will the next generation act?

mathematics and policy need to meet in preschool

Where the language of mathematics cannot be heard, neither can reason. Yet mathematics remains culturally unintegrated while the future depends on our ability to act on models of climate and other complex systems. What now?

We are all products of our environment, so education is one of our best chances of producing a better human race in time to do something about our world's plight. Our instinctive approaches to educating our children are rooted in our deep ancestry and our more recent cultural accumulations. As we see all around us, instinct and culture are failing us. Our inability to correctly model our world and act on our conclusions endangers us all.

Our ability to believe in our models rests firmly on our affinity for mathematics, yet centuries of breakthroughs in mathematical thought have not been broadly integrated into our culture. Although the fruits of pure mathematics - nuclear physics and digital computers and networking - more or less define the modern age our basic regard for the practice of mathematics has not increased in keeping with its importance, nor have our educational practices reflected the changing role of mathematics in the world. Cryptography is the backbone of all commercial use of the internet, and while hackers draw endless media attention, do you know the names Rivest, Shamir or Adleman?

Although mathematics is at least as old as agriculture our mathematical heritage is not as treasured as other cultural links with the distant past. Correcting our cultural bias against mathematics is an intergenerational struggle. In sport, art and music we encourage appreciation by non-practitioners, but interest in mathematics is expected to be confined to experts. Prejudices like *if it's not hard it's not mathematics* have interfered with our ability to appreciate or even identify mathematics.

Quilting and other forms of textile design, have some overt mathematics, counting and measuring, but making satisfying repetitive patterns uses the mathematics of symmetry. Tetris uses the tetrominos for pieces. Part of the satisfying regularity of the game is that the pieces aren't arbitrary - all the possible shapes are there. Traditional card games lead to many areas of mathematics, but the deck itself is rather arbitrary - why four suits, rather than five? We need better artifacts to train thinking.

Games

Set In comparison to a standard deck, the **Set** card game is very ordered, having 81 cards (3x3x3x3). This forms a regular-yet-surprising deck, including every possible card for four choices of three options, and thus has the same sense of completeness as the Tetris blocks. Hands are matched all-same or all-different, and even very young children catch on quickly and can compete against adults!

Doodling You can make your own mathematical games on squared paper, or just play around with ideas. For inspiration you need look no further than Vi Hart's videos.

Puzzles

Rubik's Cube The ubiquitous Cube was the definitive puzzle of the 1980s. The 3x3x3 plastic puzzle encapsulates substantial group theory, and is solved by discovering or learning algorithms. Guides for learning how to solve the Cube have improved a lot over the years, it's easier than ever to solve.

Penrose Tiles These two simple shapes fit together to produce an endless array of different patterns which never repeat and never run out. The puzzle pleases when decisions made earlier come back as you find you have to retrace your steps to continue laying the tiles. Beautiful patterns and shapes result.

Toys

Lego is the universal solvent for technical professionals. Everybody played with lego, and everybody describes how formative lego was in shaping their capacity to plan, execute and make. Modern lego has tended towards branding itself as a toy rather than a building system, but large boxes of basic bricks are still available. You can even bend it!

Zometool Want to see four dimensional space? This toy gets you about as close as is humanly possible, and you just have to build it. It is also brilliant for exploring three dimensions beyond the right angled system of Lego.

Polydron A simple idea, shapes that clip together at their edges forming a hinge. Mathematically they can look at how geometry jumps from two dimensions to three, what will you make out of them?

Meccano Another classic old toy that should not be underestimated. Metal and bolts vs. machined plastic. The long standing "Meccano people vs. Lego people" controversy can easily settled by buying both.

Scratch The easiest way for children to make software, taking their first steps into the source code that will run our lives. Scratch has excellent support for sound, graphics and even video, and is free.

Further Resources

Martin Gardner Ask mathematicians what got them into the subject as there is a very high chance that Martin Gardner will be mentioned. For years he talked puzzles, games and even broke new mathematical results in his Scientific American column. He left us with books stuffed full of curious intriguing and meaningful mathematics.

The Museum of Mathematics opens in 2012 in New York, this will be a mathematical wonderland, giving an intuitive glimpse even into many corners of mathematics. The website is packed with videos and resources.

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