Art and Science III: Children's Science Workshops

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INTRODUCTION

The discovery of the Fullerenes and the ubiquity of the basic geometrical patterns that govern their structure in the Physical World from tiny molecules to Meccano models and geodesic domes shown in Fig 1 a-c as well as in the Natural World from viruses and flies' eyes to turtle shells Fig 2 a-c was a key incentive behind the creation of a series of children's science workshops which can be viewed at www.vega.org.uk and www.geoset.info. If these elegant and beautiful structural principles had fascinated artists such as Leonardo da Vinci, Piero della Francesca and Alfred Durer as well as ancient Greeks such as Archimedes and furthermore had led them to base their fundamental ideas of the structure of matter on deeper understanding of symmetry principles it seemed ideal to use our new findings to awaken the curiosity of new generations of young people. These "Buckyball" workshops have been an outstanding international success.

Fig 1 a) Pentaphenyl-C60 molecular derivative, b) Meccano model, c) The Epcot Centre Geodesic dome in Florida.

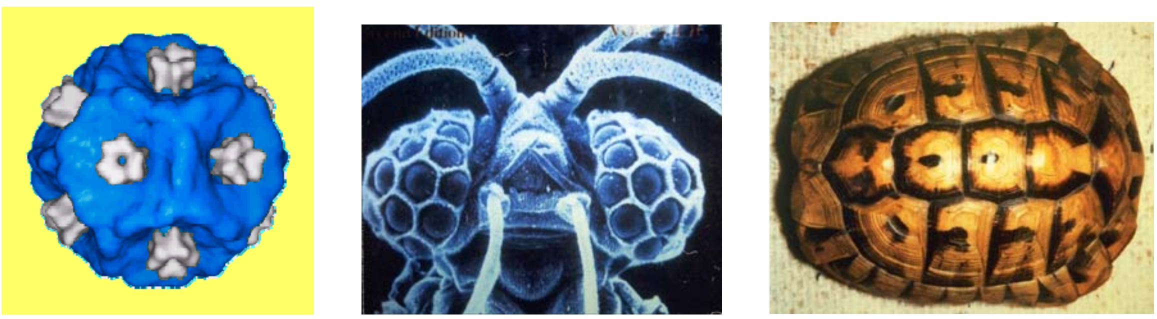


Fig 2 a) Virus, b) Australian fly, c) Turtle shell

Workshops have been held all over the world from the England, California, Japan, Germany, Scotland, Sweden, Texas, Florida, Malaysia and Ireland. They have also been broadcast on TV in Japan and the Internet in the UK, Japan and the US (Figs 3a-d).

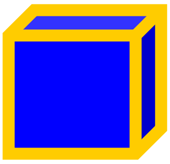
Fig 3 a *A Buckyball Workshop in Yokohama Japan*

Fig 3 b *A Buckyball Workshop at the University of California Santa Barbara*

Fig 3 c *A Buckyball Workshop in Kuala Lumpur Malaysia*

Fig 3d *A Buckyball Workshop with the help of the Manchester United Football team. Here Argentinian international Diego Forlan helps me to teach the kids algebra.*

We find that almost every small child has no difficulty in understanding how algebra works. We take a simple case such as that of a box:



and they easily work out that when they count the number of faces on a box (6) and add this number to the number of corners of the box (8) and then take away the number of edges (12) they get the number 2. The same procedure for a pyramid also yields the number 2. Indeed this is true for any other closed polyhedral surface as the famous mathematician Leonard Euler proved long time ago. We introduce them to the magic formula

Algebra

Faces + Corners – Edges = 2

F + C – E = 2

The children easily fill in a table such as this one

	F	C	E	= ?
	6	8	12	2
	4	4	6	2

The presentation has been translated in to other languages such as Japanese (below) and Hindi

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□□□□F□ + □□□□C□ – □□□□E□ = 2

F + C – E = 2

We talk to the children about how such shapes (Fig 4) appear in all different situations (Figs 1 and 2)

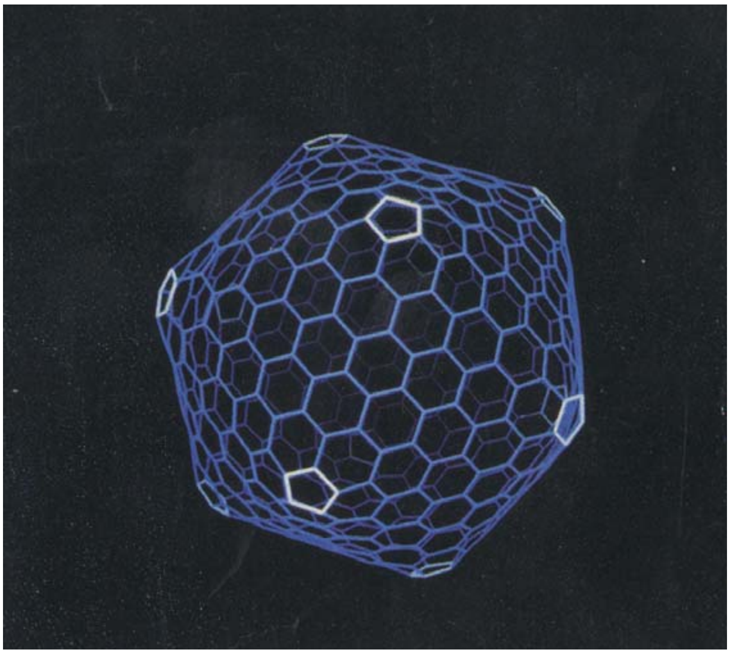

Fig 4   A Giant Fullerene

...and point out that there are 12 pentagons in the network (Fig4) and get them to have hands-on, tactile experience of shapes and patterns (Fig 5)

Fig 5   Buckyball workshop in Santa Barbara, California.

We emphasize that the caricature image that all scientists are old like the popular image that people always see of Einstein as an old man (Fig 6) is not correct

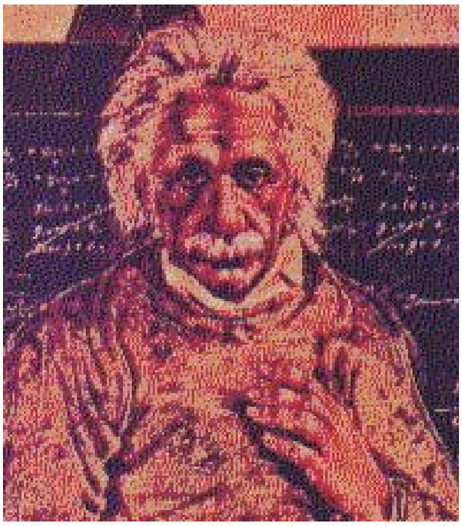

Fig 6 Painting of Einstein by Hans Erni

Fig 7 Einstein when he was in his prime

and that he was a young man (Fig 7) when he did his most famous and brilliant work. We tell them that in fact he was 17 when he first started thinking about problems that led to the famous Theory of Relativity. I point out that the young scientists such as Jim Heath, Sean O'Brien (Fig 8), Yuan Liu (Fig9) and Jon Hare (Fig 10) worked with me any my colleagues on the research programme that led eventually to the Nobel Prize

Fig 8 Jim Heath and Sean O'Brien at Rice U Texas

Fig 9 Yuan Liu at Rice U Texas

Fig 9 Jon Hare at Sussex University UK

We emphasize the relationships between the Arts and the Sciences by showing the drawings of Leonardo da Vinci Fig 11 and that beautiful images are to be found in modern computer graphics representations of molecular structure at nanoscale dimensions Fig 12

Fig 11 Drawing by Leonardo of a truncated icosahedron

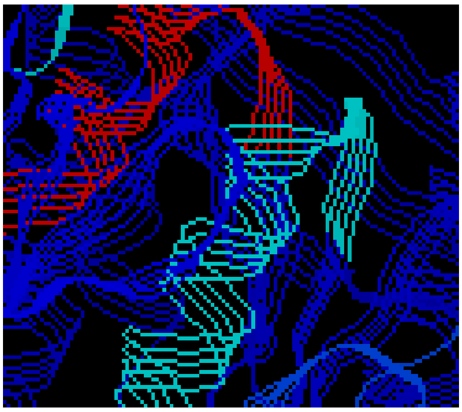

Fig 12 Part of a computer generated structure representation of a virus

We encourage the children to build models such as the sculpture in Fig 13 which helps to bridge the divide between the Arts and the Sciences

Fig 13 Buckyball sculpture built by children at a school in Sussex

The main part of the workshop programme is the hands-on building experience that the children get (Fig 14) from creating their own Buckyball model as it closes up – as if by magic - as they assemble the molecular model (Fig15)

Fig 14   Children at a Buckyball workshop in Santa Barbara

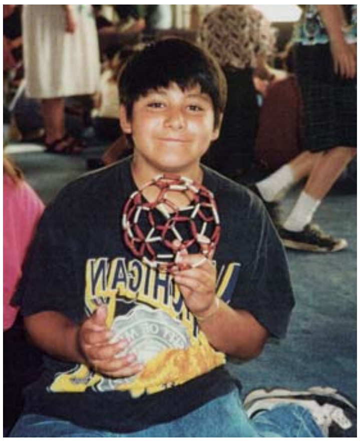

Fig 15 A typical image of satisfaction and delight at having created a buckyball for themselves

The exercise often leads to individual acts of creativity Fig 16 and 17

Fig 16   A new sort of hat maybe? (UK)

Fig 17   A new aid to Zen meditation (UK)

The workshops have shown unequivocally that science can generate delight in anyone and in particular small children (Fig 18)

Fig 18 The real reason for doing Art and Science together

The workshops are organised by the Vega Science Trust (www.vega.org.uk) in the UK and the Global Educational Outreach for Science Engineering and Technology (Geoset) initiative (www.geset.info) in the USA.

ACKNOWLEGEMENTS
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