



UNLOCKING  
CONSCIOUSNESS



## BRIAN MIND FORUM

### Appendix 035

#### Facts & Stats

##### Units of length, time and frequency

1 micron = 1,000<sup>th</sup> of a millimetre  
25.4 microns = 1,000<sup>th</sup> of an inch  
1 micron = 10<sup>-6</sup> meters  
10,000 Ångstrom = 1 micron  
10 Å = 1 nanometer

The diameter of a typical neuron cell = between 10 and 20 microns.  
The wavelength of light visible to the eye = about ½ micron.  
The distance between adjacent atoms in an organic molecule = about 2 Å.  
An average sized protein might have a diameter of about 50Å.  
Action potentials travel at about four feet per second along the neural filaments

1 millisecond = 1,000<sup>th</sup> of a second.  
1 microsecond = 1,000<sup>th</sup> of a millisecond (one millionth of a second)

1 Atto second 10<sup>-18</sup>  
Speed of the length of a wavelength of light = 10 Attoseconds Ferenc Krausz Vienna NS  
p36 9 April 2005

1	10 <sup>1</sup>	Ten		
1	10 <sup>2</sup>	1 Hundred		
1 kilo	= 10 <sup>3</sup> or	1 Thousand 1, 000		
1 mega	= 10 <sup>6</sup> or	1 Million	1	Uno
1 giga	= 10 <sup>9</sup> or	1 Billion	2	Duo
1 tera	= 10 <sup>12</sup> or	1 Trillion	3	Tres
1 peta	= 10 <sup>15</sup> or	1 Quadrillion	4	Quatuor
1 exa	= 10 <sup>18</sup>	1 Quintillion	5	Quinque

1 zeta	= 10 <sup>21</sup>	1 Sextillion	6	Sex
1 yotta	= 10 <sup>24</sup>	1 Septillion	7	Septem
1 bronto	= 10 <sup>27</sup>	1 Octillion	8	Octo
1	10 <sup>30</sup>	1 Nonillion	9	Novem
1	10 <sup>33</sup>	1 Decatillion	10	Decem

It is thought that we are born with one billion *giga* neural networks in the central nervous system and another *giga* neurons in the brain..

We grow a trillion *tera* links structures or filaments, dendrites and axons during our lifetimes.

We have a quadrillion *peta* cells (1,200 trillion) in our adult bodies (solid tissue in the bones, skin and organs plus neural and other biological structures, hormones and other chemical messengers, blood and lymph liquids, resident viruses and bacteria – mutually beneficial parasites).

There are at any one time approximately one quintillion *exa* H<sup>2</sup>O molecules in an average adult.

### Volume of Information

A study at Berkeley suggests the world generated 5 quintillion *exa* bytes of new information in 2002. <http://www2.sims.berkeley.edu/research/projects/how-much-info-2003/>

### Volumes & Quantities Graphene

28 Grams cover 28 football fields

16 cu cms could balance on a blade of grass.

### Operating Speeds

1 hertz (Htz) = 1 event or cycle per second

Middle C is about 260 Hertz

3 ½ lb ( 1350 gms) brain operating at 77 mille volts

Action potentials in Axons & Dendrites travel at about four feet per second.

Action Potentials peak voltage 120 mV. Duration: 2-5 ms.

Physics World p 45 Sep 1999

Electrons travel along axons at approximately one billion per second.

Proceedings of the National Academy of Sciences vol 107 p18127.

Synapses: Gap approx 20 nano meters. Physics World p 46 Sep 1999

Temperature about 37° c

### 'Clock Pulse' of Brain

13 Visual frames per second. [NS 24 Oct 09 p33 ]

Alpha Waves 8-12 Hertz [Sci Am p 26 August 2012]

Beta Waves 12 – 20 Hertz

**Brain Size** 1200 – 1500 cu cms

**Inversion of image.**

Variable. Possibly an index of IQ. [Biological Systems of the Brain p109.]

**Human Body**

- 120 Trillion Cells in solid tissue
- 25 Trillion Blood Cells supply the others with oxygen
- 100 Trillion Bacteria. Average gut holds 1.5 kg of microbes
- 2 Billion Neurons (of which 1 billion are in the brain at birth).
- 1-2 Trillion additional links and structures in mature Brain
- 30 Billion Glia
- (from Times Eureka article Oct 09)
- 100 Million types of viruses.

The largest chemical constituents of the body are water molecules.

There are some 100 small Peptide substances.

**Human Genome**

Four base pairs, **Nucleotides** Adenine, Cytosine, Guanine & Thymine (see DNA)

Three pairs of Nucleotides to One **Codon**

Variable number of codons to one **Gene** which create 20 **Amino Acids, RNA**

**Ribosomes**

Variable number of genes to one **Chromosome**

23 pairs of Chromosomes to the **Genome** create **stem cells**

(22 ½ in males)

There are 23 pairs of Chromosomes in one complete human genome. These vary considerably. The largest chromosomes have some 3,000 genes and some 250m base pairs of nucleotides. The smallest has some 365 genes and some 75m base pairs.

There are thought to be approximately 3 billion base pairs in each complete human genome.

**Comparisons**

Simplest Bacteria:

Mycoplasma (pneumonia) have 583,000 Base Pairs 485 Genes

Complex Bacteria:

Bacteria (mesorhizopium) have 10 million Base Pairs 8,000 Genes

Fungus: typically have 38 million Base Pairs 5,000 Genes)  
(Yeast -Saccharomyces

Animals

(Worm c Ellegans -959 cells 19,100 Genes)

Insects (Fly					13,600 Genes)
Plants: typically	have	115 million	Base Pairs		
Humans	have	3 billion	Base Pairs		25,000 Genes

(According to Craig Venter)

**Humans can sweat up to 12 litres of water in a day.**

## Cells

DNA ► RNA ► Ribosomes ► Amino acids ► Proteins ► Protein's fold into stem Cells  
► Specialised cells.

151 components blueprint for life

57 parts

1 million atoms

George Church, Harvard Medical School

Synthetic Biology

## Viruses, Bacteria and the Family of Eukaryotes

3 billion years (NS p17 8 May 2004)

Viruses	}	single celled organisms
Archaea	}	no nucleus
Prokaryotes	}	a million species
Bacteria	}	Nucleus
Cyanobacterium		Generates a majority of the Ocean's Photosynthesis
Eukaryotes	}	Nucleus
Hacrobia		
Stramenopila		
Archaeplastida		Plants
Opisthokonta		Fungi & Animals

Note NS p55 19 April 2014

## Volumes

22 Litres of steam =  $10^{23}$  molecules of H<sup>2</sup>O

## Operation of Neural Networks (and flocking)

'Resting State Networks': collective activity: Chialvo UCLA

The Axons and Dendrites transmit electrochemical signals by a succession of exchanges of

sodium and calcium ions operating at 77 mille volts, and travelling at a speed of about four feet per second.

This activity generates a faraday force field, an electromagnetic field around the axon and dendrite.

These fields generate a series of waves across swathes of the brain called Circassian rhythms.

'Self-organised criticality' coordinated, but highly responsive to external disturbance.

Balance between orderliness & adaptability:

Cavagna. Institute for complex systems Rome

Bialek. Princeton

Manfred Eigen 1967 Nobel Prize

'Critical Phase Transition'

'Scale invariance'

'Critical 'Casimir force'

'Signalling cascades'

*(See also 'What is Life' Erwin Schrödinger)*

*Note NS p47 26April 2014*

## Man & Machines

### Brains & Computers

#### Machines

#### Human Brain

##### Machine (Artificial)

##### INFORMATION

Digital binary coding system  
Based on Morse code  
supporting alphabets, numerals,  
symbols, sounds & images.

Analogue & parallel  
electrochemical patterns  
physical neural structures

##### Machine (Artificial)

##### MEMORY

Semi conductors  
Binary magnetic patterns  
on various media  
(Historically) Holes in paper tape  
and cards. Print on paper,

electrochemical patterns  
physical neural structures

##### Artificial (Machine)

##### INTELLIGENCE

Accurate and fast execution  
of algorithms, set out in  
hierarchies of programs of ever

Fast inherited & learned  
responses to events.  
"Knowing what to do when

greater sophistication and  
Complexity.

we do not know what to do.”  
“Coping with the unexpected.”  
Probability.

**Artificial (Machine)**

**THINKING**

Design, preparation and testing  
of new program algorithms.

Problem solving  
Growth of new electrochemical  
neural structures.  
Creating new ideas & concepts.  
Preparation & Feedback .

CTR Nov 2012.

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