problem. Teachers everywhere must deal with students who vary in their knowledge and motivation.

Tracking does not exist in Asian elementary schools. Children are never separated into different classrooms according to their presumed levels of intellectual ability. This egalitarian philosophy carries over to organization within the classroom. Children are not separated into reading groups according to their ability; there is no division of the class into groups differentiated by the rate at which they proceed through their mathematics books. No children leave the classroom for special classes, such as those designed for children who have been diagnosed as having learning disabilities.

How do teachers in Asian classrooms handle diversity in students' knowledge and skills? For one thing, they typically use a variety of approaches in their teaching, allowing students who may not understand one approach the opportunity to experience other approaches to presenting the material. Periods of recitation are alternated with periods in which children work for short periods on practice problems. Explanations by the teacher are interspersed with periods in which children work with concrete materials or struggle to come up with their own solutions to problems. There is continuous change from one mode of presentation, one type of representation, and one type of teaching method to another.

Asian teaching practices thrive in the face of diversity, and some practices even depend on diversity for their effectiveness. Asking students to suggest alternative solu-

tions to a problem, for example, works best when students have had experience in generating a variety of solutions. Incorrect solutions, which are typically dismissed by the American teacher, become topics for discussion in Asian classrooms, and all students can learn from this discussion. Thus, while American schools attempt to solve the problems of diversity by segregating children into different groups or different classrooms, and by spending large amounts of regular class time working with individual students, Asian teachers believe that the only way they can cope with the problem is by devising teaching techniques that accommodate the different interests and backgrounds of the children in their classrooms.

Asian teachers also exploit the fact that the same instruction can affect different students in different ways, something that may be overlooked by American teachers. In this sense, Asian teachers subscribe to what would be considered in the West to be a "constructivist" view of learning. According to this view, knowledge is regarded as something that must be constructed by the child rather than as a set of facts and skills that can be imparted by the teacher. Because children are engaged in their own construction of knowledge, some of the major tasks for the teacher are to pose provocative questions, to allow adequate time for reflection, and to vary teaching techniques so that they are responsive to differences in students' prior experience. Through such practices, Asian teachers are able to accommodate individual differences in learning, even though instruction is not tailored to each student.

## Use of Real-World Problems and Objects

Elementary school mathematics is often defined in terms of mathematical symbols and their manipulation; for example, children must learn the place-value system of numeration and the operations for manipulating numerals to add, subtract, multiply, and divide. In addition, children must be able to apply these symbols and operations to solving problems. In order to accomplish these goals, teachers rely primarily on two powerful tools for representing mathematics: language and the manipulation of concrete objects. How effectively teachers use these forms of representation plays a critical role in determining how well children will understand mathematics.

One common function of language is in defining terms and stating rules for performing mathematical operations. A second, broader function is the use of language as a means of connecting mathematical operations to the real world and of integrating what children know about mathematics. We find that American elementary school teachers are more prone to use language to define terms and state rules than are Asian teachers, who, in their efforts to make mathematics meaningful, use language to clarify different aspects of mathematics and to integrate what children know about mathematics with the demands of real-world problems. Here is an example of what we mean by a class in which the teacher defines terms and states rules:

> An American teacher announces that the lesson today concerns fractions. Fractions are defined and she names the numerator and denominator. "What do we call this?" she then asks. "And this?" After assuring herself that the children understand the meaning of the terms, she spends the rest of the lesson teaching them to apply the rules for forming fractions.

Asian teachers tend to reverse the procedure. They focus initially on interpreting and relating a real-world problem to the quantification that is necessary for a mathematical solution and then to define terms and state rules. In the following example, a third-grade teacher in Japan was also teaching a lesson that introduced the notation system for fractions.

> The lesson began with the teacher posing the question of how many liters of juice (colored water) were contained in a large beaker. "More than one liter," answered one child. "One and a half liters," answered another. After several children had made guesses, the teacher suggested that they pour the juice into some one-liter beakers and see. Horizontal lines on each beaker divided it into thirds. The juice filled one beaker and part of a second. The teacher pointed out that the water came up to the first line on the second beaker—only one of the three parts was full. The procedure was repeated with a second set of beakers to illustrate the concept of one-half. After stating that there had been one and one-out-of-three liters of juice in the first big beaker and one and one-out-of-two liters in the second, the teacher wrote the fractions on the board. He continued the lesson by asking the children how to represent two parts out of three, two parts out of five, and so forth. Near the end of the period he mentioned the term "fraction" for the first time and attached names to the numerator and the denominator.
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> He ended the lesson by summarizing how fractions can be used to represent the parts of a whole.

In the second example, the concept of fractions emerged from a meaningful experience; in the first, it was introduced initially as an abstract concept. The terms and operations in the second example flowed naturally from the teacher's questions and discussion; in the first, language was used primarily for defining and summarizing rules. Mathematics ultimately requires abstract representation, but young children understand such representation more readily if it is derived from meaningful experience than if it results from learning definitions and rules.

Asian teachers generally are more likely than American teachers to engage their students, even very young ones, in the discussion of mathematical concepts. The kind of verbal discussion we find in American classrooms is more short-answer in nature, oriented, for example, toward clarifying the correct way to implement a computational procedure.

Teachers ask questions for different reasons in the United States and in Japan. In the United States, the purpose of a question is to get an answer. In Japan, teachers

*(Continued on page 43)*

# Opening Windows for Teenagers

## *How Mentors Can Help*

By Roger S. Glass

TODAY'S HIGH school students are growing up in an increasingly complex society, one rife with problems and opportunities. It can be overwhelming for these students, to say the least.

While many young people today have a network of people dedicated to helping them become productive, responsible citizens, others are not as fortunate. While often surrounded by supportive and concerned family and friends, some youths are in need of another adult in their lives, a person willing to spend time exposing them to people and opportunities and giving them the kind of attention and encouragement that builds a youngster's self-confidence and independence.

That's where mentors come in. "The one-on-one relationship with a mentor can help a child cope with the many problems that affect life at home and at school—alienation, loneliness, low self-esteem, poor work habits, lack of basic skills, and lack of information about the community and the world of work," reads *One-on-One: A Guide for Establishing Mentor Programs.*

Mentors can help students understand the relevance of a good education by showing them the connection between school and the work world, says William Gray, president of the Canadian-based Mentoring Institute. "Students often just can't see that education and work have a connection. That has to be made clear to them."

"As students become more conscious of the opportunities around them and the possibility of postsecondary education, they'll work harder to maintain good grades. This also helps set an example for other students," says Aona Jefferson, a teacher at Woodson High School in Washington, D.C.

Mentoring programs that serve students from a range of backgrounds and with varying abilities are cropping up in school districts all over the country. Some of the programs provide a life raft to the most troubled students, youngsters who might otherwise end up pregnant, on drugs, in jail, or in gangs. Others are oriented to the average student who, with a little support and encouragement, could move from academic underachiever to college-bound senior. Still others target the best students—to ensure that they don't lose their drive, that they have the college guidance they need, that they have a place to turn if academic or social problems threaten their futures.

Some mentor programs are organized and staffed by a single corporation or service organization; others draw their volunteers from a variety of places. Some are closely tied to the school program and school structure, others only loosely so. In some programs, a single mentor is

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matched with a single student; in others, a group of mentors may "adopt" a classful of students.

But the most effective programs share common traits. First and foremost, says William Gray, they take into account the particular needs of *their* kids and offer ancillary services to meet those needs. The programs also offer training, structure, and advice to the mentor, who is taking on a potentially rewarding but often tough job. A program that simply matches mentor with student and hopes for the best is setting mentors up for failure and their charges up for one more disappointment.

Of the various types of mentoring programs, school-based ones are by far the fastest growing, says Gray. The four programs described here suggest the variety of mentoring programs that exist—mainly in, but also outside, of schools.

DERRICK JENKINS was an eighth grader when the community service organization 100 Black Men of Atlanta adopted his homeroom class. Now, he and twenty-four of his thirty-five classmates at the city's Archer High School are preparing to attend college this fall. Most of the others expect to enroll in vocational or technical schools.

Usually, only around 40 percent of Archer's graduates go on to postsecondary education.

"We made a covenant with these kids, their parents, and the community," says Herman Reese, spokesperson for the 100 Black Men of Atlanta. "We told them that if they stayed in school, got good grades, and prepared themselves for college, we'd make sure that their college tuition was paid for."

Quite a promise. But members of 100 Black Men didn't stop there. They also tutored the youngsters, served as their mentors, and provided opportunities for them to grow culturally and socially.

Archer High was chosen for the group's Project Success because of its high dropout rate and largely low-income student population. An eighth-grade homeroom was randomly selected to be the first participant in the group's innovative program.

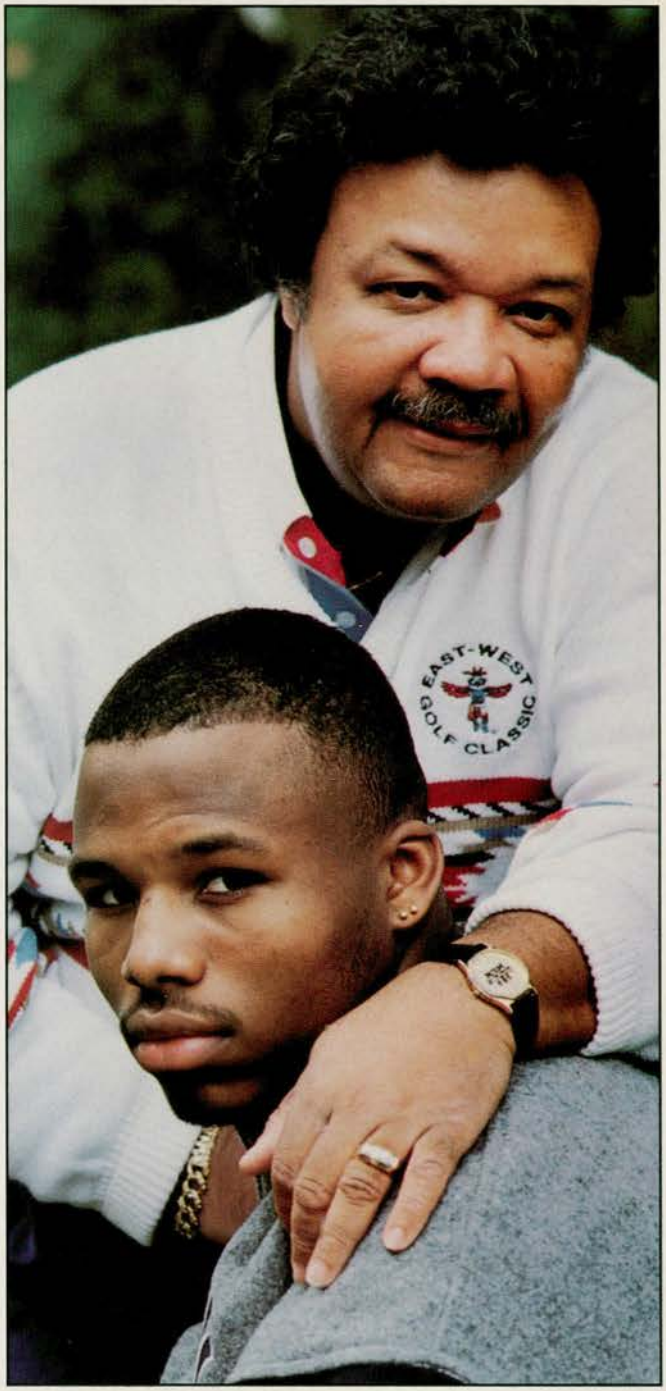
Two to three mentors—selected from among the organization's members—were assigned to each of the class's thirty-five students. They counseled and encouraged students, consulted with their teachers, took students to ball games, and introduced them to their own jobs and professional colleagues.

"We've tried to broaden their experiences by exposing them to outstanding African Americans and by taking them to book signings, educational conferences and other events," Reese explains.

The students have been the honored guests at annual luncheons featuring such speakers as author Alex Haley and Gen. Colin Powell. They have toured colleges in Tennessee, Alabama, North Carolina, Virginia, and Washington, D.C.

In 1990, 100 Black Men launched a special Saturday academy to help prepare the students for college. Taught by Atlanta public school teachers, the mandatory all-day Saturday classes include seminars on a range of academic and social subjects.

Archer senior Antonio Thomas sometimes stays with his mentor, Nathaniel Goldston III, and his family, a home where studying and school attendance are stressed. A




JEAN SHIFRIN/ATLANTA CONSTITUTION

*Nathaniel R. Goldston III with protégé Antonio Thomas from Atlanta's Project Success.*

*Lee Hughes of H.D. Woodson High School's Futures 500 Club with mentor Donna Purchase.*

MICHAEL CAMPBELL PHOTO

star athlete, Thomas is being courted by several four-year colleges, but he needs to improve his grade-point average.

Project Success is a success "by whatever measure you use," Archer principal Robert Dixon recently told the *Atlanta Constitution*. "We have more student leaders coming from this group, a larger percentage on the honor roll, higher attendance, better test scores, and on and on."

SHAYNE SCHNEIDER hoped to fill a void when she proposed a mentor program to District of Columbia public school officials more than three years ago. "There were adults in the Washington, D.C., community who were concerned about the city's youth and interested in helping but didn't know how to connect with the school system or an individual young person," says Schneider, a former teacher and now president of Mentors Inc.

What was needed, she felt, was a program that identified volunteers and matched them with students who needed and wanted mentors. The Mentors Inc. program set up by Schneider targets high school students with a "C" average. Its primary goal is to help these students finish high school and establish concrete career goals.

"In the 'C' student, I see a well of untapped potential," Schneider says. "Sometimes it's just a matter of turning the 'on' switch with these kids." Mentors Inc. has reason to boast about its "success rate": Students in the program are twice as likely to go on to college as their classmates.

Students are normally assigned a mentor in the middle of their sophomore year, a match that considers interests, hobbies and family backgrounds. Currently 350 students at ten District of Columbia high schools participate in the Mentors Inc. program.

Mentors are recruited through community organizations and church groups, alumni associations, government agencies, businesses, and many other avenues. Many of the adults who volunteer for the Mentors Inc. program "express a sense of wanting to give something back because somebody has helped them along the way," Schneider says.

At Mentors Inc., a lot of time and effort are spent in preparing mentors for their role. Mentors sign a contract that commits them to the program through the student's graduation—normally a period of two and a half-years. There is an initial day of orientation at which mentors learn specific strategies for handling such tricky tasks as "breaking the ice" with a shy teenager and establishing a relationship with the student's family.

Mentors Inc. helps its volunteers establish a productive relationship with their partners by providing information on adolescent development and suggesting a "schedule" of activities. For example, in January, normally the first month of the mentorship, pairs are expected to talk through and commit to writing the student's academic, social, and financial goals.

In later months, mentors help the students assess their progress. If specific problems exist that are holding a student back, the mentor can turn to Mentors Inc. for advice. For example, if the students' note-taking skills need strengthening, the organization recommends that the pair watch public television programs, take notes on what they saw, and then discuss the program based on their notes.

In the spring, mentors are asked to walk students through the steps necessary to land a summer job—

preparing a resume, rehearsing for a job interview, getting to interviews on time, etc. At the end of the junior year, mentors often bring students to college fairs, help them think through their college or vocational options, and guide them through the financial aid maze.

A critical element of Mentors Inc. is the followup and professional support provided by Schneider and her staff. Every mentor is called once a month to ensure that problems are being addressed. "We're there if they [mentors and proteges] run into problems, need a question answered or if any difficulties arise."

Mentors Inc. also has a Student Resource Fund for those who need money for college applications or to take the SAT. The money, which comes from foundations, corporations, and individuals, has even been used for eye exams and eye glasses for students from low-income families.

* * *

*Vivian Riefberg and Tarika Faunteroy didn't seem to have a lot in common when they met three years ago through Mentors Inc.: Vivian was white, from an upper-*

## *Making Choices*

WHAT CAN a young black middle-class male from Portland, Maine, teach a youngster from the streets of Washington, D.C., about growing up? Plenty, asserts Darryl Williams.

A little over a year ago, Williams, 29, signed on as a mentor with the Community of Hope, a privately run social services agency that serves families in one of the District of Columbia's most depressed, drug-infested neighborhoods. In addition to its mentoring program, the agency offers transitional housing for homeless families as well as legal and health services, job counseling, and other services for low-income families.

Adults who volunteer for the agency's mentoring program usually come up against youths—most either homeless or from single-parent households—for whom the thought of graduating from high school and going on to college has taken a back seat to the pressures of day-to-day survival.

Williams was paired with Louie Rucker, a streetwise youngster with huge potential but some tough decisions ahead of him. A top student in junior high school, Louie has to decide whether to follow the advice of those, like Williams, who want to see him fulfill his potential or the lead of those friends who prefer the streets to school.

Williams regularly counsels Louie on some of the pitfalls and temptations that characterize life in many inner-city neighborhoods.

"Louie has demands on him that most of us could never imagine, including unbelievable peer pressure that he's really beginning to feel now that he's in high school," his mentor says.

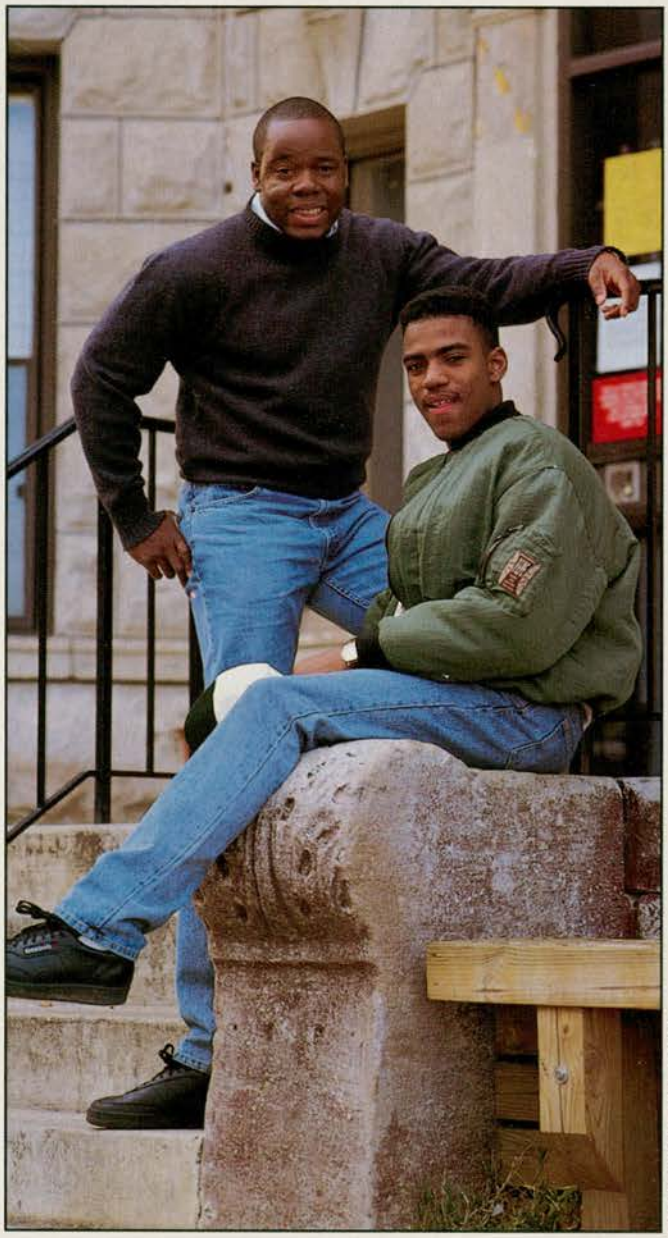
There is also the usual interest in teenage girls. "We've talked about teenage pregnancy and the impact it has on the baby's father as well as its mother," Williams says. "It's a situation I've urged him to avoid."

While there may be a world of difference between the Portland community in which he was raised and the neighborhhood in which Louie lives, Williams says he has shown Louie that "even though I come from Portland, Maine, and I have a college education, we speak the same language."

"You don't have to have grown up in the inner city to have been nurtured by the black experience and to feel an obligation to give something back," says Williams.

In addition to weekly tutoring sessions with Louie, Williams takes his protege to his church, where he introduces him to middle-class kids his age, and urges him to read the daily newspaper, which, he says, helps Louie "see beyond his immediate surroundings."

"I want him [Louie] to understand that it's not enough to have aspirations. He has to understand the process of achieving those goals." □



MICHAEL CAMPBELL PHOTO

*Louie Rucker (seated) with Community of Hope mentor Darryl Williams.*


*Tarika Faunteroy (right) and Vivian Riefberg were paired through Mentors, Inc.*

MICHAEL CAMPBELL PHOTO

*middle-class suburban family, and Harvard educated. Tarika was black, from an inner-city Washington, D.C., neighborhood, the product of a single-parent home and still in high school.*

*Yet, if you ask them today for the highlight of their mentoring relationship, you'd get the same answer from both of them—they've become fast friends.*

*"I think we've been lucky because we're really good friends" as well as mentor and protege, Vivian says. Riefberg hoped that the relationship would give her an opportunity to help Tarika, to offer her guidance and advice. "I think in life it helps to have somebody who has been there before, who can point out some of the pitfalls."*

*From the first day Vivian met Tarika, she believed Tarika could do anything she set her mind to. Vivian hoped that perhaps she could "give her the confidence that if you want something badly enough and if you work hard enough for it there is a good chance you can get it."*

*Vivian quickly discovered that the relationship was very much a two-way street. "One of the misconceptions that I went into this with was that somehow I could help Tarika more than she could help me. This is just not true. I have gotten so much more out of this than I have given.*

*"I have a great new friend, somebody, like any friend, who will listen to and encourage me," Riefberg says. "I find myself asking Tarika for advice on my dealings with friends and co-workers or just what she thinks I should get my brother for his birthday."*

*Tarika admits that the idea of opening her life up to a total stranger was a little scary at first. "I really didn't know what to expect," she says. "I was a little bit shy at first. I had to just grow into it and open up to it, but I finally did."*

*Teamed through Mentors Inc. when Tarika was a sophomore, the pair gets together frequently—going out to dinner and plays and visiting museums and college campuses in the Washington, D.C., area. Vivian had Tarika over for a slumber party on Tarika's birthday. Tarika invited Vivian to sit in on her chemistry class to observe the teacher that Tarika thought was "really good."*

*Often a mentor can open a window on a new world of people and opportunities that the student might otherwise never see. Thanks to Mentors Inc., Vivian told Tarika about a week-long teen leadership institute offered by Washington D.C.'s Mt. Vernon College each summer; after investigating, Tarika enrolled in the program.*

*"Here's a program Tarika didn't know existed. You can't pick up the phone and try to get involved if you don't know about the program to begin with," notes Vivian.*

*Last fall, Tarika and Vivian went to Boston to see a football game at Vivian's alma mater and to visit*

*Vivian's husband, who is studying at Harvard's mid-career program. They met friends of Vivian's husband, many of whom were from other countries.*

*"That was a wonderful experience to find out what goes on in their countries," Tarika says. "There were people there who had never seen snow."*

*Also when Tarika was in Boston she saw what kind of jobs Vivian's friends had. "They asked me what college I planned to go to. That's what really started to convince me about going to college and furthering my education so that I could get a good job and have the same things they have."*

* * *

AT H.D. Woodson High School in Washington, D.C., the mentor program is part of a comprehensive program to influence the entire school's culture. Since 1988, the Federal National Home Mortgage Association (Fannie Mae) has teamed its employees with some of the inner-city high school's most promising, ambitious students. Fannie Mae also finances a variety of services for the students and employs a full-time coordinator to organize its part of the program.

## *Resources on Mentoring*

**The Mentoring Institute** is a full-service resource center. Its staff can advise you on program development and grant proposals or provide on-site training for your mentors. It publishes a regular journal *Mentoring International* and runs biennial conferences on the subject. For a catalogue, write: The Mentoring Institute, Inc. Suite 510-1200 West Pender Street, Vancouver B.C. Canada V6E 2S9 or telephone (604) 684-4134.

**Project Literacy U.S.** has available a self-contained video/print package for training new mentors; a manual, "Beginning a Mentoring Program," that includes a variety of practical materials; and a series of four short videos. For information, write Project Literacy U.S., c/o The National Media Outreach Center, QED Communications, 4802 Fifth Avenue, Pittsburgh, PA 15213. (412) 622-1491.

**United Way/One to One** publishes various manuals and kits for organizations that want to get involved in mentoring. It also offers specially developed software that can help match and track mentors and students, and it will soon offer a train-the-trainer curriculum. For information, write: United Way of America, 701 North Fairfax Street, Alexandria, VA 22314, Attn.: Mary Phillips.

**The Abell Foundation** publishes a comprehensive manual on developing and implementing mentoring programs and a new handbook for mentors on the mentor relationship. Write to the Abell Foundation, #1116 Fidelity Building, 210 N. Charles Street, Baltimore, MD 21201. □

Any student who earns all A's and B's in a single semester is eligible for Woodson/Fannie Mae's "Futures 500 Club." Students in the club are assigned a mentor; granted a stipend of $500 each semester, which is deposited in an account for postsecondary education; assisted in preparing their college and financial aid applications; and considered for a summer job with Fannie Mae. The corporation also sponsors a Saturday educational enrichment session and group outings for mentors and proteges.

For example, earlier this year, mentor pairs were given the opportunity to see Avery Brooks ("Hawk" on television's "Spencer for Hire") in the Folger Shakespeare Theatre's performance of *Othello.* Pairs were asked to come to a background discussion of the play before the show. (As it turned out, the mentors needed the briefing more than the students.)

"'C' students at Woodson now have a real incentive to excel and turn those C's into A's and B's," says Aona Jefferson, who coordinates the program for the high school. "I challenge students to want to be in the club. I tell them, 'You're not a nerd for making all A's and B's. You're a nerd if you don't take advantage of this program.'"

Advice well heeded. Participation in the club has nearly tripled, from fewer than fifty students to almost 130.

Woodson's teachers have been instrumental in ensuring the program's success. "Many of the students in the program will be the first ones in their families with the opportunity to attend college," says Jefferson, "and most of their teachers feel that it's their obligation to keep those in the [Futures 500] club on target, to make sure that they are not just satisfied with graduating from high school, that they keep before them the goal of going to college."

* * *

*Donna Purchase can't take credit for her protege, Lee Hughes, earning A's and B's in his classes at H.D. Woodson High School where he is a senior. But she can lay claim to helping him understand that there are people who want to help, rather than hurt, him.*

*"When I first met Lee," Purchase recalls, "he gave me this look that seemed to say, 'What's in it for you?'"*

*"I haven't had that many people do for me, and I don't feel I need people to help me out," Lee explains. "What I get, I try to get on my own."*

*Purchase, Lee's mentor since last September, is a secretary for Fannie Mae, the federal government agency that sponsors Woodson's Futures 500 Club. Asked what she offers as a mentor, Purchase looks homeward to her three children, who, she says, "are definitely role models" for any Woodson student. "They are black, they are interested in school, they are independent.*

*"My son was like Lee in a lot of ways. He is now in the 82nd Airborne and just came back from the Middle East. He told me that 'the military is a form of life where people need other people.' I'm trying to arrange for Lee and I to go down to Fayetteville [North Carolina] for the weekend to visit him.*

*"I think that if I can give Lee anything, it will be to help him understand that there is nothing wrong with having friends or asking for help. I think if I can ever get Lee to accept that, I will have really done something.*

*(Continued on page 48)*

# CLIPPED WINGS

*The Fullest Look Yet at How Prenatal Exposure to Drugs, Alcohol, and Nicotine Hobbles Children's Learning*

BY LUCILE F. NEWMAN AND STEPHEN L. BUKA

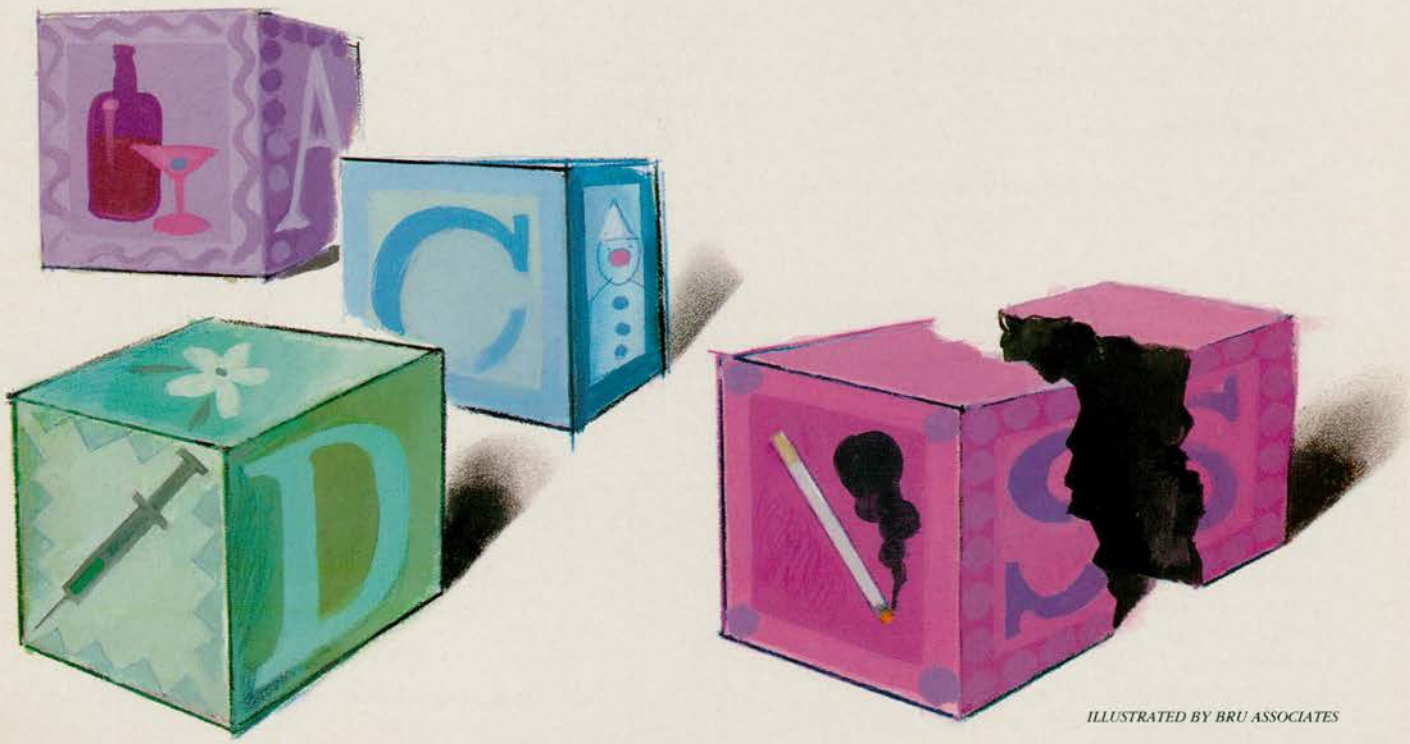
SOME FORTY thousand children a year are born with learning impairments related to their mother's alcohol use. Drug abuse during pregnancy affects 11 percent of newborns each year—more than 425,000 infants in 1988. Some 260,000 children each year are born at below normal weights—often because they were prenatally exposed to nicotine, alcohol, or illegal drugs.

What learning problems are being visited upon these children? The existing evidence has heretofore been scattered in many different fields of research—in pediatric medicine, epidemiology, public health, child development, and drug and alcohol abuse. Neither educators, health professionals, nor policy makers could go to one single place to receive a full picture of how widespread or severe were these preventable causes of learning impairment.

In our report for the Education Commission of the States, excerpts of which follow, we combed these various fields to collect and synthesize the major studies that relate prenatal exposure to nicotine, alcohol, and illegal drugs* with various indexes of students' school performance.

The state of current research in this area is not always as full and satisfying as we would wish. Most of what

*The full report for the ECS also addressed the effect on children's learning of fetal malnutrition, pre- and postnatal exposure to lead, and child abuse and neglect.




*ILLUSTRATED BY BRU ASSOCIATES*

exists is statistical and epidemiological data, which document the frequency of certain high-risk behaviors and correlate those behaviors to student performance. Such data are very interesting and useful, as they allow teachers and policy makers to calculate the probability that a student with a certain family history will experience school failure. But such data often cannot control for the effects of other risk factors, many of which tend to cluster in similar populations. In other words, the same mother who drinks during her pregnancy may also use drugs, suffer from malnutrition, be uneducated, a teenager, or poor—all factors that might ultimately affect her child's school performance. An epidemiological study generally can't tell you how much of a child's poor school performance is due exclusively to a single risk factor.

Moreover, the cumulative damage wrought by several different postnatal exposures may be greater than the damage caused by a single one operating in isolation. And many of the learning problems that are caused by prenatal exposure to drugs can be compounded by such social factors as poverty and parental disinterest and, conversely, overcome if the child lives in a high-quality postnatal environment.

All of these facts make it difficult to isolate and interpret the level and character of the damage that is caused by a single factor. Further, until recently, there was little interest among researchers in the effects of prenatal alcohol exposure because there was little awareness that it was affecting a substantial number of children. The large cohort of children affected by crack is just now entering the schools, so research on their school performance hasn't been extensive.

What does clearly emerge from the collected data is that our classrooms now include many students whose ability to pay attention, sit still, or fully develop their visual, auditory, and language skills was impaired even before they walked through our schoolhouse doors. On the brighter side, the evidence that many of these impairments can be overcome by improved environmental conditions suggests that postnatal treatment is possible; promising experiments in treatment are, in fact, under way and are outlined at the end of this article.

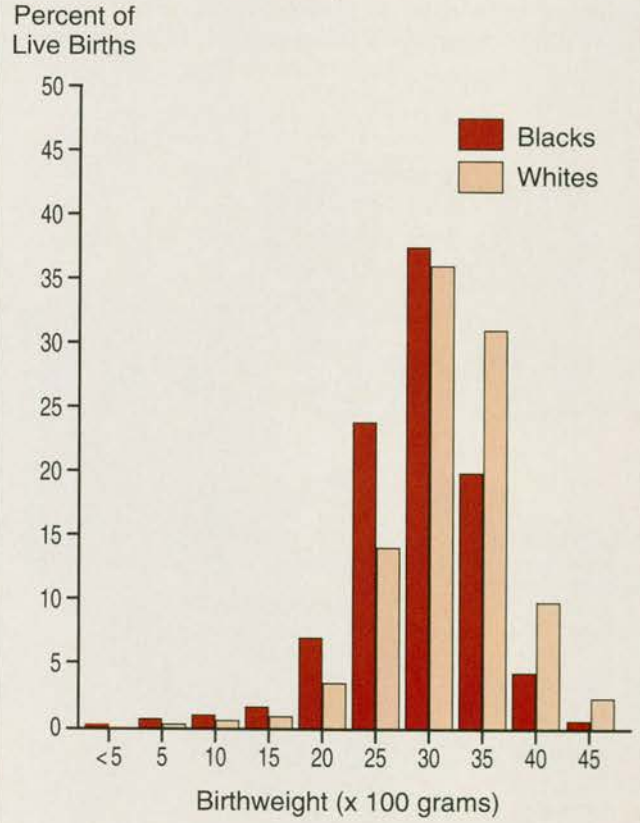
### 1. Low Birthweight

The collection of graphs begins with a set on low birthweight, which is strongly associated with lowered I.Q. and poor school performance. While low birthweight can be brought on by other factors, including maternal malnutrition and teenage pregnancy, significant causes are maternal smoking, drinking, and drug use.

Around 6.9 percent of babies born in the United States weigh less than 5.5 pounds (2,500 grams) at birth and are considered "low-birthweight" babies. In 1987, this accounted for some 269,100 infants. Low birthweight may result when babies are born prematurely (born too early) or from intrauterine growth retardation (born too small) as a result of maternal malnutrition or actions that restrict blood flow to the fetus, such as smoking or drug use.

In 1987, about 48,750 babies were born at very low birthweights (under 3.25 lbs. or 1,500 grams). Research estimates that 6 to 8 percent of these babies experience major handicaps such as severe mental retardation or cerebral palsy (Eilers et al., 1986; Hack and Breslau, 1986). Another 25 to 26 percent have borderline I.Q. scores, problems in understanding and expressing language, or other deficits (Hack and Breslau, 1986; Lefebvre et al., 1988; Nickel et al., 1982; Vohr et al., 1988). Although these children may enter the public school system, many of them show intellectual disabilities and require special educational assistance. Reading, spelling, handwriting, arts, crafts, and mathematics are difficult school subjects for them. Many are late in developing

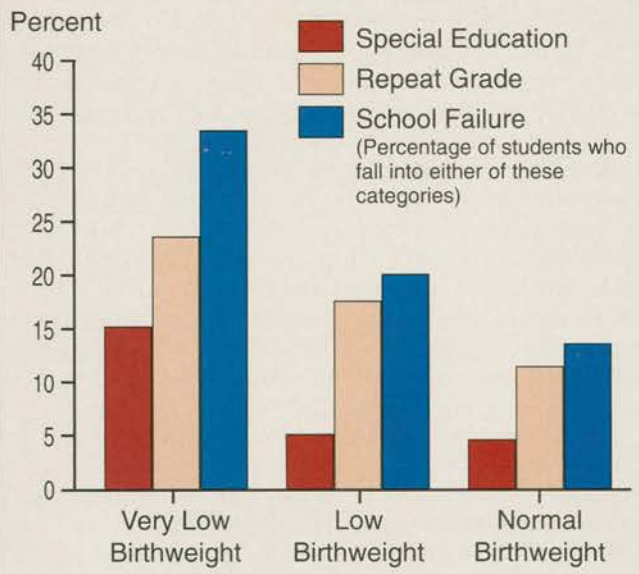
*FIGURE 1*
*DISTRIBUTION OF LIVE BIRTHS BY BIRTHWEIGHT AND RACE, 1980*




Source: *Morbidity and Mortality Weekly Report*, March 1990.

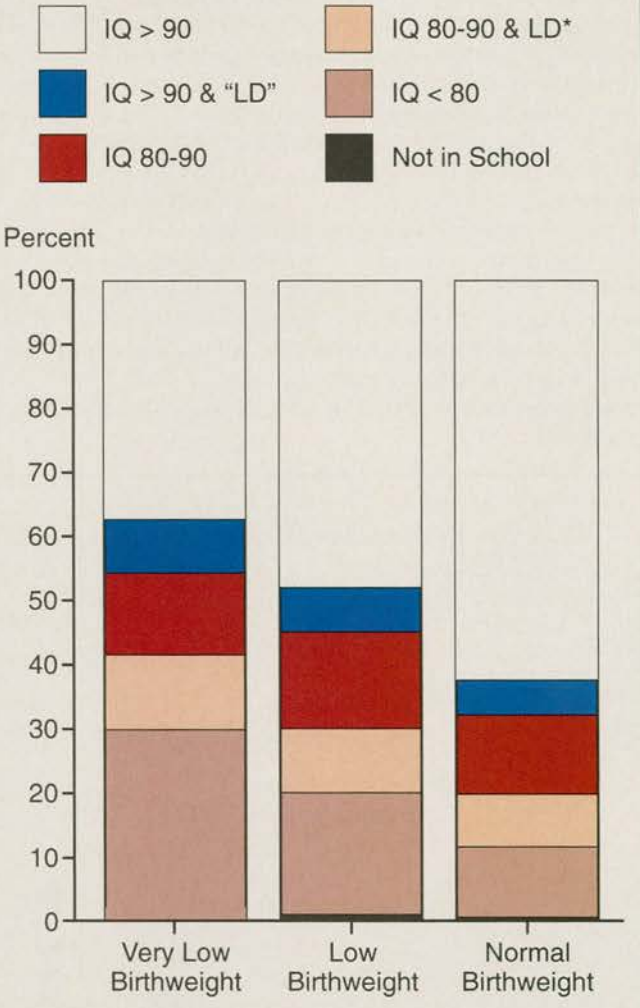
*Lucile F. Newman is a professor of community health and anthropology at Brown University and the director of the Preventable Causes of Learning Impairment Project. Stephen L. Buka is an epidemiologist and instructor at the Harvard Medical School and School of Public Health.* *This article is adapted from "Every Child a Learner: Reducing Risks of Learning Impairment During Pregnancy and Infancy," supported by the Exxon Education Foundation and published by the Education Commission of the States. Copies of the full report, including references, are available for $6.90 (inquire about bulk rates) from the ECS Distribution Center, 707 17th Street, Suite 2700, Denver, CO 80202-3427, item #SI-90-9, or by calling 303/299-3692. Orders must be prepaid or include a purchase order.*

*Figure 2*
*Relation of Birthweight to Various Measures of School Failure among Children Aged 4-17*




Source: McCormick, Gortmaker and Sobol, 1990. Based on 10,522 children in the National Health Interview Survey, Child Health Supplement.

*Figure 3*
*Relation of Birthweight to Intelligence and Achievement Scores at Age 7*




* LD (learning deficiency) refers to academic achievement scores one year or more below grade level according to WRAT reading and spelling tests.

Source: Buka et al., 1990. Based on 40,000 children followed from birth (1960-66) to age 7 in the National Collaborative Perinatal Project.

their speech and language. Children born at very low birthweights are more likely than those born at normal weights to be inattentive, hyperactive, depressed, socially withdrawn, or aggressive (Breslau et al., 1988).

New technologies and the spread of neonatal intensive care over the past decade have improved survival rates of babies born at weights ranging from 3.25 pounds to 5.5 pounds. But, as Figures 2 and 3 show, those born at low birthweight still are at increased risk of school failure. The increased risk, however, is very much tied to the child's postnatal environment. When the data on which Figure 2 is based are controlled to account for socioeconomic circumstances, very low-birthweight babies are approximately twice, not three times, as likely to repeat a grade.

Indeed, follow-up studies of low-birthweight infants at school age have concluded that "the influence of the environment far outweighs most effects of nonoptimal prenatal or perinatal factors on outcome" (Aylward et al., 1989). This finding suggests that early assistance can improve the intellectual functioning of children at risk for learning delay or impairment (Richmond, 1990).

### 2. Maternal Smoking

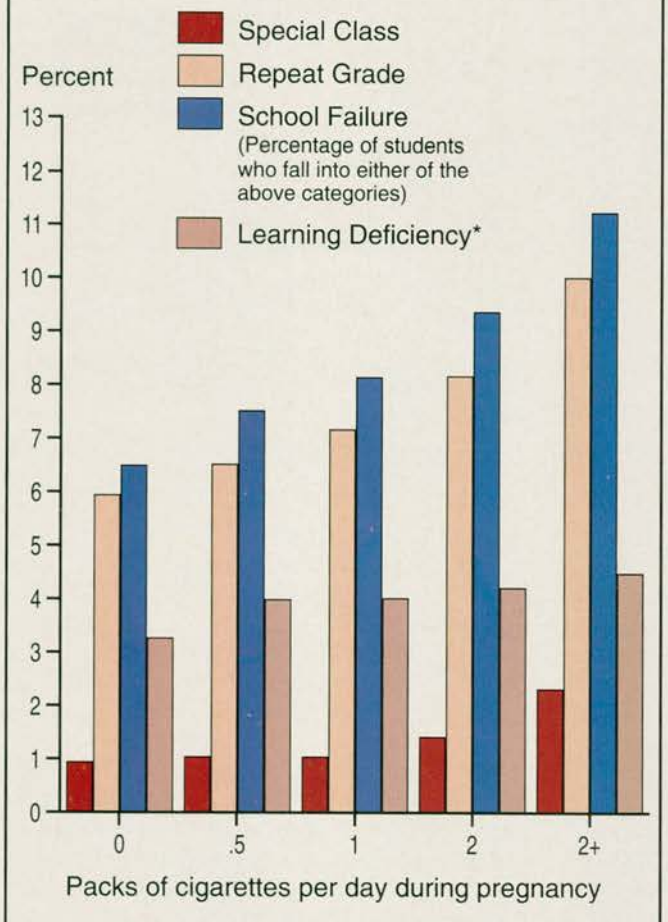
Maternal smoking during pregnancy has long been known to be related to low birthweight (Abel, 1980), an increased risk for cancer in the offspring (Stjernfeldt et al., 1986), and early and persistent asthma, which leads to, among other problems, frequent hospitalization and school absence (Streissguth, 1986). A growing number of new studies has shown that children of smokers are smaller in stature and lag behind other children in cognitive development and educational achievement. These children are particularly subject to hyperactivity and inattention (Rush and Callahan, 1989).

Data from the National Collaborative Perinatal Project on births from 1960 to 1966 measured, among other things, the amount pregnant women smoked at each prenatal visit and how their children functioned in school at age seven. Compared to offspring of nonsmokers, children of heavy smokers (more than two packs per day) were nearly twice as likely to experience school failure by age seven (see Figure 4). The impact of heavy smoking is apparently greater the earlier it occurs during pregnancy. Children of women who smoked heavily during the first trimester of pregnancy were more than twice as likely to fail than children whose mothers did not smoke during the first trimester. During the second and third trimesters, these risks decreased. In all of these analyses, it is difficult to differentiate the effects of exposure to smoking before birth and from either parent after birth; to distinguish between learning problems caused by low

birthweight and those caused by other damaging effects of smoking; or, to disentangle the effects of smoke from the socioeconomic setting of the smoker. But it is worth noting that Figure 4 is based on children born in the early sixties, an era when smoking mothers were fairly well distributed across socioeconomic groups.

One study that attempted to divorce the effects of smoking from those of poverty examined middle-class children whose mothers smoked during pregnancy (Fried and Watkinson, 1990) and found that the infants showed differences in responsiveness beginning at one week of age. Later tests at 1, 2, 3, and 4 years of age showed that on verbal tests "the children of the heavy smokers had mean test scores that were lower than those born to lighter smokers, who in turn did not perform as well as those born to nonsmokers." The study also indicated that the effects of smoke exposure, whether in the womb or after birth, may not be identifiable until later ages when a child needs to perform complex cognitive functions, such as problem solving or reading and interpretation.

*FIGURE 4*
*RELATION OF MATERNAL CIGARETTE SMOKING DURING PREGNANCY AND VARIOUS MEASURES OF SCHOOL FAILURE AND LEARNING DEFICIENCY AT AGE 7*




*Learning Deficiency= normal intelligence (IQ > 90) and reading or spelling scores one year or more below grade level on the WRAT.

Source: Buka et al., 1990. Based on 40,000 pregnancies with infants followed to age 7 in the National Collaborative Perinatal Project.

### 3. Prenatal Alcohol Exposure

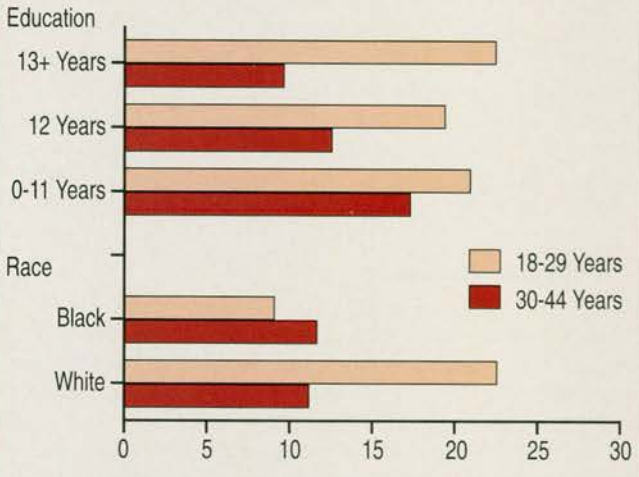
Around forty thousand babies per year are born with fetal alcohol effect resulting from alcohol abuse during pregnancy (Fitzgerald, 1988). In 1984, an estimated 7,024 of these infants were diagnosed with fetal alcohol syndrome (FAS), an incidence of 2.2 per 1,000 births (Abel and Sokol, 1987). The three main features of FAS in its extreme form are facial malformation, intrauterine growth retardation, and dysfunctions of the central nervous system, including mental retardation.

There are, in addition, about 33,000 children each year who suffer from less-severe effects of maternal alcohol use. The more prominent among these learning impairments are problems in attention (attention-deficit disorders), speech and language, and hyperactivity. General school failure also is connected to a history of fetal alcohol exposure (Abel and Sokol, 1987; Ernhart et al., 1985). Figure 5 shows the drinking habits of women of childbearing age by race and education.

When consumed in pregnancy, alcohol easily crosses the placenta, but exactly how it affects the fetus is not well known. The effects of alcohol vary according to how far along in the pregnancy the drinking occurs. The first trimester of pregnancy is a period of brain growth and organ and limb formation. The embryo is most susceptible to alcohol from week two to week eight of development, a point at which a woman may not even know she is pregnant (Hoyseth and Jones, 1989). Researchers have yet to determine how much alcohol it takes to cause problems in development and how alcohol affects each critical gestational period. It appears that the more alcohol consumed during pregnancy, the worse the effect. And many of the effects do not appear until ages four to seven, when children enter school.

Nearly one in four (23 percent) white women, eighteen to twenty-nine, reported "binge" drinking (five

*FIGURE 5*
*DRINKING HABITS OF WOMEN AGED 18-44, BY AGE, RACE, AND EDUCATION LEVEL, 1985*




Source: U.S. Department of Health and Human Services, 1988.

# What Crack Does to Babies

By Janice Hutchinson

INQUIRING TEACHERS want to know: Who are these kids and how did they get this way? The question refers to the unprecedented numbers of children—estimates range as high as one-half to one million—who are entering the classroom having suffered inutero exposure to cocaine.

Crack, the cooked form of cocaine, became widely available in 1985; the children of the first crack addicts are now in school. Teachers have described them as a new breed, unlike other children with histories of drug exposure. They are often in constant motion, disorganized, and very sensitive to stimuli. Crawling, standing, and walking take longer to develop. They are irritable and hard to please. It is hard for them to make friends. They respond less to the environment. Internal stability is poor. Learning is more difficult. Smiling and eye contact are infrequent. They do not seem to know how to play with toys or with others. And nothing you do for them seems to matter or help.

If teachers are to meet the challenges that these children bring, they may find it helpful to understand the bio-neuro-physiological effects of cocaine on the developing fetus. Scientists are just beginning to understand these effects; research in the area is incomplete and at times conflicting. Thus what we know and what we can speculate about, some of which is summarized below, is just the tip of a rather unknown iceberg. There are surely many more effects—and more complicated avenues of effect—than those so far identified. Nonetheless, there are findings—mainly from research sponsored by the National Institutes of Health and the National Institute on Drug Abuse—that allow us to begin to make some sense of what is happening to the behaviors and learning styles of these children.

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IMAGINE THAT a crack molecule has entered the body. It enters into the mucous membranes of the mouth. From there it enters the lungs, where it is absorbed into the bloodstream, and through which it then passes to the heart and, very quickly, to the brain. The immediate effect is an increase in breathing, blood pressure, and heart rate.

Upon arriving in the brain, crack acts at several sites along what is known as the brain's "pleasure pathway"—a collection of sites in the brain that seem in some ways to relate and affect each other. At one point on the pleasure pathway is the limbic system, which is the seat of strong emotional responses, including the very primitive urges to feed, flee, fight, and reproduce. At another point along the pathway is the motor cortex of the brain, which directs the body's movement. Between the limbic system and the motor cortex lies the nucleus accumbens. This is the "attraction center" of the brain; it is what pulls you toward pleasurable activity.

The crack is very active here in the nucleus accumbens; a ripple effect then seems to carry the destruction around to other points along the pleasure pathway. Within the nucleus accumbens, as elsewhere in the brain, are numerous nerve cells; the space between each nerve cell ending is known as the synaptic space. Each of these nerve cells communicates with the others across the synaptic space by sending a variety of neurotransmitters back and forth.

One such neurotransmitter is dopamine. Under normal biological conditions, dopamine, like other neurotransmitters, is continually moving across the synaptic space. In a constantly recurring pattern, the dopamine leaves its home cell, crosses the synaptic space, and reaches receptors on the receiving cell, an action that sends an electrical signal through the receiver cell. The dopamine then disattaches from the receptor cell and returns to its cell of origin where it will be recycled.

But if crack has been ingested, this normal cycle will be disrupted. Crack, upon entering the brain and then the pleasure pathway, seems to settle into the synaptic space between the neurotransmitters. It then acts to pre-

vent the dopamine from returning to its home cell. Unable to return home, the dopamine continues to stimulate the receiver cell until the crack has spent itself and dissipated. It is probably this constant stimulation of the receiver cell that causes the euphoric feeling associated with the first few minutes of cocaine ingestion. But the crack high lasts only a few minutes, after which the user will either replenish his intake or experience an often devastating "low." The constant resupply soon leads to a physical addiction, the breaking of which is accompanied by extremely painful withdrawal symptoms.

WHILE THE crack is acting on the mother's brain, what is happening to the fetus? The crack crosses the placental barrier and heads for the inutero brain. The exact effect of the crack on the fetus will depend on the age of the fetus, the dosage of the crack, and probably on other variables that we have not yet identified. But it seems likely that in general a number of things happen. First, the crack probably acts on the fetal nucleus accumbens in the same way that it acts on the user's, leading the fetus to become highly stimulated and, often, addicted. As it stimulates the nucleus accumbens, and surely in other ways as well, the crack damages fetal brain cells and thus causes neurological damage all along the pleasure pathway and in other nearby parts of the brain.

Damage to brain cells in the limbic system, the nucleus accumbens, and elsewhere along the pleasure pathway would likely impair or alter a wide range of the child's normal emotional responses, including, for example, the ability to respond to pleasurable experiences, to form emotional attachments, or to make certain kinds of judgments. Perhaps this explains in part why the crack baby is often unable to proceed through the normal phases of separation-individuation described by child psychiatrist Margaret Mahler; crack babies appear to experience much greater anxiety and difficulty in leaving their mothers when it is time for school.

In addition, the brain's motor cortex may be damaged, which might explain such effects as the slow development of crawling, standing, and walking. The brain location for speech is also nearby, and damage to it may account for the speech impairments suffered by many crack babies. In turn, the speech impairment inhibits the child's ability to communicate, which may, in turn, account for some of the difficulty these children have in forming relationships.

In addition, crack, like nicotine, constricts the adult and fetal arteries, thus slowing the blood—and therefore the oxygen flow—to the fetus and around it. This condition of low oxygenation—known as hypoxia—can also produce brain damage, and it can bring on low birthweight. Low birthweight is, in turn, associated with a wide range of disabling symptoms, including intellectual disabilities (see main article).

Reading, mathematics, spelling, handwriting, and the arts are often difficult tasks for low-birthweight babies. Speech and language problems are prominent. Temperamental problems, such as low adaptability, low persistence, and arrhythmicity (for example, the failure to sleep and wake at normal, regular times) may be part of their behavioral style. They typically cry when separated from the mother, have trouble expressing themselves, speak only in short phrases, are very active, and clumsy. Findings to date suggest that temperament influences both behavior and cognition.

These low birthweight children tend to perform poorly on the Mullen Scale of Early Learning. This test, which consists of four scales, suggests the range of learning abilities that seem to be impaired in the children exposed inutero to crack. The Visual Receptive Organization (VRO) scale assesses visual discrimination, short-term memory, visual organization and sequencing, and visual spatial awareness, including position, size, shape, left/right, and detail. The Visual Expressive Organization (VEO) assesses bilateral and unilateral manipulation, writing, visual discrimination, and visual-motor plan and control. The language receptive organization (LRO) scale assesses auditory comprehension, short- and long-term auditory memory, integration of ideas and visual spatial cues, auditory sequencing, and verbal spatial concepts. The language expressive organization (LEO) scale assesses spontaneous and formal verbal ability, language formulation, auditory comprehension, and short- and long-term memory.

What all of this means ultimately is that these low-birthweight crack children experience the world around them in a very different way from other children. Adults, including teachers, are often unaware that these children see and hear their environment in a completely different manner from adults or even other children. What the teacher often does not realize is that this difficult-to-teach, hard-to manage child is processing information in an unusual way that the child does not determine. Hence, conflict and frustration can arise between teacher and student (and also at home between parent and child).

The combined effects of prenatal drug exposure with a home environment that provides little or no nurturance, understanding, or support for the child create a terrible challenge to teachers. But initial experimental programs suggest that these children can benefit greatly from placement in highly structured, highly tailored educational day care settings beginning in early infancy. In four Washington, D.C.-area therapeutic nurseries that provide such care, two-thirds of the children seem so far to have been successfully mainstreamed into first grade.

Among the characteristics that seem to make such programs successful are early identification of the infants and very low student-teacher ratios. The establishment of an emotionally supportive atmosphere and structure is necessary. Teaching must be intense and focal. Tasks should initially be simple and singular. Too many tasks or activities overstimulate these children, and they cannot respond. Teachers must also provide emotional support and form bonds with the children. Success also depends on aggressively approaching and engaging parents in the psychotherapeutic progress. Consultation with mental health professionals may assist teachers, parents, and students. Intellectually limited students may still require individual tutoring; some students will eventually require special education; and very emotionally disturbed students may require a mental health-based psychotherapy program.

But it does seem clear that with early, appropriate interventions many of these children can improve their behavior and academic performance. Like most childhood problems, the time to act is now; later is too late. □

drinks or more a day at least five times in the past year). This was nearly three times the rate for black women of that age (about 8 percent). Fewer women (around 3 percent for both black and white) reported steady alcohol use (two drinks or more per day in the past two weeks).

### 4. Fetal Drug Exposure

The abuse of drugs of all kinds—marijuana, cocaine, crack, heroin, or amphetamines—by pregnant women affected about 11 percent of newborns in 1988—about 425,000 babies (Weston et al., 1989).

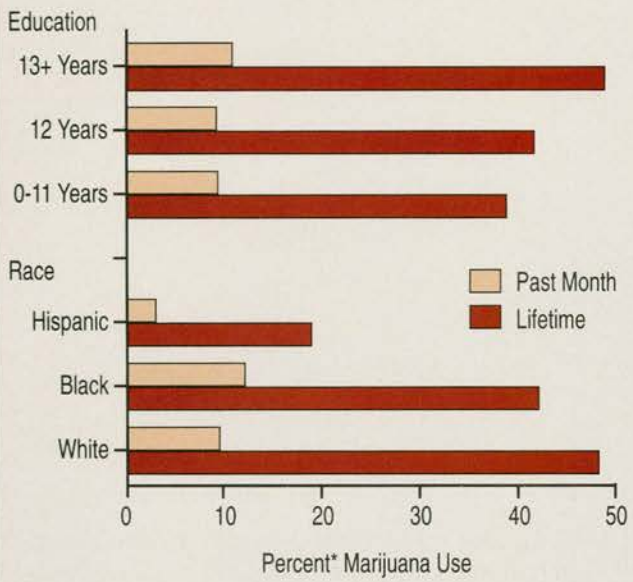
Cocaine and crack use during pregnancy are consistently associated with lower birthweight, premature birth, and smaller head circumference in comparison with babies whose mothers were free of these drugs (Chasnoff et al., 1989; Cherukuri et al., 1988; Doberczak et al., 1987; Keith et al., 1989; Zuckerman et al., 1989). In a study of 1,226 women attending a prenatal clinic, 27 percent tested positive for marijuana and 18 percent for cocaine. Infants of those who had used marijuana weighed an average of 2.8 ounces (79 grams) less at birth and were half a centimeter shorter in length. Infants of mothers who had used cocaine averaged 3.3 ounces (93 grams) less in weight and .7 of a centimeter less in length and also had a smaller head circumference than babies of nonusers (Zuckerman et al., 1989). The study concluded that "marijuana use and cocaine use during pregnancy are each independently associated with impaired fetal growth" (Zuckerman et al., 1989).

In addition, women who use these substances are likely to smoke and to gain less weight during pregnancy, two factors associated with low birthweight. The cumulative effect of these risk factors is demonstrated by the finding that infants born to women who gained little weight, who had smoked one pack of cigarettes a day, and who tested positive for marijuana and cocaine averaged nearly a pound (14.6 ounces or 416 grams) smaller than those born to women who had normal weight gain and did not use cigarettes, marijuana, and cocaine (see Table 1). The effect of these substances on size is more than the sum of the risk factors combined.

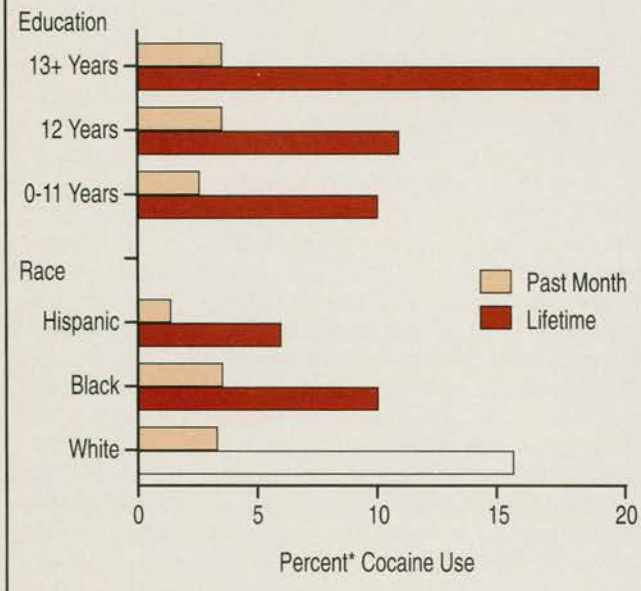
Like alcohol use, drug use has different effects at different points in fetal development. Use in very early pregnancy is more likely to cause birth defects affecting organ formation and the central nervous systems. Later use may

*(Continued on page 42)*

*Figure 6*
*Prevalence of Marijuana Use among Women Aged 22-44 Years by Race and Education Level*




*Prevalence of Cocaine Use among Women Aged 22-44 Years by Race and Education Level*




*Note different scales

Source: Adams, 1989. Based on 2,125 respondents to 1985 National Household Survey on Drug Abuse, National Institute on Drug Abuse.

*Table 1*
*Infant Weight Differences Associated with Substance Abuse*

Substance Use During Pregnancy at One Prenatal Clinic:

N = 1,226
Marijuana (n = 330) (27%)
Cocaine (n = 221) (18%)

| | Birthweight difference: |
|---|---|
| Marijuana users only vs. non-users | – 2.8 oz. |
| Cocaine users only vs. non-users | – 3.3 oz. |
| Combination users (marijuana, cocaine, one pack of cigarettes a day, low maternal weight gain) vs. non-users | –14.6 oz. |

Source: Zuckerman et al., 1989.

# BEGINNING RESEARCHERS

*How To Make Report Writing More than Copying from World Book*

BY DONNA MAXIM

"MY STUDENTS are so wonderful," Nancy Nash remarked when I stopped by her classroom after school one day. "They've just completed their research projects, and I've learned so much."

"What do you mean?" I asked.

"I remember doing research projects last year, during my student teaching. What a disaster! Now, I can see why some things didn't work. First, I'd chosen the topics. Kids had to write about a U.S. state—the focus of the research had nothing to do with what we had been studying. Then they got out the encyclopedias and started to copy. But this year my students selected their own topics, and their study evolved naturally from our science curriculum. When they went to the library, they didn't rush to the encyclopedias. They looked for resources on the shelves and used the card catalogue subject drawers. It was really exciting. They took notes without copying. And then they . . . ."

I smiled as I listened to Nancy talk about her fourth-grade researchers. I knew the work they had done as third graders: all the literature they had read and listened to, all the carefully planned activities that had helped them to succeed in fourth grade. I smiled because it's not often that a third-grade teacher hears words of praise for her former students from an upper-grade colleague and because I knew that the beginning research techniques that I taught had helped my kids become confident, skilled researchers.

Third graders enter this metamorphic year as hands-on investigators. Over many months they move toward independent research by using reading and writing as vehicles to make new discoveries about themselves and the world around them. But before my third graders ever become involved in independent research projects, I model a variety of procedures used by researchers. I demonstrate, students practice, and we share our discoveries as we investigate new topics across the curriculum. I show them note-taking and interviewing strategies and teach them how to use log entries to predict and then evaluate information brought to the classroom by visiting speakers. I also help them set up individual research notebooks, each complete with a resource list, webs, questions to pursue, and notes. Then they plan final products—not full-blown research papers but manageable formats that beginning researchers can control to display their new-found information. Finally, students discuss what helped them during their research and the discoveries they made during the process.

This article is organized around the range of research activities that I sponsored to expose my students to a vari-

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*Donna Maxim teaches at the Center for Teaching and Learning in Edgecombe, Maine. This article and the sidebar by Nancie Atwell are reprinted with permission from* Coming to Know: Writing to Learn in the Intermediate Grades, *edited by Nancie Atwell and published by Heinemann Educational Books, Inc., 1990. The book may be ordered from Heinemann by pre-paying $16 plus $3.50 shipping and handling (361 Hanover St., Portsmouth, NH 03801-3959. Order #08500. Telephone 1-800-541-2086).*

ILLUSTRATED BY BOBBI TULL

ety of research principles and procedures and to give them practice in note taking, observing, interviewing, and questioning. I will also describe project formats that third graders have used to share their new information.

EARLY IN the fall, I introduced methods for note taking that helped my students avoid both plagiarism and an overreliance on the encyclopedia as a source of information. I began an ocean unit in science by reading aloud the author blurb from the back cover of Vincent Dethier's *Newberry: Life and Times of a Maine Clam* and asking why the information about Dethier's background is important enough to appear on the book jacket. Dethier is a professor of zoology, a person who studies animal life, and although *Newberry* is a fictional story, within it are embedded many facts that he learned through his own research.

During the first read-aloud, the class listed on chart paper the sea creatures they had met and the facts they had learned about each. The following day, after I had read another chapter, I asked children to write down the facts they had heard as individual log entries. During each of the subsequent daily readings, students did the same. After each log entry I also encouraged them to list questions that the story made them wonder about, questions that they might need other resources to answer. In this typical log entry, Dixie has written six facts that she recalled from the story and added two questions that she wondered about.

10/27 8:55

1. Starfish have suction cups.
2. Clams have two shells.
3. Starfish can take their stomachs out of their body to get food.
4. Starfish eat clams.
5. Clams don't like starfish.
6. Starfish can pull clams and mussels shells apart.

How do starfish take out their stomachs?
What do starfish eat besides clams and mussels?

On another day, Steven wrote:

A clam can build his shell bigger on the edges. A shrimp can shed its shell when it gets too small. A shrimp can eat a mussell.

Based on Steven's log entry, we discussed the fact that a shrimp is a filter feeder and, in the story, could not have eaten the mussel on Newberry's muffler. Over several readings we discussed fact versus fiction as we posed questions: Are shrimp filter feeders? Do shrimp really eat mussels? The students searched out other sources of information to answer their questions, and we concluded the reading of *Newberry* with a "Clam Facts" bulletin board.

Another book I read to students during science class was Arthur Myers's *Sea Creatures Do Amazing Things,* a collection of short articles about the strange habits of ocean animals. In a three-minute log entry, Sarah recorded the facts she had learned about a fiddler crab.

11/6 11:10

1. Fiddler crabs do burrow in sand.
2. A fiddler crab's biggest claw does look like a violin.
3. A fiddler crab's small claw does look like a bow.

In another note-taking session, children listened to a Random House tape and filmstrip on Newberry Medalist Margaret Henry. In her own words, Heather noted what she regarded as the important facts about Margaret Henry's life and the thoroughness of the research that goes into her books for children.

11/23 9:30

Margaret Henry is a Newberry Award winner. She loves horses. She wrote lots of books. She hated doing maps. She wrote mostly animal stories. She likes animals a lot. She traveled a lot. She likes children a lot. She went to horse ranges. She went to the Grand Canyon. She went to Italy three times in a year. She gets a lot of letters. When she was ten, she sold a piece for twelve dollars.

In each of these log entries, students took notes without being tempted to copy: to read and write at the same time. I gave them practice in listening to build up their skill and confidence as note takers and to build up to taking notes from print resources. Then I turned to *Zoobooks,* a monthly magazine published by Wildlife Education Ltd., and they had their first experience taking notes from their own reading.

Each student chose one back issue of *Zoobooks* but was not permitted to open it. I asked them to look at the front cover and generate questions they thought they might find answers to in the magazine. Andrea's questions about the wolf set the stage for her active participation as a reader of her particular *Zoobooks.*

12/6 2:00

1. What do wolves eat?
2. How do they live? (What is their house made of?)
3. How many years old can it grow up to?
4. Can they eat anything?
5. How many miles per hour do they think they can run?
6. Can they climb trees?
7. Would they eat another wolf?
8. Would they eat a dog that looks like them?

After they recorded their questions, I sent the students away from their desks, their lists of questions, and their pencils, to read for ten minutes. When the time was up they returned to their desks, this time leaving the *Zoobooks* behind. In their logs they wrote any answers they had found to their questions and added any new information they recalled. Students were beginning to take notes without copying. For many, this was difficult; they wanted to retrieve the magazines and copy the relevant information, something that I did not allow. A couple more sessions of writing without reading showed my third graders that they could read and then take their notes.

Through such activities as these, I teach my students how to listen to, read for, and respond to information. They learn how to recognize important facts, use more than one resource to verify information, take meaningful notes, and record facts quickly and easily. Instead of copying someone else's words, they are beginning to see themselves as researchers who take notes. The chances are good that they will not become victims of the plagiarism syndrome.

AT THE same time that the children practiced note taking, we continued our ocean study with slide shows, a visit from a speaker from the Department of Marine Resources (complete with live specimens), a field trip to Reid State Park, charts listing ocean life forms, and numerous read-alouds and discussions of fiction and nonfiction books as well as poetry. Eventually, the students

were prepared to choose a sea creature to research and report on.

The students began their independent research by using resources from both our classroom and the school library. Each student set up a research notebook, a three-ring binder that allowed easy access to information. The first page was a title page; the second page was a list of questions about their creature; and the third was reserved for listing resources by title, author, and page number. Students recorded notes on the remaining four or five pages. It was a simple, specific format for collecting, organizing, and keeping track of new information.

During the research process, Alice Fossett, our school librarian, helped students become familiar with resources within the library. She planned activities to map library resources and to use the card catalogue as well as the *National Geographic* index to locate magazine articles on chosen topics. Students kept running notes in their three-ring binders.

1/11 1:50

NOTES

Bony meat.
Large eye.
14 inches long.
6-10 inches
1/2-1 pound.
Bait on bluefish.
Sweet tasting.
Schooling fish.
Found Penobscot River.
60,000-100,000 eggs.
Goes to fresh water to spawn.
Lives in salt water.
1 ft.
Lobster bait.
Grayish-green.
3 years.
Silver belly.
Related shad.

Gearry's log entry shows how he used the ten minutes that I gave my students, after reading in the library, to record information that he recalled from his reading. His notes had changed since the beginning of the year. Now he used his time to capture many brief pieces of specific information, rather than wasting time composing long sentences. He was also selective, deciding which facts were worth keeping. In a mini-lesson, Gearry discussed his notes with the rest of the class via an overhead transparency, explaining why he wrote only concise phrases and how this technique helped him to get more information down.

After two weeks of researching and sharing their notes, the students wrote up their facts in the form of acrostic poems. I had read about a high school teacher's use of acrostics, or blopoems (Johnston 1985), and felt that this would be a simpler genre for third graders to control than the complex format of a traditional research report. An acrostic uses the letters of the word that is its subject as the beginning letter of each line. I added one rule: Each line must be a fact about the poet's creature.

LOBSTERS

Lays up to 5,000 eggs
One claw is to crush their prey
Bait is what they use to catch lobster with
Sometimes if you hold one it might pinch
Turns red when it's cooked
Eats pogies, mackerel, bluefish, and redfish
Return females with eggs to the ocean
Scavengers!

Betsy wrote lots of facts in her acrostic and showed what she had learned. Wendy, a classmate, listened to another student's draft of his acrostic in a group share meeting and declared that one line—"Clams are neat"—was an opinion, not a fact. From that day on I had many keen observers of the differences between facts and opinions.

I also taught the children interviewing techniques. I began by modeling an interview in a mini-lesson. I had prepared a list of questions about a marine creature that one of my students was studying, and I interviewed her about it, with her permission, in front of the class. Then the other students, working in pairs, wrote interview questions about their marine animals as log entries and practiced interviewing each other. Afterward, volunteers shared reactions to their interviews with the class, and we noted their strengths and weaknesses on a chart.

My students decided that good interviews featured lots of questions, were prepared ahead of time, and included an interviewer's explanation of why the question was being asked. Then I arranged for them to interview fifth graders who were also studying marine creatures. Because the older kids' topics were also self-selected, the range was so great that we had few matching topics, so each student chose a fifth grader's topic and prepared a good list of marine-related questions. The interviews worked well, showing my nervous students that they could question older children; they also served to generate questions that could be used in their own research. (Some third graders discovered that they knew as much as some fifth graders about a particular subject.) A drawback was that the third graders had no personal need for the information they were gathering.

Interviewing techniques flowed over into social studies class, where I was reading aloud *Marching to Freedom: The Story of Martin Luther King, Jr.* by Joyce Milton. The children had already discussed their dreams, including dreams for the Boothbay school, so I asked them to brainstorm questions they might ask parents, teachers, school board members, our principal, or some other adult about their dreams for schools. Each student wrote a log entry setting up an interview. Then, as a class, they discussed the discoveries they had made: how they needed to explain who they were and why they were calling when approaching people they didn't know, how a good friend was approached differently from a stranger.

# *Genres for Report Writing*

By Nancie Atwell

THIS APPENDIX presents most of the options for reporting knowledge across the disciplines generated by the children and teachers in the writing-to-learn project. Teachers who plan to invite multi-genre reports might wish to review these modes and select those most appropriate for their students and subject areas. It is not a list to hand to children but a starting point for the teacher who is considering options to present to students and is willing to show children, in conferences and mini-lessons, how the genres work.

1. *Individual bound books* for the classroom library. Giacobbe's bookbinding technique, described in Graves, is one that children can manage independently from around third grade.

2. *Picture books* that introduce younger children to a topic and are based on students' knowledge of good, content-area literature for children (e.g., illustrated books about electricity, black bears, local architecture, the human skeleton).

3. *Textbooks* for which each student in the class writes a chapter (e.g., the results of statistical surveys conducted by students in a math class, an anthology about life in ancient Greece, an examination of the effects of World War II on the local community).

4. *Correspondence* between two real or imagined historical personages (e.g., a woman from ancient Sparta and one from Athens, Thomas Paine and a twentieth-century fifth grader, Harriet Tubman and a young slave).

5. *Journals or diaries* of real or imagined historical personages (e.g., the diary of a serf, the journal of a young survivor of the flu epidemic of 1918).

6. *Oral histories and interviews,* transcribed and supplemented by background information, photographs, drawings, poetry, etc. Linda Rief's eighth-grade study of aging is a lovely example, as are oral histories published in the *Foxfire* collections edited by Eliot Wigginton.

7. *Scripts:* radio and television plays to be tape recorded or videotaped; speeches, plays, and skits to be performed; interviews; and film strips.

8. *Historical fiction:* short stories about historical personages or about imagined people taking part in important historical events (e.g., a day in a child's life during the plague or on a wagon train, a fictional account of Anne Hutchinson's trial).

9. *Autobiographical sketches* of real or imagined historical personages or living things (e.g., a first-person account of the boyhood of Alexander the Great, a deciduous tree describes a year in its life).

10. *Poetry:* collections of poems about a topic—free verse, rhymed, counted syllable and/or acrostic formats—in which information about a topic is embedded.

11. *Animal stories:* a favorite genre of third through fifth graders; the stories must strike a balance between presenting the animal as a character and giving an accurate account of its existence without anthropomorphizing it (see Wilde 1988).

12. *How-to books* in which students pass on specialized knowledge related to a unit of study (e.g., blacksmithing, trapping, tapestry weaving, stargazing, reducing fractions).

13. *Field guides* that describe characteristics of a particular species or community.

14. *Class or individual newspapers* in which each article, column, advertisement, editorial, interview, want ad, and cartoon is related to a time and place in history (e.g., a Boston newspaper of 1776, a Gettysburg paper from 1863).

15. *Games and puzzles* that demonstrate and require a knowledge of a time, place, or unit of study (e.g., a trivia game about Portland, a crossword puzzle with the solar system as its theme).

16. *Annotated catalogs* of artifacts (e.g., the dress of men and women of ancient Greece; cooking implements found in the kitchen at Sturbridge Village).

17. *Annotated family trees* of real or imagined historical personages (e.g., Greek gods and goddesses, a passenger on the *Mayflower*).

18. *Bulletin boards* of drawings or photos with accompanying text (e.g., plants that grow in the desert, Portland then and now).

19. *Posters, murals, time lines, and mobiles* that include text (e.g., a dinosaur mobile, a mural depicting the destruction of Pompeii, a poster showing a plant's life cycle).

20. *Coloring books* with accompanying text, to be photocopied for classmates and/or younger children (e.g., scenes from New England states, the Underground Railroad, the life of a hermit crab).

21. *Calendars,* each page annotated with a drawing and text related to the topic (e.g., a Medieval knight's calendar, a calendar for stargazers, a puffin calendar).

22. *Alphabet books* in which each letter supplies relevant information about the topic (e.g., a Beverly Cleary ABC, an astronaut's ABC, a geologist's ABC).

23. *Shadow boxes and dioramas* with accompanying text (e.g., the habitat of the eastern panther, Anne Frank's secret annex, the parts of a stem). □

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*Adapted with permission from* Coming to Know. *Nancie Atwell directs the Center for Teaching and Learning, a model elementary school in Edgecombe, Maine. Her book* In the Middle: Writing, Reading, and Learning with Adolescents *won the highest research award given by the National Council of Teachers of English.*

Again, they role played interviews in log entries, and we charted whom they might contact. We also charted how they might contact particular individuals and listed questions they might ask. Students generated their own final guidelines for interviews and listed these on a separate chart:

Tell or Ask:

- Your name
- Where you're from
- Your grade
- What the project is
- Questions to ask
- Follow-up questions
- Thank you

The interviewing techniques I modeled and discussed and the actual interviews they conducted gave my third graders valuable insights into another avenue for research. They needed to look to primary sources—to people—as well as to good literature. The various interview activities helped them overcome their nervousness and take more control of their search for information.

ANOTHER RESEARCH practice I initiated early in the year was keeping logs of observations. Such logs show students how researchers set up and record information, help them to discover the differences between observations and predictions, and allow them to see themselves as resources in their own research.

In the fall, I asked each student to choose a tree in our playground to observe throughout the four seasons. The students recorded observations of their adopted trees and the surrounding environment at the beginning of each month and noted seasonal changes from September to June. This is Wendy's entry for March:

3/12 2:00

1. My tree's trunk has gotten smaller.
2. My tree has a lot of moss on it.
3. My tree has a lot of snow near it.
4. My tree's branches are very bare.
5. My tree has a lot of twigs near it.

In response to Wendy's observation, we had a lengthy class discussion about how she knew that her tree's trunk was smaller. She explained that she could tell by looking. Other students pointed out that that could be inaccurate, and she decided to measure the trunk next time.

A comparison of Dixie's October and March entries shows how she captured the changing of the seasons.

10/4 2:00

Now the tree has more of a greyish color on it. It has three woodpecker holes. Also the tree looked a little bit bigger.

3/12 3:00

1. It changed color.
2. It does not have any leaves left.
3. My tag fell off.
4. My tree got a lot, lot bigger.
5. I have lichen on my tree.

We also kept a caterpillar diary in which we recorded observations of a monarch caterpillar that we kept in the classroom as it formed a chrysalis and hatched into a butterfly. I initiated the activity by reading aloud *The Caterpillar Diary* by David Drew, an excellent example of a diary of observations. The following day I read *A New Friend for Morganfield* by Ann Hobart, and we guessed what might happen to our chrysalis in response to Hobart's prediction of a fourteen-day incubation period. As a class, we discussed the difference between observations and predictions. Then I set up a class diary and students took turns writing an entry each day.

DAY 1

The caterpillar has made his chrysalis. It is green and it is shiny. It has little gold dots on the chrysalis. In a while it will turn into a monarch butterfly. Justin

Next year, I plan to have everyone keep his or her own diary, with daily sharing of individuals' observations to provide more opportunities to practice keeping track of observations.

We also kept a log of daily weather observations throughout the year, noting which data we could observe with our eyes and which we needed to measure. Observing, record keeping, and categorizing are all important procedures that researchers frequently use.

This variety of methods—note taking without copying, research notebooks, acrostics, interviews, and logs of observation—assisted third graders as they began to learn what researchers do. A combination of hands-on approaches and writing activities proved much more accessible to eight- and nine-year-olds than formal report writing.

AS THE year progressed, I allowed students more choice in formats for final products, now that they had some experience as researchers. As a class, they brainstormed a list of potential formats; they came up with seven, and I added other alternatives that I thought were appropriate for beginning researchers from the list generated by the children and teachers in the writing-to-learn project (see sidebar). Individual students then chose the formats that allowed them to share their knowledge of their sea creatures. These five were their favorites.

## DIORAMAS

The diorama was one of the most popular formats because it involved painting. (Next year, the boxes will be painted during art class, since they took three or four class sessions to complete.) Each diorama included a written description of the sea creature portrayed. We had dioramas on penguins, the octopus, and killer whales.

## PUBLISHED BOOKS

Other students wanted to write up their research as a story to publish in a book, complete with covers made

from cardboard and contact paper, with pages bound on a sewing machine. For this project, my colleague Jo Haney developed an improvised galley sheet: a mimeographed form with six or eight lines at the bottom that helped students divide the drafts of their stories into separate pages to be typed and illustrated. Figure 1 shows how Mark used a galley sheet to set up one page of his book about whales and to organize his information.

*FIGURE 1*
*ONE OF MARK'S GALLEY SHEETS FOR HIS BOOK*

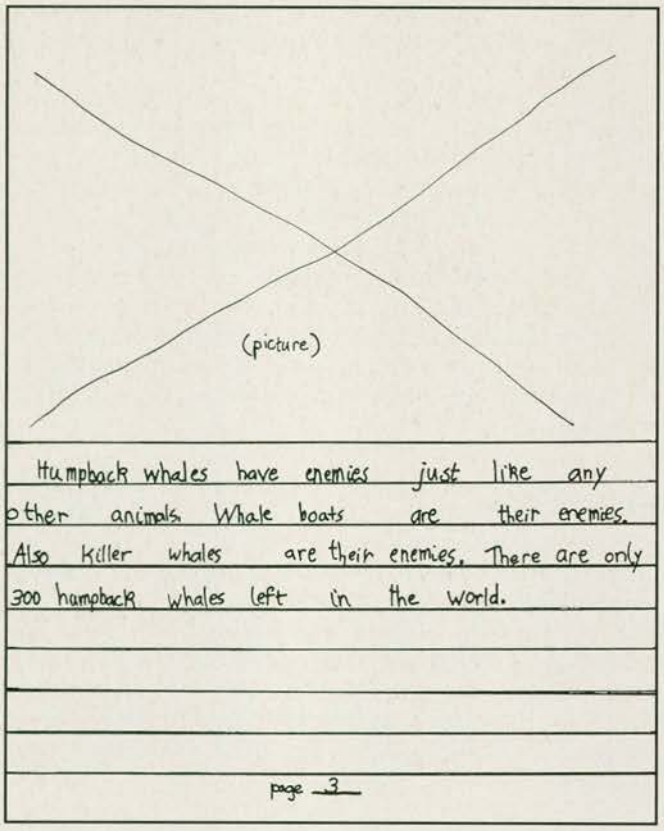
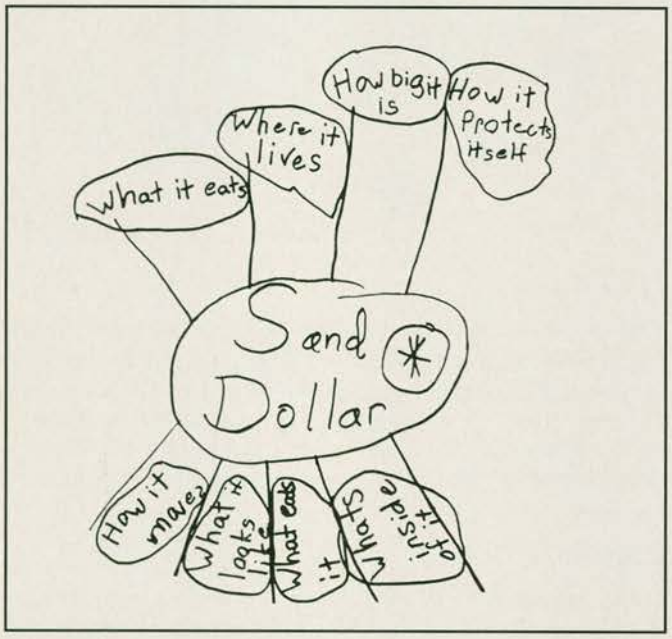



*FIGURE 2*
*DIXIE'S WEB: PREPARATION FOR HER BULLETIN BOARD*




## BULLETIN BOARDS

Dixie organized her research on sand dollars as a bulletin board display with a picture of a giant sand dollar in the middle and relevant facts arranged on cards around it. She planned her bulletin board in her learning log by drafting a web to help her make decisions about her topic and organize her information (Figure 2).

## GAMES

Two members of my class developed games from their research. One board game was on the narwhal and took players on a trip around the Arctic, posing questions to be answered along the way. Alewives were the subject of another board game and involved a journey up the falls; players' responses to questions determined whether they climbed the alewife ladder.

## TIME LINES

As part of our science curriculum, we study space. While the other two third-grade classrooms prepared a tour of the solar system, sharing facts on each planet, my students and I constructed a time line of the creation of the solar system. I read aloud *Life Story* by Virginia Burton, an account of the creation of the universe written as a play, and showed several examples of time lines, one on U.S. presidents and another on inventions. Each student selected one era that he or she would take responsibility for in creating our time line. They researched their eras, then drew pictures portraying what they had discovered about each period. Then they drafted descriptions of what was happening in their pictures. The following excerpts show the very beginning of the time line.

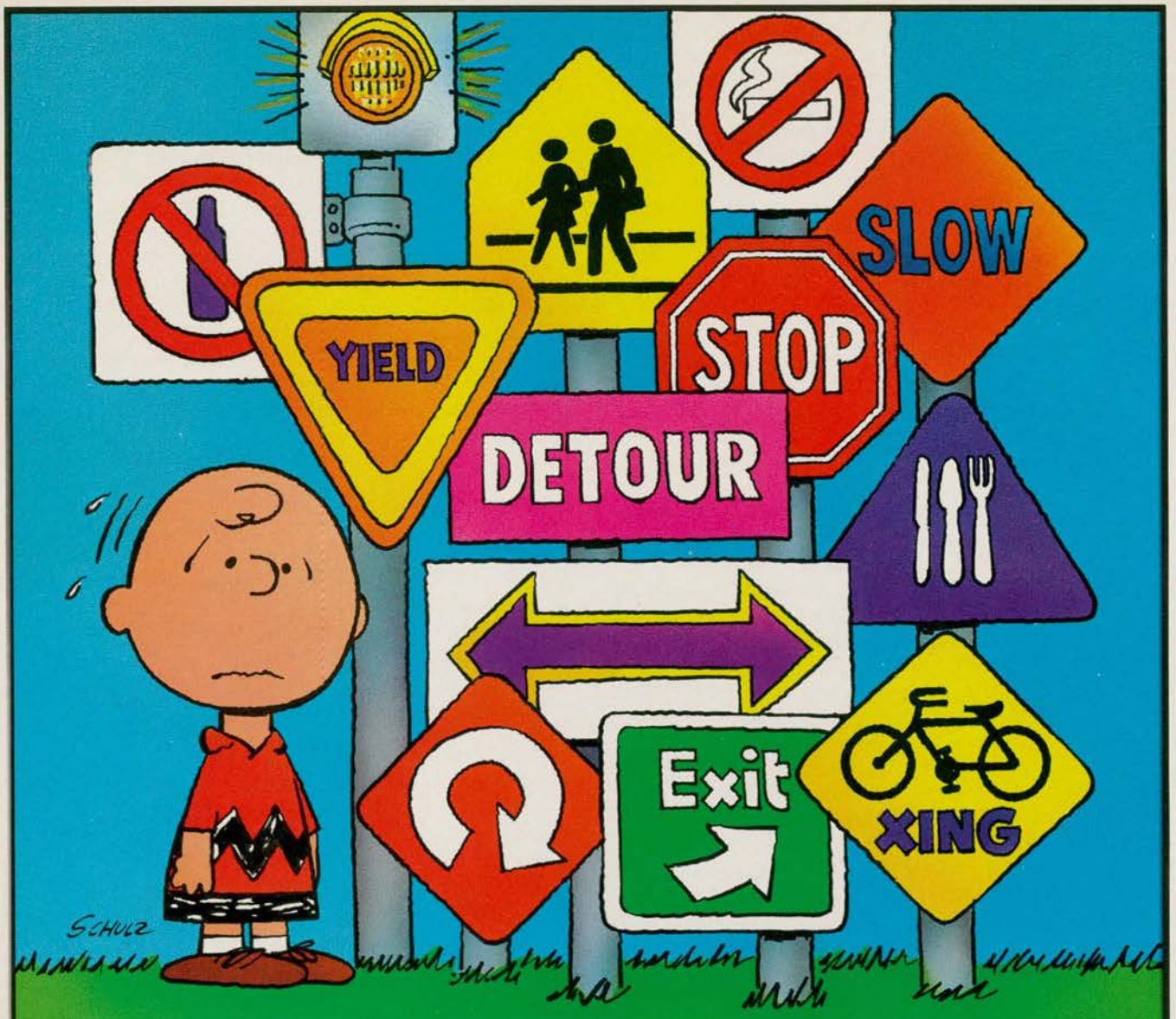
> Today scientists think that 4.5 billion years ago, our solar system used to be dust and gases. All of a sudden a star exploded and then our solar system was a large, spinning disk. Mike

> Two to one billion years ago the crust of our earth started to form. The earth started to wrinkle. High mountains and low valleys started to form. There were deep ocean basins. Metamorphic rock started to form. The metamorphic rock formed by the heat and pressure. There were thick clouds that blocked the sun from shining on earth. Rae

> About thirty to forty million years ago the climate started getting cooler. Mammals started developing. Plants started blooming. Volcanoes began to erupt, and mountains started to rise. Meggan

We practiced reading the time line aloud and then presented all twenty-six feet of it during an assembly for grades four to six. The idea for this particular project began with a read-aloud, was researched through independent reading, and developed first as an illustration, and then as a written description.

After our presentation, I discovered a book called *Earth Story* by Eric Maddern, a poem about the creation of the earth. As I began reading it to my class, Mike commented, "That's just like what Herbie did in his picture," and as I continued reading, eyes lit up around the room. The children recognized "their" information and were

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proud of what they had accomplished. When I closed the book, Heather wondered why the poem had not included the creation of life, as our own time line had. Joey's hand shot up. "Maybe he can write another poem to show that!"

My students shared their projects with pride and confidence. During the preparation of final projects, I highlighted many techniques in conferences and minilessons: galleys, the use of pen or marker (as opposed to pencil) on bulletin boards, diorama construction, and techniques for making books. When the projects were completed, I asked the students to evaluate themselves and to write advice they might offer to next year's class. Because they had taken responsibility for their own learning, they could reflect on and assess what was helpful to them as beginning researchers and what was not.

Throughout the third-grade year, I plan activities that help students explore, investigate, experiment, and record—not in isolation but in cooperation with a teacher and classmates who offer encouragement and questions. I provide as many opportunities and as much time as I can for students to try the procedures I demonstrate.

When Nancy Nash talked with me that afternoon about her students' research, she was affirming our hard work of the year before. As a teacher, I can do something that no commercial program can ever accomplish: allow students' individual interests to become a catalyst for their involvement in their own learning. I can teach research principles and procedures in the context of classroom discussions, activities, and resources. I can expose third graders to rich print resources as well as films, tapes, and local experts and provide opportunities for them to draw on these resources in investigating self-selected topics. I can make sure that their first research project does not become an overwhelming task but rather one approached with confidence and genuine curiosity as they investigate, organize, and share new information in a variety of formats. And I can act as their guide: not expecting students to possess the skills of researchers as if by magic but planning activities, demonstrating techniques, and gathering resources that will help them to take their first steps as beginning researchers. □

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*Zoobooks.* Wildlife Education, Ltd., Box 28870, San Diego, California 92128-9848.


## Prenatal Exposure

*(Continued from page 33)*

result in low birthweight due to either preterm birth or intrauterine growth retardation (Kaye et al., 1989; MacGregor et al., 1987; Petitti and Coleman, 1990). While some symptoms may be immediately visible, others may not be apparent until later childhood (Weston et al., 1989; Gray and Yaffe, 1986; Frank et al., 1988).

In infancy, damaged babies can experience problems in such taken-for-granted functions as sleeping and waking, resulting in exhaustion and poor development. In childhood, problems are found in vision, motor control, and in social interaction (Weston et al., 1989). Such problems may be caused not only by fetal drug exposure but also by insufficient prenatal care for the mother or by an unstimulating or difficult home environment for the infant (Lifschitz et al., 1985).

WHAT CAN be done to ameliorate the condition of children born with such damage? Quite a bit, based on the success of supportive prenatal care and the results of model projects that have provided intensive assistance to both baby and mother from the time of birth. These projects have successfully raised the I.Q. of low- and very-low birthweight babies an average of ten points or more—an increase that may lift a child with below-average intelligence into a higher I.Q. category (i.e., from retarded to low average or from low average to average). Generally known as either educational day care or infant day care, these programs provide a developmentally stimulating environment to high-risk babies and/or intensive parent support to prepare the parent to help her child.

In one such program based at the University of California/Los Angeles, weekly meetings were held among staff, parents, and infants over a period of four years. By the project's end, the low-birthweight babies had caught up in mental function to the control group of normal birthweight children (Rauh et al., 1988). The Infant Health and Development Project, which was conducted in eight cities and provided low-birthweight babies with pediatric follow-up and an educational curriculum with family support, on average increased their I.Q. scores by thirteen points and the scores of very-low birthweight children by more than six points. Another project targeted poor single teenage mothers whose infants were at high risk for intellectual impairment (Martin, Ramey and Ramey, 1990). One group of children was enrolled in educational day care from six and one-half weeks of age to four and one-half years for five days a week, fifty weeks a year. By four and one-half years, the children's I.Q. scores were in the normal range and ten points higher than a control group. In addition, by the time their children were four and one-half, mothers in the experimental group were more likely to have graduated from high school and be self-supporting than were mothers in the control group.

These studies indicate that some disadvantages of poverty and low birthweight can be mitigated and intellectual impairment avoided. The key is attention to the cognitive development of young children, in conjunction with social support of their families. □

*(Continued from page 20)*

pose questions to stimulate thought. A Japanese teacher considers a question to be a poor one if it elicits an immediate answer, for this indicates that students were not challenged to think. One teacher we interviewed told us of discussions she had with her fellow teachers on how to improve teaching practices. "What do you talk about?" we wondered. "A great deal of time," she reported, "is spent talking about questions we can pose to the class—which wordings work best to get students involved in thinking and discussing the material. One good question can keep a whole class going for a long time; a bad one produces little more than a simple answer."

In one memorable example recorded by our observers, a Japanese first-grade teacher began her class by posing the question to one of her students: "Would you explain the difference between what we learned in yesterday's lesson and what you came across in preparing for today's lesson?" The young student thought for a long time, but then answered the question intelligently, a performance that undoubtedly enhanced his understanding of both lessons.

## CONCRETE REPRESENTATIONS

Every elementary school student in Sendai possesses a "Math Set," a box of colorful, well-designed materials for teaching mathematical concepts: tiles, clock, ruler, checkerboard, colored triangles, beads, and many other attractive objects.

In Taipei, every classroom is equipped with a similar, but larger, set of such objects. In Beijing, where there is much less money available for purchasing such materials, teachers improvise with colored paper, wax fruit, plates, and other easily obtained objects. In all cases, these concrete objects are considered to be critically important tools for teaching mathematics, for it is through manipulating these objects that children can form important links between real-world problems and abstract mathematical notations.

American teachers are much less likely than Chinese or Japanese teachers to use concrete objects. At fifth grade, for example, Sendai teachers were nearly twice as likely to use concrete objects as the Chicago area teachers, and Taipei teachers were nearly five times as likely. There was also a subtle, but important, difference in the way Asian and American teachers used concrete objects. Japanese teachers, for example, use the items in the Math Set throughout the elementary school years and introduced small tiles in a high percentage of the lessons we observed in the first grade. American teachers seek variety and may use Popsicle sticks in one lesson, and in another, marbles, Cheerios, M&Ms, checkers, poker chips, or plastic animals. The American view is that objects should be varied in order to maintain children's interest. The Asian view is that using a variety of representational materials may confuse children, and thereby make it more difficult for them to use the objects for the representation and solution of mathematics problems. Having learned to add with tiles makes multiplication easier to understand when the same tiles are used.

Through the skillful use of concrete objects, teachers are able to teach elementary school children to understand and solve problems that are not introduced in American curricula until much later. An example occurred in a fourth-grade mathematics lesson we observed in Japan. The problem the teacher posed is a difficult one for fourth graders, and its solution is generally not taught in the United States until much later. This is the problem:

> There are a total of thirty-eight children in Akira's class. There are six more boys than there are girls. How many boys and how many girls are in the class?

This lesson began with a discussion of the problem and with the children proposing ways to solve it. After the discussion, the teacher handed each child two strips of paper, one six units longer than the other, and told the class that the strips would be used to help them think about the problem. One slip represented the number of girls in the class and the other represented the number of boys. By lining the strips next to each other, the children could see that the degree to which the longer one protruded beyond the shorter one represented 6 boys. The procedure for solving the problem then unfolded as the teacher, through skillful questioning, led the children to the solution: The number of girls was found by taking the total of both strips, subtracting 6 to make the strips of equal length, and then dividing by 2. The number of boys could be found, of course, by adding 6 to the number of girls. With this concrete visual representation of the problem and careful guidance from the teacher, even fourth graders were able to understand the problem and its solution.

## STUDENTS CONSTRUCT MULTIPLE SOLUTIONS

A common Western stereotype is that the Asian teacher is an authoritarian purveyor of information, one who expects students to listen and memorize correct answers or correct procedures rather than to construct knowledge themselves. This may or may not be an accurate description of Asian high school teachers,[4] but, as we have seen in previous examples, it does not describe the dozens of elementary school teachers that we have observed.

Chinese and Japanese teachers rely on students to generate ideas and evaluate the correctness of the ideas. The possibility that they will be called upon to state their own solution as well as to evaluate what another student has proposed keeps Asian students alert, but this technique has two other important functions. First, it engages students in the lesson, increasing their motivation by making them feel they are participants in a group process. Second, it conveys a more realistic impression of how knowledge is acquired. Mathematics, for example, is a body of knowledge that has evolved gradually through a process of argument and proof. Learning to argue about mathematical ideas is fundamental to understanding mathematics. Chinese and Japanese children begin learning these skills in the first grade; many American elementary school students are never exposed to them.

We can illustrate the way Asian teachers use students'

ideas with the following example. A fifth-grade teacher in Taiwan began her mathematics lesson by calling attention to a six-sided figure she had drawn on the blackboard. She asked the students how they might go about finding the area of the shaded region. "I don't want you to tell me what the actual area is, just tell me the approach you would use to solve the problem. Think of as many different ways as you can of ways you could determine the area that I have drawn in yellow chalk." She allowed the students several minutes to work in small groups and then called upon a child from each group to describe the group's solution. After each proposal, many of which were quite complex, the teacher asked members of the other groups whether the procedure described could yield a correct answer. After several different procedures had been suggested, the teacher moved on to a second problem with a different embedded figure and repeated the process. Neither teacher nor students actually carried out a solution to the problem until all of the alternative solutions had been discussed. The lesson ended with the teacher affirming the importance of coming up with multiple solutions. "After all," she said, "we face many problems every day in the real world. We have to remember that there is not only one way we can solve each problem."

American teachers are less likely to give students opportunities to respond at such length. Although a great deal of interaction appears to occur in American classrooms—with teachers and students posing questions and giving answers—American teachers generally pose questions that are answerable with a yes or no or with a short phrase. They seek a correct answer and continue calling on students until one produces it. "Since we can't subtract 8 from 6," says an American teacher, "we have to . . . what?" Hands go up, the teacher calls on a girl who says "Borrow." "Correct," the teacher replies. This kind of interchange does not establish the student as a valid source of information, for the final arbiter of the correctness of the student's opinions is still the teacher. The situation is very different in Asian classrooms, where children are likely to be asked to explain their answers and other children are then called upon to evaluate their correctness.

Clear evidence of these differing beliefs about the roles of students and teachers appears in the observations of how teachers evaluate students' responses. The most frequent form of evaluation used by American teachers was praise, a technique that was rarely used in either Taiwan or Japan. In Japan, evaluation most frequently took the form of a discussion of children's errors.

Praise serves to cut off discussion and to highlight the teacher's role as the authority. It also encourages children to be satisfied with their performance rather than informing them about where they need improvement. Discussing errors, on the other hand, encourages argument and justification and involves students in the exciting quest of assessing the strengths and weaknesses of the various alternative solutions that have been proposed.

Why are American teachers often reluctant to encourage students to participate at greater length during mathematics lessons? One possibility is that they feel insecure about the depth of their own mathematical training. Placing more emphasis on students' explanations necessarily requires teachers to relinquish some control over the direction the lesson will take. This can be a frightening prospect to a teacher who is unprepared to evaluate the validity of novel ideas that students inevitably propose.

## Using Errors Effectively

We have been struck by the different reactions of Asian and American teachers to children's errors. For Americans, errors tend to be interpreted as an indication of failure in learning the lesson. For Chinese and Japanese, they are an index of what still needs to be learned. These divergent interpretations result in very different reactions to the display of errors—embarrassment on the part of the American children, calm acceptance by Asian children. They also result in differences in the manner in which teachers utilize errors as effective means of instruction.

We visited a fifth-grade classroom in Japan the first day the teacher introduced the problem of adding fractions with unequal denominators. The problem was a simple one: adding one-third and one-half. The children were told to solve the problem and that the class would then review the different solutions.

***The most frequent form of evaluation used by American teachers was praise, a technique that was rarely used in either Taiwan or Japan.***

After everyone appeared to have completed the task, the teacher called on one of the students to give his answer and to explain his solution. "The answer is two-fifths," he stated. Pointing first to the numerators and then to the denominators, he explained: "One plus one is two; three plus two is five. The answer is two-fifths." Without comment, the teacher asked another boy for his solution. "Two point one plus three point one, when changed into a fraction adds up to two-fifths." The children in the classroom looked puzzled. The teacher, unperturbed, asked a third student for her solution. "The answer is five-sixths." The student went on to explain how she had found the common denominator, changed the fractions so that each had this denominator, and then added them.

The teacher returned to the first solution. "How many of you think this solution is correct?" Most agreed that it was not. She used the opportunity to direct the children's attention to reasons why the solution was incorrect. "Which is larger, two-fifths or one-half?" The class agreed that it was one-half. "It is strange, isn't it, that you could add a number to one-half and get a number that is smaller than one-half?" She went on to explain how the pro-

cedure the child used would result in the odd situation where, when one-half was added to one-half, the answer yielded is one-half. In a similarly careful, interactive manner, she discussed how the second boy had confused fractions with decimals to come up with his surprising answer. Rather than ignoring the incorrect solutions and concentrating her attention on the correct solution, the teacher capitalized on the errors the children made in order to dispel two common misperceptions about fractions.

We have not observed American teachers responding to children's errors so inventively. Perhaps because of the strong influence of behavioristic teaching that conditions should be arranged so that the learner avoids errors and makes only a reinforceable response, American teachers place little emphasis on the constructive use of errors as a teaching technique. It seems likely, however, that learning about what is wrong may hasten children's understanding of why the correct procedures are appropriate.

## Why Not Here?

Few who have visited urban classrooms in Asia would disagree that the great majority of Chinese and Japanese teachers are highly skilled professionals. Their dedication is legendary; what is often not appreciated is how thoughtfully and adroitly they guide children through the vast amount of material that they must master during the six years of elementary school. We, of course, witnessed examples of excellent lessons in American classrooms. And there are of course individual differences among Asian teachers. But what has impressed us in our personal observations and in the data from our observational studies is how remarkably well most Asian teachers teach. It is the *widespread* excellence of Asian class lessons, the high level of performance of the *average* teacher, that is so stunning.

The techniques used by Chinese and Japanese teachers are not new to the teaching profession—nor are they foreign or exotic. In fact, they are the types of techniques often recommended by American educators. What the Japanese and Chinese examples demonstrate so compellingly is that when widely implemented, such practices can produce extraordinary outcomes.

Unfortunately, these techniques have not been broadly applied in the United States. Why? One reason, as we have discussed, is the Asian belief that the whole-group lesson, if done well, can be made to work for every child. With that assumption, Asian teachers can focus on the perfection of that lesson. However, even if American educators shared that belief, it would be difficult for them to achieve anything near the broad-based high quality that we observed in Asian classrooms. This is not the fault of American teachers. The fault lies with a system that prepares them inadequately and then exhausts them physically, emotionally, and intellectually while denying them the collegial interaction that every profession relies upon for the growth and refinement of its knowledge base.

The first major obstacle to the widespread development and execution of excellent lessons in America is the fact that American teachers are overworked. It is inconceivable that American teachers, by themselves, would be able to organize lively, vivid, coherent lessons under a regimen that requires that they teach hour after hour every day throughout the school year. Preparing lessons that require the discovery of knowledge and the construction of understanding takes time. Teaching them effectively requires energy. Both are in very short supply for most American teachers.

Being an elementary school teacher in the United States at the end of the twentieth century is extraordinarily difficult, and the demands made by American society exhaust even the most energetic among them. "I'm dancing as fast as I can" one teacher summarized her feelings about her job, "but with all the things that I'm supposed to do, I just can't keep up."

The full realization of how little time American teachers have when they are not directly in charge of children became clear to us during a meeting in Beijing. We were discussing the teachers' workday. When we informed the Chinese teachers that American teachers are responsible for their classes all day long, with only an hour or less outside the classroom each day, they looked incredulous. How could any teacher be expected to do a good job when there is no time outside of class to prepare and correct lessons, work with individual children, consult with other teachers, and attend to all of the matters that arise in a typical day at school! Beijing teachers teach no more than three hours a day, unless the teacher is a homeroom teacher, in which case, the total is four hours. During the first three grades, the teaching assignment includes both reading and mathematics; for the upper three grades of elementary school, teachers specialize in one of these subjects. They spend the rest of their day at school carrying out all of their other responsibilities to their students and to the school. The situation is similar in Japan. According to our estimate, Japanese elementary school teachers are in charge of classes only 60 percent of the time they are at school.

The large amounts of nonteaching time at school are available to Asian teachers because of two factors. The first concerns the number of teachers typically assigned to Asian schools. Although class sizes are considerably larger in Asia, the student-to-teacher ratio within a school does not differ greatly from that in the United States. By having more students in each class and the same number of teachers in the school, all teachers can have fewer teaching hours. Time is freed up for teachers to meet and work together on a daily basis, to prepare lessons for the next day, to work with individual children, and to attend staff meetings.

The second factor increasing the time available to Japanese and Chinese teachers at school is that they spend more hours at school each day than do American teachers. In our study, for example, teachers in Sendai and Taipei spent an average of 9.5 and 9.1 hours per day, respectively, compared to only 7.3 hours for the American teachers. Asian teachers arrive at school early and stay late, which gives them time to meet together and to work with children who need extra help. Most American teachers, in contrast, arrive at school shortly before classes begin and leave not long after they end. This does not mean a shorter work week for American teachers. What it does mean is that they must devote their evenings to working alone on the next day's lessons, further increasing their sense of isolation.

## Learning from Each Other

The second reason Asian class lessons are so well crafted is that there is a very systematic effort to pass on the accumulated wisdom of teaching practice to each new generation of teachers and to keep perfecting that practice by providing teachers the opportunities to continually learn from each other.

Americans often act as if good teachers are born, not made. We hear this from both teachers and parents. They seem to believe that good teaching happens if the teacher has a knack with children, gets along well with them, and keeps them reasonably attentive and enthusiastic about learning. It is a commonly accepted truism in many colleges of education that teaching is an art and that students cannot be taught how to teach.

Perhaps because of this belief, students emerge from American colleges of education with little training in how to design and teach effective lessons. It is assumed that teachers will discover this for themselves. Courses in teaching methods are designed to serve a different purpose. On the one hand, they present theories of learning and cognitive development. Although the students are able to quote the major tenets of the theorists currently in vogue, the theories remain as broad generalizations that are difficult to apply to the everyday tasks that they will face as classroom teachers. At the opposite extreme, these methods courses provide education students with lists of specific suggestions for activities and materials that are easy to use and that children should enjoy (for example, pieces of breakfast cereal make handy counters for teaching basic number facts). Teachers are faced, therefore, with information that is either too general to be applied readily or so specific that it has only limited usefulness. Because of this, American teachers complain that most of what they know had to be learned by themselves, alone, on the job.

In Asia, graduates of teacher training programs are still considered to be novices who need the guidance and support of their experienced colleagues. In the United States, training comes to a near halt after the teachers acquire their teaching certificates. American teachers may take additional coursework in the evenings or during summer vacations, or they may attend district or citywide workshops from time to time. But these opportunities are not considered to be an essential part of the American system of teacher training.

In Japan, the system of teacher training is much like an apprenticeship under the guidance of experienced colleagues. The teacher's first year of employment marks the beginning of a lengthy and elaborate training process. By Japanese law, beginning teachers must receive a minimum of twenty days of inservice training during their first year on the job.[5] Supervising the inservice training are master teachers, selected for their teaching ability and their willingness to assist their young colleagues. During one-year leaves of absence from their own classrooms, they observe the beginner in the classroom and offer suggestions for improvement.

In addition to this early tutelage in teaching techniques, Japanese teachers, beginners as well as seasoned teachers, are required to continually perfect their teaching skills through interaction with other teachers. One mechanism is through meetings organized by the vice principal and head teachers of their own school. These experienced professionals assume responsibility for advising and guiding their young colleagues. The head teachers organize meetings to discuss teaching techniques and to devise lesson plans and handouts. These meetings are supplemented by informal districtwide study groups and courses at municipal or prefectural education centers.[6]

A glimpse at what takes place in these study groups is provided in a conversation we recently had with a Japanese teacher. She and her colleagues spend a good deal of their time together working on lesson plans. After they finish a plan, one teacher from the group teaches the lesson to her students while the other teachers look on. Afterward, the group meets again to criticize the teacher's performance and to make suggestions for how the lesson could be improved. In her school, there is an annual "teaching fair." Teachers from other schools are invited to visit the school and observe the lessons being taught. The visitors rate the lessons, and the teacher with the best lesson is declared the winner.

In addition, national television in Japan presents programs that show how master teachers handle particular lessons or concepts. In Taiwan, such demonstrations are available on sets of videotapes that cover the whole curriculum.

Making use of lessons that have been honed over time does not mean that the Asian teacher simply mimics what she sees. As with great actors or musicians, the substance of the curriculum becomes the script or the score; the goal is to perform the role or piece as effectively and creatively as possible. Rather than executing the curriculum as a mere routine, the skilled teacher strives to perfect the presentation of each lesson. She uses the teaching techniques she has learned and imposes her own interpretation on these techniques in a manner that she thinks will interest and motivate her pupils.

Of course, teachers find it easier to share helpful tips and techniques among themselves when they are all teaching the same lesson at about the same time. The fact that Taiwan, Japan, and China each has a national curriculum that provides a common focus is a significant factor in teacher interaction. Not only do we have no national curriculum in the United States, but the curriculum may not be consistent within a city or even within a single school. American textbooks, with a spiral curriculum that repeats topics year after year and with a profusion of material about each topic, force teachers to omit some of each year's material. Even when teachers use the same textbook, their classes differ according to which topics they choose to skip and in the pace with which they proceed through the text. As a result, American teachers have less incentive than Asian teachers to share experiences with each other or to benefit from the successes and failures that others have had in teaching particular lessons.

Adding further to the sense of isolation is the fact that American teachers, unlike other professionals, do not share a common body of knowledge and experience. The courses offered at different universities and colleges vary, and even among their required courses, there is often little common content from college to college. Student teaching, the only other activity in which all bud-

ding teachers participate, is a solitary endeavor shared only with the regular classroom teacher and perhaps a few fellow student teachers.

Opportunities for Asian teachers to learn from each other are influenced, in part, by the physical arrangements of the schools. In Japanese and Chinese schools, a large room in each school is designed as a teachers' room, and each teacher is assigned a desk in this room. It is here that they spend their time away from the classroom preparing lessons, correcting students' papers, and discussing teaching techniques. American teachers, isolated in their own classrooms, find it much harder to discuss their work with colleagues. Their desk and teaching materials are in their own classrooms, and the only common space available to teachers is usually a cramped room that often houses supplies and the school's duplicating facilities, along with a few chairs and a coffee machine. Rarely do teachers have enough time in their visits to this room to engage in serious discussions of educational policy or teaching practices.

* * *

Critics argue that the problems facing the American teacher are unique and that it is futile to consider what Japanese and Chinese teaching are like in seeking solutions to educational problems in the United States. One of the frequent arguments is that the students in the typical Asian classroom share a common language and culture, are well disciplined and attentive, and are not distracted by family crises and their own personal problems, whereas the typical American teacher is often faced with a diverse, burdened, distracted group of students. To be sure, the conditions encountered by teachers differ greatly among these societies. Week after week, American teachers must cope with children who present them with complex, wrenching personal problems. But much of what gives American classrooms their aura of disarray and disorganization may be traced to how schools are organized and teachers are trained as well as to characteristics of the children.

It is easy to blame teachers for the problems confronting American education, and this is something that the American public is prone to do. The accusation is unfair. We cannot blame teachers when we deprive them of adequate training and yet expect that on their own they will become innovative teachers; when we cast them in the roles of surrogate parents, counselors, and psychotherapists and still expect them to be effective teachers; and when we keep them so busy in the classroom that they have little time or opportunity for professional development once they have joined the ranks of the teaching profession.

Surely the most immediate and pressing task in educating young students is to create a new type of school environment, one where great lessons are a commonplace occurrence. In order to do this, we must ask how we can institute reforms that will make it possible for American teachers to practice their profession under conditions that are as favorable for their own professional development and for the education of children as those that exist in Asia. □

*Note: The research described in this article has been funded by grants from the National Institute of Mental Health, the National Science Foundation, and the W.T. Grant Foundation. The research is the result of collaboration with a large group of colleagues in China, Japan, Taiwan, and the United States who have worked together for the past decade. We are indebted to each of these colleagues and are especially grateful to Shinying Lee of the University of Michigan who has been a major contributor to the research described in this article.*

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[1]The superior academic achievement of Chinese and Japanese children sometimes leads to speculation that they are brighter than American children. This possibility has been supported in a few reports that have received attention in the popular press and in several scientific journals. What has not been reported or widely understood is that, without exception, the studies contending that differences in intelligence are responsible for differences in academic performance have failed to meet acceptable standards of scientific inquiry. In fact, studies that have reported differences in I.Q. scores between Asian and American children have been flawed conceptually and methodologically. Their major defects are nonequivalent tests used in the different locations and noncomparable samples of children.

To determine the cognitive abilities of children in the three cultures, we needed tests that were linguistically comparable and culturally unbiased. These requirements preclude reliance on tests translated from one language to another or the evaluation of children in one country on the basis of norms obtained in another country. We assembled a team with members from each of the three cultures, and they developed ten cognitive tasks falling into traditional "verbal" and "performance" categories.

The test results revealed no evidence of overall differences in the cognitive functioning of American, Chinese, and Japanese children. There was no tendency for children from any of the three cultures to achieve significantly higher average scores on all the tasks. Children in each culture had strengths and weaknesses, but by the fifth grade of elementary school, the most notable feature of children's cognitive performance was the similarity in level and variability of their scores. [Stevenson, H.W., Stigler, J.W., Lee, S.Y., Lucker, G.W., Kitamura, S., & Hsu, C.C. (1985). Cognitive performance and academic achievement of Japanese, Chinese, and American children. *Child Development,* 56, 718-734.]

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## Opening Windows

*(Continued from page 26)*

*Because you can't go through life alone," says Purchase.*

*Lee is the first to admit that Purchase has been a positive influence on his life. "She has been an outlet for me," Lee admits. A positive outlet in what Lee sees as a sea of "negativity" surrounding him and many other inner-city black youths.*

*Purchase says that Lee is a bright student who likely would have gone on to college in any case. "All I have ever offered Lee is an ear. Just a friend if he wants one and a resource person if he needs something."*

*But partly because of her nudging, Lee is going directly to Hampton University next fall rather than taking a year off. "I think Lee was looking for immediate money, and I tried to explain to him that immediate money is not so immediate without an education."*

*Part of the power of mentoring is how it engages a student in a relationship that matters with someone who values academic success, a person whom you can please and "pay back" by doing well in school.*

*Indeed, Lee sees himself "paying Donna back" by "being successful"; by pursuing his dream to become an engineer.*

* * *

MENTORS ENRICH students' lives in many, many ways—academically, culturally, and socially. Sometimes their impact is subtle, sometimes obvious. Mentors are often the people with whom young people share their inner-most concerns and aspirations; someone they can talk to about anything and anybody.

Gaining the trust and confidence of adolescents requires an openness and a sustained personal commitment to their well-being. Mentors who move in and out of a youth's life have little impact, organizers of mentoring programs emphasize.

Those mentoring programs that stress what the kids really need and want generally are the most effective, the Mentoring Institute's Gray says.

"It's important that you get the input of the participants, the stakeholders," says Gray. That's when the programs take off and fly. ☐

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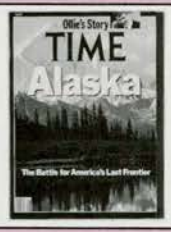


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