

Hidden Beauty of Quadrilaterals

A **QUADRILATERAL** has four sides. *Quad* means four in Latin — a quad 'bike' has four wheels (not two as implied by the Greek *bi* of bike) and *latus, lateris* is Latin for 'side'.

The **square**, **rhombus** (square pushed out of shape), **rectangle** (oblong), **parallelogram** (rectangle pushed out of shape), and **trapezium** are special quadrilaterals.

The general quadrilateral is an irregular figure with **four unequal sides** and **four unequal angles**.

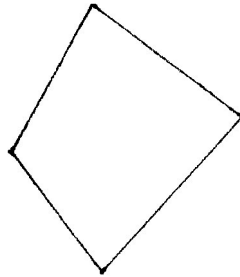
Yet it has a hidden beauty:-

- mark the four midpoints
- join them up and
- a **parallelogram** appears!

Beauty is veiled and discovered unexpectedly.

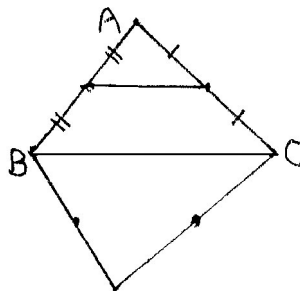
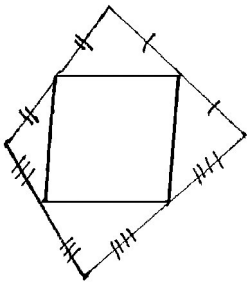
Order is hidden under apparent absence of order.

Design is discerned only by a thinker — which is a parable of Nature leading man to God.



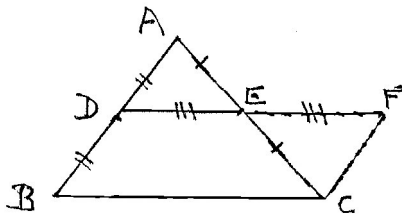
WHY IS IT A PARALLELOGRAM?

Draw diagonal BC and study the top triangle ΔABC .



Construction:

Mark midpoints D and E and produce line DE to F so that $DE = EF$; join F to C.



In the Δ s ADE & CFE

$AE = EC$ (from data) and $DE = EF$ (by construction) and $\angle AED = \angle CEF$ (being vertically opposite angles)

$\therefore \Delta$ s ADE & CFE are congruent.

$\angle ADE = \angle CFE$ (angles opposite equal sides)

$\therefore AD \parallel CF$, so $BD \parallel CF$

Also, $AD = CF$ (in congruent Δ s) and $AD = BD$ (data)

$\therefore BD = CF$, but it is also \parallel to it.

Now lines joining the ends of equal and parallel lines are themselves equal and parallel:

\therefore BDFC is a parallelogram, so $DE \parallel BC$

Similarly for the lower triangle (two diagrams up).

\therefore the lines joining the mid-points of the sides of a quadrilateral are parallel to the quadrilaterals respective diagonals and form a parallelogram. Q.E.D.

Enquiring Minds

ENCHANTING QUESTIONS for Enquiring Minds

1982 by Professor Julius Sumner Miller of the TV shows (ISBN 0 85902 280 3). It's his puzzle on left, but my solution. Its back cover says:-

A **look** does not guarantee seeing — to **listen** does not guarantee hearing. The mind must be tuned to a deeper action — the passion for **understanding** cultivated and the **imagination** aroused!

Understanding is a far cry from mere knowing. Knowing is superficial — understanding demands penetration by the intellect.

A student for a B.A. at Campion College kindly lent me the book. He said Miller reminded him of me.

I agree. And it reminds me of Max Lawson, the father of the nine children in *New Boys in the Bush* (read it!) whose teaching of maths, science and religion to his twin daughters and his next three sons is integrated into the adventure. After his early morning class with them, he walks 40 minutes to catch his train to work, where he teaches maths at the Galway Crags High School. Meanwhile his wife and mother-in-law continue the homeschooling in greater detail.

His teaching methods are my own: he wants to make maths interesting and digestible for those boys and girls who have swallowed the calumnies against it. He makes models out of wood and cardboard, and does science experiments with string stretched between chairs and burning candles girt by water in bowls.

He believes in handling solid models rather than simply drawing diagrams, or puzzling over pages of abstract argumentation. The diagrams and logic come after the feel and look and listen and think and speak.

If some are not yet 'ready' (shades of Piaget) for the harder stuff, they have seen and heard and picked up some basic maths by an experimental approach.

Mr Lawson also uses science for parables on faith and morals; cf. Our Lord and Old Testament prophets.

He would have cut models out of hardboard or thick cardboard to introduce the abstract proof about the quadrilateral and parallelogram, and led the pupils to see that the midpoints are the only way to make it fit.

It is effective teaching.

Prof Julian Sumner Miller has more to say about **imagination** (begun in quote above):

Children possess this in infinite degree. A sand castle is a REAL castle. But this noble virtue of the Mind — I fear — dies for want of nurture with the burden of growing up. It is a pity.

And one last ingredient — **ENTHUSIASM...**

So this book cultivates intellectual enquiry.

...The book is good for fathers and mothers and ministers and priests and rabbis — and the so-called 'man in the street'. There is not one amongst the 'people' who will not say: 'Ya know — I have wondered about that.'

Father James Tierney

God Designed Man with Maths

CHILDREN'S SURFACE AREA & VOLUME

CHILDREN ON BUSHWALKS in very hot and very cold weather are at greater risk than adults. They get dried out quicker in hot weather, and they get cold quicker at lower temperatures, so they are a deal more prone to dehydration, heat exhaustion, hyperthermia and hypothermia.

The reason is the proportion of their surface area to their volume. It is a deal greater. See below.

Dehydration increases with surface area, not with depth or with volume. If there is a bigger volume, dehydration goes on for a longer time, but the rate of dehydration, depends on the area.

Just think of shallow dams with less water in them than deeper dams. Compare the shallow Pejar Dam at Goulburn with the deep Warragamba Dam near Sydney. The Pejar Dam dries right up quite easily.

Think too of how much quicker it is to cool a hot cup of tea by pouring it into the saucer. This, by the way, was the original purpose of saucers, to cool the tea quickly and to drink out of them!

Of course, the surface area of a child is smaller than of an adult, but the child's weight is much smaller too. and not proportionate to the area of his skin.

Peeling onions in the kitchen gives a hint of this. There is a lot less peeling to do with a couple of big onions than a lot of smaller ones that add up to the same weight of onion. Ask any mother.

MATHS WITHOUT TEARS...

A cube (e.g. from a box of blocks) with a side S has an area $A = 6S^2$ because its 6 sides are S^2 each and a volume $V = S^3$ therefore for a cube $A/V = 6/S$

A sphere (e.g. a ball or marble) with diameter D has an area $A = \pi D^2$ and a volume $V = \pi D^3/6$ therefore for a sphere $A/V = 6/D$.

(Don't be put off by a formula using the diameter: it's more practical than a radius for an engineer to measure.)

A cylinder (a squat one) with height H and diameter H has an area $3\pi H^2/2$

(N.B. counting the curved surface as well as both ends) and a volume $V = \pi H^3/4$, therefore for a cylinder $A/V = 6/H$.

For all three shapes, the bigger the size, whether it's S , D or H , the smaller the area needed to pack into it a given volume.

Put abstractly, area to volume is inversely proportional to size, Area depends on the square of a length (or the multiplying of two lengths), whereas the volume depends on cubing a length (or multiplying three lengths together).

FURTHER READING: see article in *Keeping in Touch* called *Try some 'hands-on' Science, Maths, Prayer*. One part of it showed how the ratios of the volumes of a cube to a sphere to a cylinder to a cone are about 4:3:2:1, or expressed exactly $12/\pi:3:2:1$

What the Pope said on Maths

THE POPE TOLD his young questioners in 2006 that the great Galileo said that God wrote the book of nature in the form of the language of mathematics.

He was convinced that God has given us two books: **the book of Sacred Scripture and the book of nature**. [See picture p. 19 of the *Catholic Family Catechism Disciples' Edition II*.] And the **language of nature - it was his conviction - is mathematics**, so it is a language of God, a language of the Creator.

The surprising thing is that **this invention of our human intellect is truly the key to understanding nature**, that nature is truly structured in a mathematical way, and that **our mathematics, invented by our human mind, is truly the instrument for working with nature**, to put it at our service, to use it through technology.

It seems to me almost incredible that an invention of the human mind and the structure of the universe coincide. Mathematics, which we invented, really gives us access to the nature of the universe and makes it possible for us to use it.

Therefore, the intellectual structure of the human subject and the objective structure of reality coincide: the subjective reason and the objective reason of nature are identical. I think that this coincidence between what we thought up and how nature is fulfilled and behaves is a great enigma and a great challenge, for we see that, in the end, it is **'one' reason that links them both**.

One reason could not discover this other reason were there not an identical antecedent reason for both. In this sense it really seems to me that **mathematics - in which as such God cannot appear - shows us the intelligent structure of the universe**. Now there are also theories of chaos, but they are limited because if chaos had the upper hand, all technology would become impossible. Only because our mathematics is reliable, it technology reliable...

See, Judge, Act

SEE

The facts are that a liberal arts degree once included some maths, In 1817, Cardinal Newman studied it as an undergraduate, and so did J.L. Tierney in 1912.

JUDGE

They had a richer tertiary schooling in those days. So could we today, if we resisted the brainwashing against maths by our peers. Their prejudices make it so hard for maths teachers and nigh to impossible for a lot of secondary students.

ACT

Be counter-cultural and politically incorrect: Refuse to be bullied and bluffed by know-alls. Don't turn to jelly at the sight of numbers, algebra and geometry.

Drop boredom and discover hidden beauty and truth.

There *are* people who can teach it interestingly and some wonderfully well-written books. Fax 02 4829 0297 for help.