The Math+Science journal

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Patterns issue

Understanding gravity by Homer B. Tilton

"Any species, in order to assure its long-time survival, must continually strive to go beyond where it now is." President Biden, 2019

Premise: We presently know everything needed to fully understand gravity - its origins and causes; but we don't understand it fully. Why? Maybe it's because of the way our brains are wired. Maybe we think using the wrong paradigm - the wrong patterns.

Galileo had a feel for gravity, especially in the principle of equivalence (the equivalence of gravitation and acceleration); Newton carried understanding a quantum leap further with his treatment of orbital mechanics; Einstein geometrized gravity. But how does the fact of gravity fit in with the "Electric Universe" (David Bodanis)? What's happening at the nano-level and beyond? Do pirouetting electric dipoles somehow cancel out their electric fields but leave something else behind that we call gravitation? Just how does it all work? Caution: Stating the action mathematically is inadequate by itself. We need understanding.

How to rewire our brains to enable us to fully understand gravity? Taking Viagra won't do it; playing the lottery won't do it; spending our leisure hours at Vegas won't do it. Studying math is a good start. Perhaps a concentrated study of quantum mechanics is the quickest way to get there. If that doesn't rewire your brain, what will?

Of course someone who belongs to that other crowd probably isn't interested in understanding gravity. But if we are ever to go to the stars to assure our long-time survival we need to fully understand gravity.

Consider a positron-electron dipole. Its net electric charge at a distance will be zero, yet each component 'tron has a (positive) electromagnetic mass resulting from its electric charge which will be sensed externally as a total 2e mass and you have the inertial aspect of mass. We're halfway there.


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Notation and patterns in math

Minus sign (-) is used as a sign of operation (subtraction) or of polarity (negative); plus sign (+) is used as a sign of addition or of positive polarity. Compound signs: ++12 means +12 and --23 means +23; +23 is also written just 23. And if we see the notation |±5|=5, that means |±5|=±5. Also, +6 and -6 both mean -6, that is a number whose magnitude is 6 and whose polarity is negative. (Compare six degrees below zero on a thermometer.) For example 1-(-2-3) = 1-2-(-3) = 1-2+3.

SuperCalculator does all of the above; but the typical handheld calculator doesn't because it has separate keys for subtraction [-] and negation [(-)].

Analogously, with / indicating division and * indicating multiplication, possible sign combinations are ** & // both of which can be replaced with *, and */ & /* which can be replaced with /. (Your computer math program may not do this.) For example 1/(2/3)=1/2//3=1/2*3 which is normally written 1/(2/3)=1*3/(2/3). This illustrates the use of distribution over multiplication and division, analogous to distribution over addition and subtraction.

- continued on p.7 -

The polarity of zero

Prof. Juncosa: "Zero is between +0 and -0 and it has no sign."

Norm: "Nonsense. All real numbers have to have a sign. To aid the thought processes let's say that positive numbers are green and negative numbers are red. At the zero point on that colored number line, green and red abut and every point on that two-color line is either green or red; there is no place where it has "no color." That means zero always has a polarity of either + or -, depending on how you got there; if it is not known how you got there, then its polarity is not known, but it is always either + or -. Yes, "0" without a sign is only a place holder but "+0" or "-0" (or say "±0") is a real number - a particular point on the real number line.

Prof. Juncosa: What?

Norm: Also the absolute value of 0 is not 0, it is +0.

Prof. Juncosa: Really?!

Norm: Yup. |0|=+0. Or we can write |±0|=+0. When we write 2 that means +2 but when we write 0 that means ±0.

Is this a useful distinction? Yes it is; it makes a ton of difference in advanced math courses. Particularly when dealing with functions having a simple discontinuity or with continuous broken functions. Even simply dealing with the continuous smooth function \( f(x)=x^2 \), it is easy to see just by visualizing its graph that the sign of \( f(x) \) must everywhere be positive and so \( f(0) = +0 \). As we approach the origin of coordinates moving along the curve in the x-direction, the y-value goes to 0, then continuing to move we back away in the y-direction and - not having crossed the x-axis at all - the polarity of every point of the function - even at \( x=0 \) - has to be positive.

Conceptually, \( f(0) \) cannot have "no sign" if it is to be a real number.

Rule 1: The signs of a real number and its reciprocal are the same.

The sign of \( 1/x \) is clearly + or - for all real \( x \); therefore the sign of \( x \) must be also, meaning that 0 as a real number cannot correctly be said to have "no sign."
Why is math hard for some students?
by Homer B. Tilton

Is math inherently difficult to learn? It could be that math is not nearly as hard as even the best contemporary textbooks make it seem. The student should look for patterns and associations in math to make learning less hard.

Typically, modern math textbooks present the material historically and by categories, often obscuring the inherent patterns and associations running through math that can make learning easy and even fun. Unfortunately, clarity of patterns and associations are not criteria that administrators look for when selecting a math textbook for a course. Thus math is harder than it needs to be.

All math flows from numbers and counting. All math is connected. Look for the connections. Math per se is not like the income tax which is a "ton" of disconnected calculations. Albert Einstein is reported to have said, "The income tax is the hardest thing to understand."

Patterns in math -

The multiplication table contains a strong pattern. To construct one, lay out a row of nine numbers by counting from 1 by 1's; the 2nd row is made by counting from 2 by 2's, the 3rd row by counting from 3 by 3's, and so on. You may end it with the 9th row as indicated here:

1 2 3 4 5 6 7 8 9
2 4 6 8 10 12 14 16 18
3 6 9 12 15 18 21 24 27
... ...
9 18 27 36 45 54 63 72 81

To use this multiplication table, take a number from the top row, say 6, and a number from the leftmost column, say 3, (the rows run horizontally, the columns vertically like the columns of a building); the product of those two numbers appears at the intersection of the 6th column and the 3rd row, namely 18 in the present example.

Flourishes may be added to that table in the textbooks, tending to obscure the pattern. (See for example p.43 of footnote reference.)

That pattern is an easy one to learn; take a minute to learn it and you will never again be without a multiplication table; you will always have one with you, right there, in your head!

Soon you will no longer need the multiplication table. A multiplication table is like training wheels for a bicycle; useful for learning a skill (multiplying or bicycling) only to be retired to storage once the skill is learned.

Associations in math -

In a math textbook currently being used at Pima,* in ch.1 (p.44) "12/3" is identified as a division; then in ch.4 (p.227) "5/8" is called a common fraction! Both interpretations of the slash symbol (/) are correct if we recognize that a common fraction is just an indicated division. But that association is lost in the book because those two interpretations are presented far apart and are not referenced one to the other!

And that valuable association in unused in the book, the authors are stuck in the past, reverting generally to the historical ÷ sign for division, and vertical format for common fractions, like ---. 

- continued -

* Identification of that prealgebra textbook - one of the very best - is available on request.
Does life get less funny as time goes by?

There used to be this joke:
"Clyde, the Post Office is increasing postal rates. You'd better stock up on first-class stamps before the price goes up."
That used to be funny before the "Forever Stamp" came along; funny because it was nonsense. It's no longer nonsense and no longer funny.
So, is life becoming less funny? No, it's just that "funny" is a moving target!

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Mail Matters

Open letter to Chris Mathews (Rockefeller Center, NBC, NY,NY):

On your Sunday (4 Jan’09) show on NBC you reminded us all that Barack Obama has indicated he is a supporter of science. When you asked the panel what that meant, they suggested stem-cell research and health care; no mention of space science. What is Mr. Obama’s stand — and your panel’s — on space science?

You have been compared to the legendary Walter Winchell. Someone I knew well, Benjamin E. Tilton, wrote a poem during his time (March 1942), "Walter Winchell - The Mental Dynamo." I’ll see that you get a copy as something to continue to live up to! (No TV then; we had R-A-D-I-O. No cable or satellite needed!)

...HBT, editor

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As a student you can request a free copy of SuperCalculator Notebook; others can get one for $29.95 + $3.50 P&H. Contact Homer Tilton/Echo Electronic Press/8401 E.Desert Steppes Dr./Tucson,AZ 85710-4207. A three-ring binder is included. To order SuperCalculator Notebook without the binder, send only $19.95 + $2.50 P&H. SuperCalculator Notebook is a complete instruction manual. SuperCalculator™ is proprietary to Homer B. Tilton.

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Don’t look to Microsoft® for information on SuperCalculator. SuperC techniques are not yet acknowledged by Microsoft; in fact, Microsoft has said they won’t work.

[See The MS-DOS Encyclopedia (Foreword by Bill Gates) note appearing on page 759.]

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Patterns in SuperCalculator™
Using the Do command

So you came across SuperCalculator sitting there in a corner of the Tutoring Center. "What's this?" maybe you asked. Sit down and take it for a spin. Your first command might be Do ?2+2 followed by a tap on one of the two [Enter] keys. It returns "4". "Ah, amazing" you say. (Maybe not.)

Try a temperature conversion or two: To convert from F=212° to C:

Do F=212°: ?5/9*(F-32) "degrees Celsius".

With the formula right in there. Or to convert from C=100° to F use that other formula:

Do C=100°: ?9/5*C+32 "degrees Fahrenheit".

Tap [UpArrow] to recall the last-used command. Change the preamble (the F=212° or C=100° part) for other temperatures. Try C=-40° for a thrill. The degree symbol (°) may be omitted from the command.

Next find the area of a circle, and the area and volume of a sphere:

Do R=2: ?pi*R^2 "is sq.units of area of a circle w/radius R units"
Do R=2: ?4*pi*R^2 "is sq.units of surface area of a sphere w/radius R units"
Do R=2: ?4/3*pi*R^3 "is cubic units of volume of a sphere w/radius R units"

Theodore Wildi calls these formulas "quantity equations" meaning the units can be any measure of length: inches, centimeters, meters, feet, miles, etc. Instead of pi you may type π(pi) where π is Alt 227 (NK).

Now display a table of square roots (SQR(√)) for numbers from 1 to 10:

Do For i=1 to 10: i SQR(√i):next 'square roots. Letter "i" is the count index.

The root symbol (√) is optional. Print your table out with the [PrntScr]n key.

Yes, you can Do anything mathematical as long as it can be expressed using no more than 127 characters. If you aspire to do truly anything, period, see SuperCalculator Notebook. Look for it nearby. You don't have to settle for the limited usefulness of a commercial handheld calculator or learn to use the pricey Mathematica® program with its 1400-page instruction manual.

At some point you may actually feel compelled to say "Amazing" to Super-Calculator. Now for the coup de grace: SuperCalculator Notebook tells, up front, how to configure your own laptop to serve as a programmable graphing scientific SuperCalculator at no cost to you!

Type ° or √ by depressing and holding an [Alt] key down while keying 248 or 251 in the numeric keypad (NK). That is; ° is Alt 248 (NK), √ is Alt 251 (NK).

The Do commands run a Do.BAT program (see "Patterns in SuperCalculator" above). That program listing follows:

:: This is Do.BAT; H.Tilton, public domain; Dec.08
@Echo off
If NOT "%9" == "" echo Too many parameters
Echo pi=4*ATN(1):%1 %2 %3 %4 %5 %6 %7 %8 %9 !ok
My sincere thanks to Bob Wise and Richard for getting my web site up and running. See back issues of TM+Sc there, at http://ecc.pima.edu/~htilton/

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Recommended for your library:

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T of C: 1. Numbers, trigonometric functions and coordinate geometry
   2. Variables, functions and mappings
   3. Sequences, limits and continuity
   4. Complex numbers and vectors
   5. Differentiation of function of one or more real variables
   6. Exponential, logarithmic and hyperbolic functions and an introduction to complex functions
   7. Fundamentals of integration
   8. Systematic integration
   9. Double integrals in Cartesian and plane polar coordinates
  10. Matrices and linear transformations
  11. Scalars, vectors and fields
  12. Series, Taylor's theorem and its uses
  13. Differential equations and geometry
  14. First-order differential equations
  15. Higher-order linear differential equations
  16. Fourier series
  17. Numerical analysis
  18. Probability and statistics
  19. Symbolic algebraic manipulation by computer software

Notation and patterns in math, continued from page 2 -

If you sense an unfamiliar ring, that may simply be because we normally do not write $1/(2/3)$ as $1/2/3 = 1/2*3$. But this only points up the fact that notation makes a difference. For example arithmetic is next to impossible using Roman numerals; all ancient computers including the Romans calculated using the abacus:

"We finally realize that writing numerals and making computations are two entirely different things; ... But didn't people make calculations with Roman numerals? No, they did not!" ...Karl Menninger, *Number Words and Number Symbols: A Cultural History of Numbers*, 1992, ISBN 0-486-27096-3, p.294

One reason Arabic numbers work so well for computation is that they are laid out like an abacus using a place-value pattern. Patterns in math, when we find them, can be most enlightening and helpful.
CALENDAR for 2009

04 5 6 7 8 9 10 Jan - Paydays are Fri.odd-numbered weeks in 2009
02 11 12 13 14 15 16 17 MLK(Mon);Spring sem.start(Tue);MAT086 start(Sat)
03 18 19 20 21 22 23 24
04 25 26 27 28 29 30 31
05 1 2 3 4 5 6 Feb 7
06 8 9 10 11 12 13 14 5th annual Relativity/Starflight Conf.Tucson(13)
07 15 16 17 18 19 20 21
08 22 23 24 25 26 27 28 Rodeo Holiday(26,27)
09 1 2 3 4 5 6 7 Mar 10 8 9 10 11 12 13 14
11 15 16 17 18 19 20 21 Spring Break(16-22)
12 22 23 24 25 26 27 28
13 29 30 31 1 2 3 4
14 5 6 7 8 9 10 11 Apr 15 12 13 14 15 16 17 18
16 19 20 21 22 23 24 25 Sunday comes from the sun;
17 26 27 28 29 30 1 2 Monday comes from the moon;
18 3 4 5 6 7 8 9 May Tuesday comes from Mars;
19 10 11 12 13 14 15 16 Wednesday comes from Mercury;
20 17 18 19 20 21 22 23 Thursday comes from Jupiter;
21 24 25 26 27 28 29 30 Friday comes from Venus;
22 31 1 2 3 4 5 6 Saturday comes from Saturn...
23 7 8 9 10 11 12 13 Jun
24 14 15 16 17 18 19 20 That leaves left-over:
25 21 22 23 24 25 26 27 Earth
26 28 29 30 1 2 3 (4) Uranus
27 5 6 7 8 9 10 11 Jul Pluto
28 12 13 14 15 16 17 18
29 19 20 21 22 23 24 25
30 26 27 28 29 30 1 2
31 2 3 4 5 6 7 8 Aug
32 9 10 11 12 13 14 15
33 16 17 18 19 20 21 22
34 23 24 25 26 27 28 29
35 30 31 1 2 3 4 5
36 6 (7) 8 9 10 11 12 Sep
37 13 14 15 16 17 18 19
38 20 21 22 23 24 25 26
39 27 28 29 30 1 2 3
40 4 5 6 7 8 9 10 Oct
41 11 12 13 14 15 16 17
42 18 19 20 21 22 23 24
43 25 26 27 28 29 30(31)
44 1 2 3 4 5 6 7 Nov
45 8 9 10 11 12 13 14
46 15 16 17 18 19 20 21
47 22 23 24 25(26)27 28
48 29 30 1 2 3 4 5
49 6 7 8 9 10 11 12 Dec Winter Solstice Holiday Season: Starts with
50 13 14 15 16 17 18 19 Dec.21 or Hannukah or Kwanzaa whichever comes
51 20 21 22 23 24(25)26 first; runs through Jan.1.