

# Catch them young

Fear + loathing = algebra. Unless you're one of the thousands of 9-year-old Americans to have discovered that algebra = fun. By **Polly Ghazi**

The equation on the blackboard reads  $2(3x - 1) = x + 22$ . "Who wants to explain how they solved this?" asks the teacher, Vicki Fisk. A forest of young hands shoots up. Jack, aged 10, is chosen. He jumps up and runs to what looks like a colourful toy set up on a desk in front of the blackboard. He rearranges the blue pawns (representing  $x$ ) and red numbered cubes set out on a plastic balance beam to produce the right answer, amid nods from his classmates at Somerset Elementary in Maryland, US.

"It's easy and it's fun. I really enjoy maths lessons now," confides Richard Kingdom, nine, whose family moved from Wiltshire to America two years ago. "Last year I was trying to do algebra in my head and I found it very difficult. Now I can take the pieces away with my hands and make the two sides balance and I understand what it's all about."

Had he stayed in England, Richard would not have been taught such a complicated equation until he was at least 12 years old. But in the US, a new philosophy of demystifying algebra — a subject that traditionally terrifies pupils — by starting children younger is producing highly encouraging results. And for thousands of American teachers it is a new breed of educational toy that is making all the difference.

The balance beam system used by Vicki Fisk, for example, has been made a mandatory part of maths lessons for eight- to 11-year-olds in Maryland's Montgomery County, one of the US's largest school districts. Nationwide, tens of thousands of teachers have had training in using the system, known as Hands On Equations, which was developed by Dr Henry Borenson, a Pennsylvania maths teacher.

"I wanted to literally make algebra child's play," explains Borenson, who developed his system with the help of children with learning difficulties. "We have had a lot of feedback that using the equipment greatly boosts children's self-esteem. Teachers who struggled themselves with algebra have called it a revelation."

America's National Council for Teachers of Mathematics is spearheading the drive to begin teaching some high school maths concepts, algebra in particular, to children as young as six. According to the council's president, Lee Stiff, results



Beaming: Noah Sennett, 10, solves an algebra equation at Somerset Elementary School in the US Photograph: Tom Allen

## Testing...

**A class of nine- and 10-year-old American children individually solved these eight equations in just under half an hour. Can you do better? (Answers on page 8)**

- 1  $3x + 2x = 10$
- 2  $4x + 2x = x + x + 20$
- 3  $3x + 5 = x + 19$
- 4  $2(3x + 1) = x + 22$
- 5  $5x + 2 = 3x + 12$
- 6  $2x + 1 + x + 4 = x + 16 + x$
- 7  $5x - 3x + x + 8 = 2x + 1 + x + x$
- 8  $2(x + 4) = x + 10$

over the past five years have been impressive, aided by educational toys such as Borenson's. "We have evidence from a number of states showing that nine-year-olds are doing better at basic algebra than older kids who come to it cold," he said.

The American approach was welcomed last week by British maths experts, many of whom believe algebra is introduced too late into UK schools. Roger Fentem, a maths educator who trains primary and secondary teachers at the College of St Mark and St John in Plymouth, described as "astonishing" the prowess shown by Vicki Fisk's class. "In Britain we would expect a bright 12-year-old or an average 14-year-old

to solve that equation," he said.

Barry Lewis, director of UK Maths Year 2000, launched in January to "challenge the national fear of figures", agreed. "The leap from physical numbers into abstract qualities such as using letters in equations is the critical place where maths leaves many students behind," he said. "We support making algebra accessible and exciting at as young an age as possible. This kind of educational toy, which emphasises the concept of balance as the central principle of algebra, is spot on."

Such educational toys, however, are not generally used in British schools although many secondary-school textbooks and maths computer games use balance beam illustrations to teach algebra. What's more the national numeracy strategy, launched in September 1999 to raise basic maths standards, explicitly excludes algebra teaching in primary schools. As a result, children do not start learning even the most basic algebraic equations or formulae, such as  $5 \text{ plus } x = 8$ , therefore  $x = 3$ , until they reach 11 or 12.

"Really children should be learning such formulae as soon as teachers start asking them 'five plus what is eight?' which is usually around seven or eight years old," said Fentem. "Part of the way ahead is to raise primary school teachers' knowledge of basic algebra and their confidence in their ability to link numeracy lessons with

algebra. Based on the success of the numeracy strategy so far, I believe we should see great strides in algebra standards among British children over the next few years."

Making such strides is not just about academic success. American research suggests that pupils who drop out of algebra are less likely to achieve successful careers in well-paid fields such as computing and engineering. And a recent British study found that students achieving maths A-level went on to earn incomes roughly 20% higher than fellow students with only arts A-levels.

Meanwhile, a pioneering maths-teaching programme developed by Exeter University's School of Education will give some insight over the next few years into whether teaching algebra early could be as successful here as in the US. Forty primary schools around the country are using specialised lesson plans to introduce simple algebraic concepts to children

as young as five. "I believe teaching algebra at 11 or 12 is far too late. Pupils find it very scary because they have no foundations in place to understand what the  $x$  and the brackets mean," says Professor David Burghes, who heads Exeter's School of Education and sat on the government's national numeracy task force.

"We find that five-year-olds have no problems understanding that  $5 \text{ plus a square box equals } 7$  and then working out that the box equals  $2$ . In fact they love it. But my views are not mainstream in Britain. I am out on a limb."

Back in Montgomery County, Vicki Fisk has no doubts about the pluses of teaching algebra at an age when some children are still learning to read. "The kids just love it — and they learn very fast," she says. "I have a friend who teaches seven- and eight-year-olds using Hands On Equations and they actually start crying when they have to miss a maths lesson!"

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# Math teacher accomplishes difficult feat

## Made algebra fun, fourth-graders say

BY MARK CARNOPIS  
Democrat Staff Writer

A mathematics teacher from Pennsylvania has made it fun for elementary school students to understand and solve algebraic linear equations, believe it or not.

That was the consensus Friday among four fourth-graders from Sylvan Hills Elementary School who participated in a workshop by Dr. Henry Borenson, a full-time math teacher at Council Rock Junior High School in Bucks County, Pa.

The workshop was part of the Southwest Regional Conference of the National Council of Teachers and Mathematics that runs through noon today at the Statehouse Convention Center.

Borenson is the creator of Hands-On Equations Learning System, which utilizes a scale, playing pieces and numbered dice to teach fourth-, fifth- and sixth-grade students how to solve algebra problems they will normally encounter in the ninth grade.

He spent the 90-minute session showing about 16 conference participants how easy elementary school students pick up on the process.

"It (the program) gives confidence in algebra and builds self-esteem," Borenson explained. "It's important that a child at that early age can feel good about algebra. Self-perception determines what we do more than any other factor."

The four boys participating in the workshop, Chris Price, Chris Coleman and Peter Wilkinson, all 10, and Joel Jewel, 9, seemed confused at first about the system and refused to offer answers.

"The boys are a bit tense. They'll warm up soon," Borenson told teachers.

True to his word, at the end of 20 minutes, they seemed eager to learn more.



Arkansas Democrat/Berry D. Arthur

**ALGEBRA LESSON** - Chris Price, 10, a fourth grade student at Sylvan Hills Elementary, tries to determine the value of  $x$  (represented by the pawns), in order to make both sides equal.

"I love it. He taught us good," Price said enthusiastically. "We wouldn't have learned about this until the end of sixth grade or the beginning of seventh grade."

"Most of the way the teachers teach this is harder," Coleman added. "It is easier this way than the teacher doing it on the board."

Borenson said he developed the system about 3½ years ago. The program is broken into three levels corresponding to grades four through six. Increasingly difficult equations

are introduced as a student progresses.

He said the program is not designed to replace ninth-grade algebra. Rather, it gives students a solid background in algebra and allows teachers to move more quickly through lessons.

Borenson said his system is in use in at least one school district in 20 states.

He said it is a success because it provides younger students with both pictorial and concrete objects with which to work.