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Review Article

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Vector(y) & Verticality for Victory -the Form of Good Health

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Abstract

(Existing in thought or as an idea but not having a physical or concrete existence)

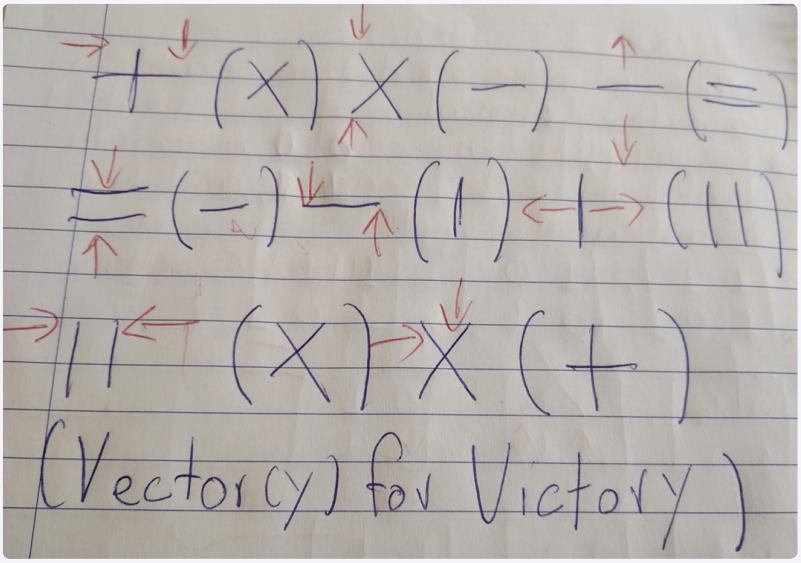


Figure 1

Keywords

- Vector (a quantity possessing both magnitude and direction, represented by an arrow the direction of which indicates the direction of the quantity and the length of which is proportional to the magnitude; such a quantity with the additional requirement that such quantities are to transform in a particular way under changes of the coordinate system).
- Vectory (a Scandinavian company specialised in solutions incorporating inertial sensors).
- Verticality (position at right angles to the horizon).

Introduction

Let me start the process of abstract thinking (figure 1). Addition (usually signified by the symbol +) is one of the four basic operations of arithmetic, the other three being multiplication (usually signified by the symbol ×), subtraction (usually signified by the symbol −), and division (usually signified by the symbol ÷; the symbol = in the abstract signifies division or seperation). The plus and minus signs, + and −, are used to represent the notions of positive and negative as well.

There has been considerable behavioral research on the cognitive processes associated with these operations over the past several decades. The four basic arithmetic operations rely on a complex profile of distributed responses within the Posterior Parietal Cortex (PPC), involving differential levels of activation and deactivation across distinct subdivisions of the Intraparietal Sulcus (IPS), Superior Parietal Lobule (SPL) and Angular Gyrus (AG).

Many studies have shown that solving addition and subtraction problems can induce overt shifts of spatial attention. In particular, right-side targets are detected faster than left-side targets when

preceded by an addition operation, while left-side targets are detected faster than right-side targets when preceded by a subtraction operation. However, the interaction between space and arithmetic in multiplication or division is hardly studied and remains controversial.

Recently a great deal of interest has been shown by researchers on developing a bio-molecule based computer. The basic building blocks of such a computer are arithmetic units and memory. These units can be designed using Boolean logic gates as in the case of electronic circuits. Instead of using silicon-based technology, Boolean logic gates can be generated from biological systems. One such system can be generated by a DNA reaction mechanism based on a reversible strand displacement process. A generalized pipeline architecture employing DNA reaction chain mechanism for the arithmetic operations such as addition, subtraction, multiplication, and division is discussed as the ultimate goal to design an automated system using logic gates, which make decisions within living cells.

Every day, every hour, every second one of the most important events in life is going on in the body—cells are dividing. When cells divide, they make new cells. A single cell divides to make two cells and these two cells then divide to make four cells, and so on. This process is called “cell division” and “cell reproduction,” because new cells are formed when old cells divide. The ability of cells to divide is unique and fundamental for living organisms. When organisms grow, it isn’t because cells are getting larger. Organisms grow because cells are dividing to produce more and more cells (multiplication). In human bodies, nearly two trillion cells divide every day. It is also important for cells to stop dividing at the right time. Depending on the type of cell, there are two ways cells divide—mitosis and meiosis. Each of these methods of cell division has special characteristics. One of the key differences in mitosis is a single cell divides into two cells that are replicas of each other and have the same number of chromosomes. This type of cell division is good for basic growth, repair, and maintenance. In meiosis, a cell divides into four cells that have half the number of chromosomes. Reducing the number of chromosomes by half is important for sexual reproduction and provides for genetic diversity.

Life is an unfolding “polynomial” (from the Greek words ’poly’ means ‘many’ and ‘nominal’ means ‘terms’, so altogether it said many terms) mystery of expressions which consist of variables and coefficients. But behind the arithmetic symbols and the actions of addition, multiplication, subtraction, and division, there is a hidden driving force that decides which operation or combination of operations will take place, where and for how long until this order will change to a new algorithmic model of processes.

The red arrows are that drive!
Therefore, matrix (symbols) and vector (arrows) combination is a plot (x, y) that creates a 2-D line plot of the data in Y versus the corresponding values in X (axis).

The axes perspective

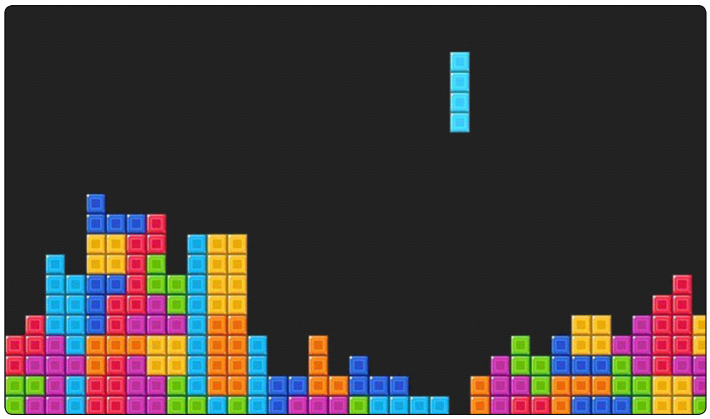


Figure 2

The game of TETRIS originated in the Soviet Union where it was designed by Alexy Pazhitnov and programmed by Vadim Gerasimov in 1984. Over 25 years later, it continues to see world-wide success on a multitude of gaming systems and countless variations have been developed. TETRIS has drawn a substantial amount of interest, not only from puzzle enthusiasts, but also from psychologists, computer scientists and mathematicians alike.

TETRIS is played with the reflexive set of Tetrominoes: Bar, Tee, Square, Left & Right Kink, Left & Right Elbow (see in Fig. 1 relative set of algorithmic symbols).

TETRIS is a one-player game that is played in a 10×20 rectangular well of empty unit cells. The current piece drop from the centre of the well at a steady speed as the player translates and/or rotates the piece in 90 degree increments until it lands on the bottom of the well or a previously played piece, where it can be moved for an amount of time before ”locking” into place. Pieces cannot drop through spaces in which they do not fit. For example, a piece of width two cannot be forced through a gap of width one. The primary objective of the game is to manipulate the pieces to fill the rows. Once all the cells in a given row are full, the row empties (clears) and all rows above it drop by one. The speed at which the pieces falls increases as the game progresses, providing an additional challenge to the player. The game is lost as soon as a cell above row 20 is occupied.

What one can understand from the TETRIS game is that as soon as the row (horizontal line) is cleared, deleted, or moved away, the player gains time to continue playing. The main purpose of the game is to keep on playing as long as possible. If the horizontal axis persists and not removed in time, the game comes gradually to an end since there is not enough space remaining on the top of the pile to put the current new piece. The same TETRIS understanding goes for life too. Being horizontal for long and not being able to raise in time has adverse consequences in health.

The figure 3 shown below depicts vividly an emergency incident, a critical health condition of a man who is critically ill (COVID19) and struggles in ICU to survive. But this is easy and obvious. The

puzzling thing is to see further from the apparent, meaning to perceive the spatial-axis difference between the sufferer and the ones standing beside him. And that because axis antithesis shows that does matter in life, and every spatial variation holds valuable information. So the one lying on the stretcher is horizontally, and the ones operating close to aid him are vertically positioned, which strongly indicates that disease from health and vise versa is axis connected and spatial oriented.

According to the Hospital Episode Statistics Analysis report for 2014, approximately 250,000 patients were admitted to intensive care units (ICU) in the UK. Patients in these wards are heterogeneous clinically and suffer from life threatening conditions including sepsis/infection; renal failure; cardiac surgery and major trauma.

Critically ill patients often show symptoms typically involving an initial systemic inflammatory response syndrome (SIRS), characterised by the release of pro-inflammatory mediators. SIRS is initially caused by non-infective events, such as cardiogenic shock, resuscitation, surgery, or trauma-related tissue damage and affects almost half of patients admitted to ICU. SIRS is accompanied by a compensatory anti-inflammatory response syndrome (CARS) initiated to dampen the inflammatory process and aid return to homeostasis. Either an excessive CARs or an insufficient SIRs response will render the host susceptible to infections or unable to clear existing infections. Nosocomial infections in critically ill patients are associated with an increased length of hospital stay, elevated health care costs and increased mortality.

Immunoparesis is seen post-critical illness and involves alterations in both innate and adaptive immune responses, including neutrophil dysfunction, altered monocyte phenotype and antigen presentation capacity, lymphopenia and impaired lymphocyte responses to novel challenge and elevated pro-inflammatory cytokines. The clinical consequences of immune suppression in the ICU setting include increased risk of multiple organ failure, infections and mortality.

Immunological dysregulation in critically ill patients is a serious challenge in critical care management because its occurrence increases risk of secondary infections in ICU patients, which increases their length of stay and health care costs. Patients with persistent critical illness have a high mortality and a high risk of long-term morbidity.

The persistent critically ill patient may develop an aged phenotype. It is well established that the immune system declines with age, termed immune senescence and that this contributes to increased risk of infection. Key features of immunesenescence are reduced innate cell function, a reduced naïve: memory T cell ratio and thymic output, shorter lymphocyte telomeres, increased numbers of functionally senescent T cells and reduced B regulatory lymphocyte frequency and function.

Lymphopenia was associated with increased ICU length of stay and in trauma patients; it has been reported to be associated with mortality and multiple organ dysfunction. Naïve T cells frequency declined in ICU patients. Accumulation of senescent T cells also occurred during critical illness. Increase in immature granulocytes in blood, which has been reported in major trauma patients but not previously in the broad setting of ICU patients. Natural Killer (NK) cells are cytotoxic cells that are responsible for killing virus infected cells and are also an important source of inflammatory cytokines. A state of NK lymphopenia reported in critically ill patients.

Persistent critical illness induces some remodelling of the adaptive immune cell populations, with evidence of a phenotype similar to age-related immune decline in lymphocytes, notably reduced thymic output, increased frequency of senescent T cells and reduced regulatory B cells, increased neutrophil: lymphocyte ratio and loss of monocyte HLADR expression as biomarkers for increased length of stay in critically ill patients.

Figure 3

Moreover, the commonest physical problem reported by intensive care patients is severe weakness and fatigue. Patients in intensive care can lose about 2% of muscle mass a day during their illness owing to a combination of primary muscle catabolism and atrophy secondary to neuropathic degeneration. They may lose over half their muscle mass, resulting in severe physical disability. Rebuilding such muscle losses can take over a year. Initially, patients may be so weak that they struggle to feed themselves, their cough power is greatly reduced, and they may have poor control of their swallowing and upper airways with a risk of aspiration. The nursing burden can be large. If patients can stand, they are in danger of falling. This is often compounded by postural hypotension, which may reflect autonomic disturbances.

On discharge from intensive care, patients may seem completely oriented and to understand the information they are given about their illness. Yet when questioned a few days later, many have little or no memory of their stay in intensive care or can remember only pain, suctioning, or lack of sleep. The only memories of some patients are nightmares, often of a persecutory nature in which they are subjected to torture, or paranoid delusions. These

nightmares and delusions may be attributed to the illness, the use of opiate and sedative drugs, the unnatural environment of intensive care with its lack of a proper day and night, and to constant noise. Patients nursed in an intensive care unit without windows have even more unpleasant memories than those nursed in a unit with large windows.

Early progressive mobilization (vertical positioning) of adult intensive care unit (ICU) patients has been shown to be safe and feasible and result in reduced delirium, improved functional outcomes, reduced hospital length of stay, and reduced mortality in patients with acute respiratory failure. In a recent systematic review of physiotherapy in ICU, Stiller suggested that, given the evidence supporting the outcomes for early mobilization, "ICU physiotherapists should give priority to interventions aimed at early progressive mobilization". However, point-prevalence studies from Germany and Australia and New Zealand have demonstrated a low incidence of mobilization of patients with an endotracheal tube (8% in Germany and 0% in Australia and New Zealand).

Figure 4

Medical research has repeatedly demonstrated that the results of pilot studies and phase II studies may not result in improved patient-centered outcomes when tested in a larger trial.

Early mobilization is a complex intervention that requires careful patient assessment and management, as well as interdisciplinary team cooperation and training. Patient safety is one of the most commonly reported barriers to delivering early mobilization, including respiratory, cardiovascular and neurological stability and the integrity of invasive lines. In a recent systematic review and meta-analysis of patient safety during early mobilization, 48 studies were identified that reported data on safety during early mobilization, including falls, removal of endotracheal tubes (ETT), removal or dysfunction of intravascular catheters, removal of catheters or tubes, , hemodynamic changes, oxygen desaturation and cardiac arrest.

The doctor shown in figure 5 is staring at a screen, watching as a graph peaks and dips. The peaks come to be farther and farther apart, and then suddenly, the line goes flat. "We've lost him!" the doctor says. The television show moves on to the next crisis, and the camera shifts away from the monitor. But what does the flat line mean? Why is "flatlined" synonymous with "dead"?

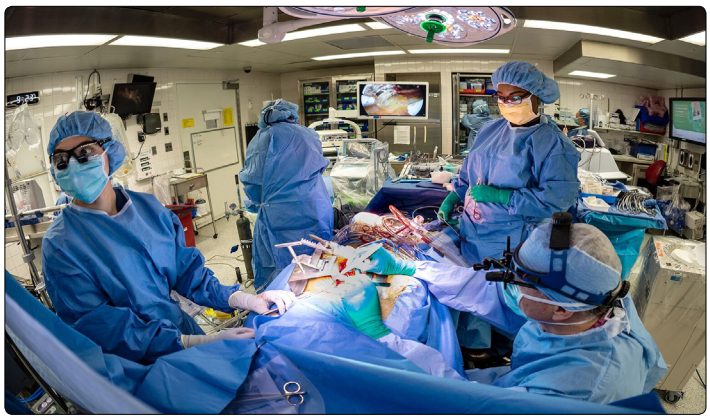


Figure 5

The machine featured the television show is called an electrocardiogram machine, or EKG (or ECG, figure 6). The EKG measures electrical activity in the heart. Your heart beats because one part of it, the SA node, generates electrical impulses. Located in the upper right chamber of your heart, the SA node sets the pace of your heartbeat. If it ceases to follow a steady pattern, you will develop an irregular heartbeat. If the SA node fails to function or becomes blocked, another node, known as the AV node, normally can take over. However, it's not as effective in the role of pacemaker, resulting in a usually slower and weaker heartbeat. If the AV node also fails, there will be no more electrical impulses. Instead of showing heartbeats, the EKG will display a horizontal line, indicating that there are no longer changes in the heart's electrical activity over time. It means that the patient has died.

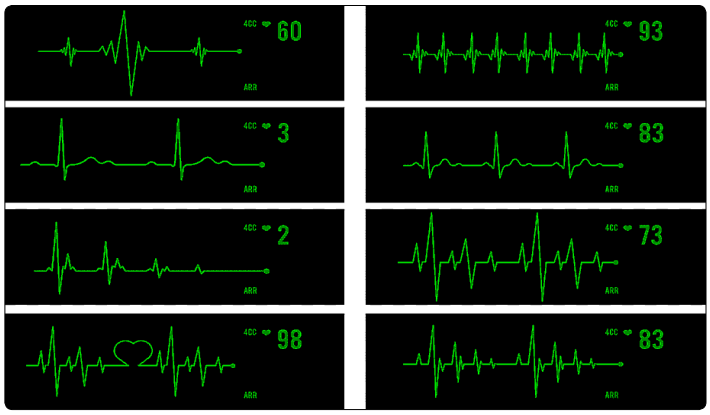


Figure 6

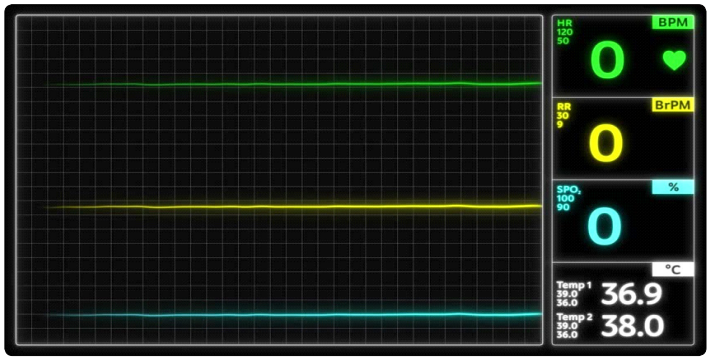


Figure 7

Flat·lined, flat·Lin·ing, flat·lines

To show a horizontal line on the monitor of an electrocardiogram or an electroencephalogram, indicating no electrical activity.

Informal: To die.

To be in an unchanging condition, to cease to live, flourish, or succeed; die literally or figuratively.

clear that row (on time)

Morpheus ('Fashioner', derived from the Ancient Greek: μορφή meaning 'form, shape') is a god associated with sleep and dreams. In Ovid's Metamorphoses he is the son of Sleep, and he appears in dreams in human form. From the medieval period, the name began to stand more generally for the god of dreams, or of sleep.

We often hear about the real dangers of getting too little sleep, but on the other end of the spectrum, sleeping too much also appears to have some risks.

When it comes to sleep, can you have too much of a good thing? It's true a good night's sleep is essential for health. But oversleeping has been linked to a host of medical problems, including headaches, back pain, obesity, diabetes, heart disease, depression, and increased risk of death.

The amount of sleep you need varies significantly over the course of your lifetime. It depends on your age and activity level as well as your general health and lifestyle habits. For instance, during periods of stress or illness, you may feel an increased need for sleep. But although sleep needs differ over time and from person to person, experts typically recommend that adults should sleep between seven and nine hours each night (the horizontal position must change in time as in Tetris).

Oversleeping is called hypersomnia or "long sleeping." This condition affects about 2 percent of people. People with hypersomnia might require as many as 10 to 12 hours of sleep per night to feel their best.

For people with hypersomnia, oversleeping may cause the following issues:

- anxiety
- low energy
- memory problems

"Virtue is the golden mean between two vices, the one of excess and the other of deficiency" — Aristotle

Aristotle is one of greatest Greek thinkers in the history of western science and philosophy. Together with Plato and Socrates, he laid much of the groundwork for our modern way of thinking. One of the main ideas of Aristotle's teachings is the idea of finding balance. Aristotle argued that all virtue in life is achieved by "maintaining the Golden Mean". This means that, in order to find happiness, people should always strive for a balance between 2 extremes. In a society where non-stop stimulation is widely available, I see a lot of people suffering to apply the rule. People either succumb in the extreme of excess, which can take form in the accumulation of wealth, food, drugs, alcohol OR descend into deficiency, like inadequate attention to education, healthy sport activities or intellectual pursuits.

Aristotle recommends moderation. We all know too much alcohol will cause a hangover. We all know sleeping only 3–4 hours will harm our body and health. We all know that too much sunlight will give us a sunburn. Still, people keep falling into this trap time after time. But what is it that makes living in excess or deficiency so tempting? Aristotle argues that people who don't respect the Golden Mean principle think more about short-term gratification. Maintaining a relativity of balance requires willpower and long-term thinking abilities. I think this ancient principle is still very powerful. Our current world bombards us with temptations, either causing us to over-consume or stay in our shelves out of fear and anxiety. Finding that balance is a very important aspect of our well-being. I even think it is crucial in building a healthy self-esteem. Balancing your desires will allow you to strengthen your willpower muscles and keep you focused on your long-term goals.

Vertical is life

If one wants to delve deeper and reverse from flat, horizontal, disease and death to vertical, creation, beauty and life, the embryonic development from an abstract and not analytical or anatomical perspective will shed a shining light about the understanding of the language of the forms of living organisms, the inner movements, the coherence, the changing patterns, and the flow of life's processes.

In the fifth until the eighth week (the un-folding), the body gets its final form. First, the enfolding movement of the fourth week is continued and the embryo gets rounder. Then an unfolding movement can be seen: the spine and the backstretch and the neck and later the waist and the hips appear. Head and limbs become apart from the torso. This process goes vertically from top to bottom: first the neck, then the waist. It is this unfolding process that makes man human. He is centred, and acts from this centre.

Neck and waist ensure that head, chest and limbs become separate areas. The three foldness of the human body is there.

Man is the only organism that stands and goes upright: all joints (eg., neck, shoulder, hip, knee, ankle) are in one vertical plane. When man stands, he is in balance. Standing and locomotion take little energy. Because he stands on his feet, his hands are free to use at his discretion.

Apes also go through the process of unfolding their back and the development of a neck and a waist, but they lose the erect posture again, the chimpanzee not until after birth (Verhulst).

Figure 8

On the side of the head, the embryo develops faster than on the side of the tail. The neural tube closes earlier at that side, it is at the head that the digestive tract is formed earlier; the arms develop earlier and faster than the legs. This is called the cranio-caudal (= head-tail) growth movement. This is in contrast with the limbs, where the fingers and toes appear first and the shoulders and pelvis appear last. What is closest to the centre comes last and what is furthest away comes first. This is a reversal of the cranio-caudal development movement. This second growth movement can be called the centre-periphery (or disto-proximal) growth movement. This growth movement is important for humans: this long embryonic development-time, gives more time to develop what arises late. As a consequence, the legs grow longer than the arms and the upper legs longer than the under legs (Verhulst). This growth movement largely determines the upright (vertical) posture of man.

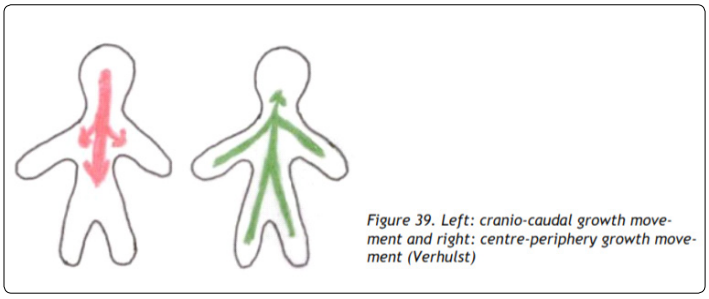


Figure 39. Left: cranio-caudal growth movement and right: centre-periphery growth movement (Verhulst)

Figure 9

Growing on (dividing & multiplying)

The ability of cells to divide is unique and fundamental for living organisms. When organisms grow, it isn't because cells are getting larger. Organisms grow because cells are dividing to produce more and more cells (multiplication).

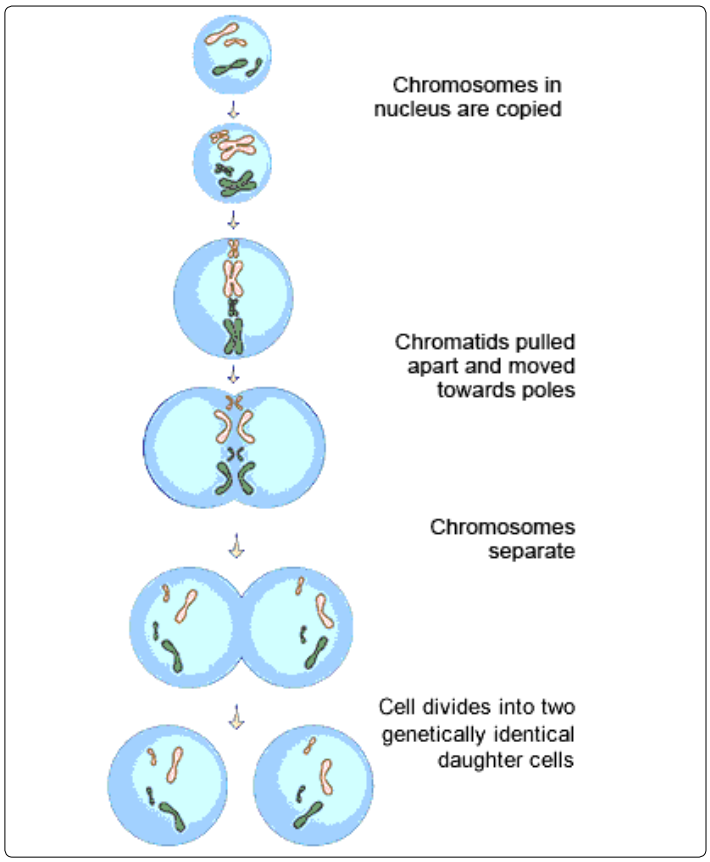


Figure 10

Figure 10 shows a vertical division (mitosis), in which one cell becomes two. In human bodies, nearly two trillion cells divide every day.

Cells are atoms (protons-neutrons-electrons), and charges too (positive + and negative −). The number of atoms in one person is almost too big to write out. Hydrogen, oxygen and carbon make up about 99% of the average human. A 70 kg body would have approximately 7*1027 atoms. That is, 7 followed by 27 zeros: 7,0 00,000,000,000,000,000,000,000,000. Of that, 4.7*1027 would be hydrogen atoms, which have one proton and one electron each. Another 1.8*1027 would be oxygen, which has 8 protons, 8 neutrons and 8 electrons. There are 7.0*1026 carbon atoms, which have 6 protons, 6 neutrons and 6 electrons. Now, let's add that all up:

Table

	Protons	Neutrons	Electrons
Hydrogen	4.7*1027	0	4.7*1027
Oxygen	1.4*1028	1.4*1028	1.4*1028
Carbon	4.2*1027	4.2*1027	4.2*1027
Total	2.3*1028	1.8*1028	2.3*1028

2/3 is hydrogen, 1/4 is oxygen, and about 1/10 is carbon. These three atoms add up to 99% of the total.

Electricity is everywhere, even in the human body. Our cells are specialized to conduct electrical currents. Electricity is required for the nervous system to send signals throughout the body and to the brain, making it possible for us to move, think and feel.

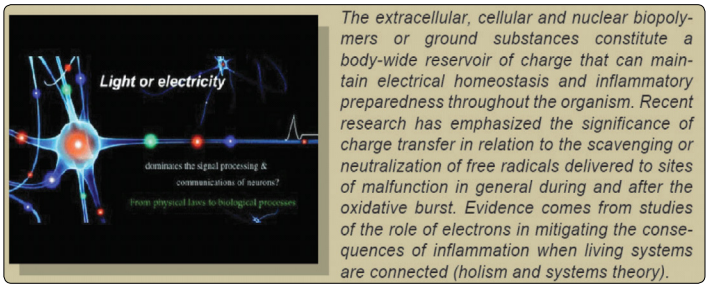
So, how do cells control electrical currents?
The elements in our bodies, like sodium, potassium, calcium, and magnesium, have a specific electrical charge. Almost all of our cells can use these charged elements, called ions, to generate electricity.

The contents of the cell are protected from the outside environment by a cell membrane. This cell membrane is made up of lipids that create a barrier that only certain substances can cross to reach the cell interior. Not only does the cell membrane function as a barrier to molecules, it also acts as a way for the cell to generate electrical currents. Resting cells are negatively charged on the inside, while the outside environment is more positively charged. This is due to a slight imbalance between positive and negative ions inside and outside the cell. Cells can achieve this charge separation by allowing charged ions to flow in and out through the membrane. The flow of charges across the cell membrane is what generates electrical currents.

Cells control the flow of specific charged elements across the membrane with proteins that sit on the cell surface and create an opening for certain ions to pass through. These proteins are called ion channels. When a cell is stimulated, it allows positive charges to enter the cell through open ion channels. The inside of the cell then becomes more positively charged, which triggers further electrical currents that can turn into electrical pulses, called action potentials. Our bodies use certain patterns of action potentials to initiate the correct movements, thoughts and behaviors.

A disruption in electrical currents can lead to illness. For example, in order for the heart to pump, cells must generate electrical currents that allow the heart muscle to contract at the right time. Doctors can even observe these electrical pulses in the heart using a machine, called an electrocardiogram or ECG. Irregular electrical currents can prevent heart muscles from contracting correctly, leading to a heart attack. This is just one example showing the important role of electricity in health and disease.

Integrins are a family of ubiquitous cell surface receptors comprising heterodimers of alpha and beta chains that are required for cell adhesion and motility. Integrin-dependent adhesion and signaling is associated with major conformational changes in the ectodomain as it shifts from a low-affinity “bent” to a high-affinity “extended” structure. The ability of a cell to regulate dynamically the affinity or activation state of an integrin, and hence its binding to extracellular matrix or cell adhesion molecules, is assumed to be driven by intracellular signaling events transmitted by protein binding to the cytoplasmic tail. The binding of an integrin to its ligand can then transmit signals back into the cell to regulate the formation of a macromolecular focal adhesion complex that effectively anchors the cytoskeleton to the adhesion site. Many proteins have been reported to associate physically and functionally with integrins, leading to altered signaling events. A particularly intriguing molecular association exists between integrins and transmembrane proteins that gate the movement of charge, especially voltage-gated potassium channels, although the significance of this interaction is not understood. Although ample evidence indicates that the engagement of integrins can promote potassium efflux by both excitable and nonexcitable cells, we speculate the converse, that the activation state of integrins is dynamically regulated by changes in a transmembrane potential. In this way, direct-current electric fields generated at a site of tissue injury can promote the galvanotaxis (movement of an organism or any of its parts in a particular direction in response to an electric current; electrotaxis) or directed migration of cells involved in tissue repair and inflammation.



The extracellular, cellular and nuclear biopolymers or ground substances constitute a body-wide reservoir of charge that can maintain electrical homeostasis and inflammatory preparedness throughout the organism. Recent research has emphasized the significance of charge transfer in relation to the scavenging or neutralization of free radicals delivered to sites of malfunction in general during and after the oxidative burst. Evidence comes from studies of the role of electrons in mitigating the consequences of inflammation when living systems are connected (holism and systems theory).

Figure 11

Going In -> or Going Out <- (adding or subtracting)

Tonicity is a measure of the relative concentration of solute particles on either side of a semi-permeable membrane (e.g. inside a cell versus outside the cell). Only solutes that cannot cross the membrane contribute to tonicity. It determines the direction and extent to which water moves by osmosis. The higher the tonicity the greater the difference in the concentration of solutes (dissolved substances) and therefore the concentration of water.

A hypertonic solution will have higher concentration of dissolved solutes than the solution inside the cell. Therefore, a hypertonic solution has a lower concentration of water than the solution within the cell. As a result, a hypotonic solution will force water out the cell (there is a net movement of water out the cell).

A hypotonic solution will have a lower concentration of dissolved solutes than the solution inside the cell. Therefore, a hypotonic solution has a higher concentration of water than the solution within the cell. As a result, a hypotonic solution will force water into the cell (there is a net movement of water into the cell).

An isotonic solution will have an equal concentration of solutes to the solution inside the cell. Therefore, an isotonic solution has an equal concentration of water to the solution within the cell. As a result, water moves in and out of the cell at an equal rate. There is no net movement of water.

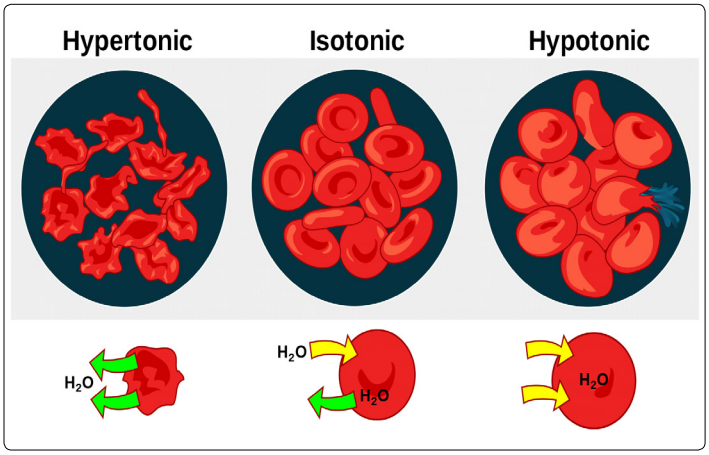


Figure 12

A hypertonic solution causes water to move out of the cell and the cell becomes shrivelled. Red blood cells develop a star-shaped appearance that resembles a spiked ball (they become crenated). An isotonic solution does not result in any net movement of water in / out of the cell and so, it remains unaffected. A hypotonic solution causes water to move into the cell. Animal cells do not have a tough cellulose wall and if water continues to move into the cell pressure builds until ultimately the cell bursts (cell lysis).

Unlike osmotic pressure, tonicity is influenced only by solutes that cannot cross the membrane, as only these exert an effective osmotic pressure. Solutes able to freely cross the membrane do not affect tonicity because they will always equilibrate with equal concentrations on both sides of the membrane without net solvent movement. It is also a factor affecting imbibition.

The absorption of water by the solid particles of an adsorbent without forming a solution is called Imbibition. In other words, the adsorption of water by hydrophilic colloids is known as Imbibition. Solid substance or adsorbent which take part in imbibition are called Imbibants. The liquid which is imbibed is known as Imbibate. Imbibition of water increases the volume of the imbibant due to which pressure is created known as Imbibitional Pressure (IP).

Imbibant substance is an adsorbent. Imbibant holds imbibate (water) by adsorption due to the great force of attraction between the two.

Imbibants have a very high negative water potential. It is called matric potential. Water has (the highest) maximum water potential (maximum being zero).

Imbibing capacity differs/varies in different imbibants for example; proteins being hydrophilic colloids have maximum imbibing capacity.

Imbibition of water by cell walls helps to keep the cells moist.

Water, the main component of the body, is distributed in the extracellular and intracellular compartments. Water exchange between these compartments is mainly governed by osmotic pressure. Extracellular water osmolarity must remain within very narrow limits to be compatible with life. Older adults lose the thirst sensation and the ability to concentrate urine, and this favours increased extracellular osmolarity (hyperosmotic stress). This situation, in turn, leads to cell dehydration, which has severe consequences for the intracellular protein structure and function and, ultimately, results in cell damage. Moreover, the fact that water determines cell volume may act as a metabolic signal, with cell swelling acting as an anabolic signal and cell shrinkage acting as a catabolic signal. Ageing also leads to a progressive loss in muscle mass and strength. Muscle strength is the main determinant of functional capacity, and, in elderly people, depends more on muscle quality than on muscle quantity (or muscle mass). Intracellular water content in lean mass has been related to muscle strength, functional capacity, and frailty risk, and has been proposed as an indicator of muscle quality and cell hydration. Water represents approximately 76% of muscle mass.

Sarcopenia is a condition characterized by loss of skeletal muscle mass and function. Although it is primarily a disease of the elderly, its development may be associated with conditions that are not exclusively seen in older persons. Sarcopenia is a syndrome characterized by progressive and generalized loss of skeletal muscle mass and strength and it is strictly correlated with physical disability, poor quality of life and death. Risk factors for sarcopenia include age, gender and level of physical activity. In conditions such as malignancy, rheumatoid arthritis and aging, lean body mass is lost while fat mass may be preserved or even increased. The loss in muscle mass may be associated with increased body fat so that despite normal weight there is marked weakness, this is a condition called sarcopenic obesity. There is an important correlation between inactivity and losses of muscle mass and strength, this suggests that physical activity should be a protective factor for the prevention but also the management of sarcopenia. Furthermore, one of the first step to be taken for a person with sarcopenia or clinical frailty is to ensure that the sarcopenic patient is receiving correct and sufficient nutrition. Sarcopenia has a greater effect on survival. It should be important to prevent or postpone as much as possible the onset of this condition, to enhance survival and to reduce the demand for long-term care. Interventions for sarcopenia need to be developed with most attention on exercise and nutritional interventions.

The minimal shape of water

Water is H2O, hydrogen two parts, oxygen one, but there is also a third thing, that makes it water and nobody knows what it is - D.H. Lawrence (1885-1930)

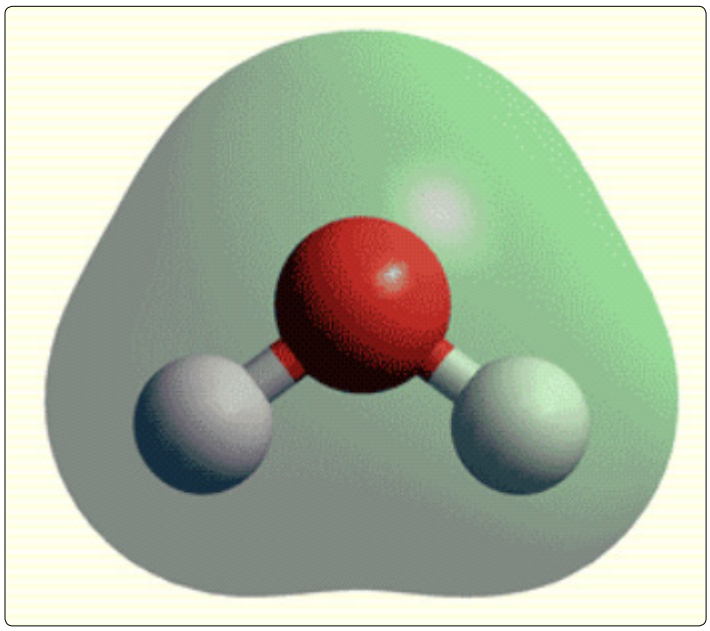


Figure 13

Looking at the water molecule structure by using one's imagination, it looks like a head with arms or a pelvis with legs. However, each one of those combinations has a particular functional task when examining its anatomical parts separately. The head, for example, is for observing and thinking, the pelvis and the head are for core stabilization, and the limbs are for action. Yet, if one moves vertically from this point and roll, unfold like papyrus the information given, it appears that the sequence: water molecule structure, sarcopenia and exercise, muscle quality or quantity, cell hydration, imbibition, tonicity, and upright embryological development to be firmly woven by an abstract force; an unseen activity that surrounds them like an amnion (a membranous sac which surrounds and protects the embryo) and circulates within and influences them positively (+) or negatively (-).

This "fabric" exerts specific and important influences upon cellular dynamics, just as much as hormones and neurotransmitters. Body water as an intervening substance (intracellular-extracellular fluid) and its clear unobstructed flow through which information is carried and conveyed to senses, forces, or shapes, generates, and transmits vibrations in the form of mechanical waves, electrical signals, electromagnetic fields, heat, and light.

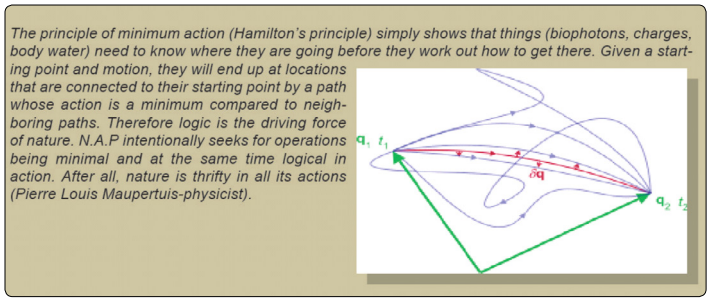


Figure 14

vertical integrity (easier said than done)

Roll, pitch and heave

Vectory Sensor Systems is a Scandinavian company specialised in solutions incorporating inertial sensors such as Inertial Navigation Systems, Motion Reference Units (MRUs) and Tilt Sensors.

Motion Reference Units or MRUs use gyroscopes and accelerometers to measure the roll and pitch (attitude) of an object with reference to the absolute vertical. In addition to the attitude, MRUs also measure vertical displacement of the object relative to some initial starting point. This displacement is known as the heave.

Attitude is calculated by integrating rate gyro measurements. However, as all gyros have an inherent bias; this will cause the attitude outputs to drift over longer time. Also, as rate gyros can only measure attitude rates, they cannot give roll and pitch angles relative to the absolute vertical.

Accelerometers can give an attitude measurement relative to the absolute vertical, and they do not experience drift. However, attitude measurements derived only from accelerometers are disturbed by any movement of the MRU. By combining the measurements from gyros and accelerometers, one can get the best of two worlds. It is exactly this method an MRU uses to get accurate roll and pitch measurements in a dynamic environment. Fusing of gyro and accelerometer measurements are usually done by a Kalman Filter (KF), which is a method to fuse noisy data from separate data sources in an optimal way.

To calculate heave, MRUs use their knowledge of the roll and pitch of the system together with the triad of accelerometers to determine the acceleration of the sensor in the vertical direction. By integrating the acceleration twice, the position is obtained, which is the heave output. However, as with the rate gyros, the accelerometers also have an inherent bias. This bias will make the heave estimate drift off. To overcome this limitation, high-pass filtering is used in the heave algorithms to filter out the bias prior to integration. High-pass filtering comes at the expense of phase distortion, attenuation, and delay in the heave output, so choosing the right high-pass filter is key to good heave performance.

Tilt sensors / inclinometers

Tilt sensors use a measure of gravity to find the tilt or inclination of the sensor. Gravity can be modelled as a three dimensional vector in space, pointing from the surface of the earth towards the center. The Microrad tilt sensor uses a triad of state of the art silicon capacitive micro-electromechanical system (MEMS) accelerometers to measure each dimension of the gravity acting on the sensor. When the tilt sensor is exactly horizontal, only the vertical axis will measure the gravity vector. However, as the sensor is tilted, the two other axes will measure a component of gravity proportional to the sine of the tilt angle. This principle is used to measure the tilt of the unit.

Any sensor will have an inherent noise that limits its maximum accuracy. Filtering can be used to lower the noise, but at the expense of bandwidth. Ie. The more filtering, the slower the

system will respond to changes in tilt. To get accurate measurements of tilt, a static tilt sensor needs to be stationary. Any movement will have a direct influence on the accuracy of the tilt measurement. When tilt needs to be measured while moving, a motion sensor must be used. This sensor uses very high accuracy gyroscopes to compensate for these disturbances.

The human vestibulo-ocular system is a vectory sensor system.
To maintain a stable perception of the world around us while we engage in normal movements throughout our day, such as walking, we have something known as the vestibulo-ocular reflex (VOR). This reflex keeps us steady and balanced even though our eyes and head are continuously moving when we perform most actions. When we make a head movement, our eye muscles are triggered instantly to create an eye movement opposite to that of our head movement at the exact same speed to readjust the visual world, which, in turn, stabilizes our retinal image by keeping the eye still in space and focused on an object, despite the head motion.

The vestibulo-ocular reflex involves three parts:

1. A peripheral sensory apparatus (which consists of a set of motion sensors: the semicircular canals and the otolith organs (saccule and utricle)
2. A central processing mechanism
3. A motor output (which are the eye muscles)

Otolith organs are sensitive to linear acceleration and therefore detect the position of the head relative to gravity and head translation. Semicircular canals, however, are responsible for detecting head rotation since these are sensitive to angular acceleration. These organize in a push-pull structure consisting of one coplanar canal on the left side and another coplanar canal on the right side, which work by coordinating with each other. Humans have a total of six canals arranged in three main planes (anterior, posterior, horizontal) on both sides; each plane has a pair of canals. A canal will get stimulated by head motion towards that canal. When a canal on one side is activated, there is inhibition of the other one during angular head movements. When there are head movements and rotation, the velocity of the movements dictates the difference in firing rate between the two semicircular canals. Hair cells are embedded in a fluid and gelatinous structure called the ampulla in each canal. When our heads rotate, the canal will move relative to the fluid inside of it, which will create a force against the ampulla, causing hair cells to bend. When the head is at rest, vestibular afferents have tonic discharge; this results in a balance between the semicircular canal pairs.

Information regarding linear acceleration, angular velocity, and orientation of the head relative to gravity are all collected by these peripheral motion sensors. These sensors relay this information to the central nervous system. Here, information from somatosensors (carrying other sensory information) is combined with motion sensory information to calculate head orientation.

The central nervous system (CNS) is the central processing mechanism, which sends its outputs to the spinal cord and ocular muscles to generate the VOR. Each SSC has excitatory projections to a pair of extraocular muscles in each eye and inhibitory projections to an antagonistic pair of muscles. In addition to the VOR, we also have a vestibulospinal reflex (VSR), which prevents falls by maintaining head and postural stability. It does this by creating compensatory body movements. To attain an even better orientation, this information also goes to cortical structures (posterior insular vestibular cortex (PIVC)) for further integration with tactile, auditory, and proprioceptive inputs. Actions of the VOR and VSR becomes controlled and continuously adjusted as needed by the CNS.

Control of the neck is exerted primarily by two sensory systems, the vestibular system in response to the signals received by the vestibular end organs (the otoliths and the semicircular canals within the vestibular labyrinths) and the proprioceptors of the cervical spine. Two automatic and stereotypical responses can be elicited by direct stimulation of these receptors. The vestibulocollic reflex (VCR) is a compensatory response of the neck muscles when head motion is sensed by the vestibular organs in the inner ear. The cervicocollic reflex (CCR) is a compensatory response of the neck muscles that is driven by neck proprioceptive inputs during motion of the body.

Despite its high prevalence, the etiology underlying idiopathic scoliosis remains unclear. Although initial scrutiny has focused on genetic, biochemical, biomechanical, nutritional and congenital causes, there is growing evidence that aberrations in the vestibular system may play a role in the etiology of scoliosis.

Vestibular asymmetries can result from a variety of conditions. Acute unilateral loss is interpreted by the brain as a dramatic rotation of the head, activating the VOR and causing nystagmus, vertigo, and postural instability. Over time, however, the brain can accommodate partially to chronic asymmetry and these symptoms become much less pronounced. Changes in the responsiveness of brainstem and cerebellar neurons to peripheral input form an important mechanism for this compensatory process.

Although we know much about compensation in the VOR to asymmetric vestibular input, we understand much less about how changes in the VCR and reflexive circuits affect muscle tension lower in the spine. The vestibular system can profoundly shift perceived verticality, head yaw/position and other balance-related functions, and therefore can induce a neurogenic trunk shift or torsional effect on the spine by activating particular muscle groups asymmetrically. Some evidence suggests that this muscle asymmetry alone could induce a scoliotic change. If this suggestion is true, vestibular asymmetry leads to asymmetric recruitment of paraspinous musculature and, in turn, may lead to scoliosis.

Scoliosis is a multifactorial three-dimensional (3D) spinal deformity that always involves elemental deformities in the three main planes: lateral curvature in frontal, anteroposterior (mainly lordotic) deviation in sagittal, and (very characteristically) vertebral axial rotation in the horizontal plane. Studies of vertebral

rotation, translation and angulation have revealed that a direct nonlinear relationship may exist between these elemental components of spinal deformities, but details of this relationship remain unclear.

Vertebral rotation has been demonstrated to play a fundamental role in the pathomechanism of the onset of scoliosis. Even though quantification of the vertebral rotation is important in the planning of surgical corrections and the evaluation of surgical results, current techniques in scoliosis surgery are not based on its accurate measurement and evaluation

Accurate perception of verticality is important in maintenance of upright posture and gait. It is believed that abnormal postural sway present in patients with adolescent idiopathic scoliosis (AIS) may be related to their perception of body orientation in space.

Visual and proprioceptive cues are important for body orientation to maintain correct posture. A study investigated the effects of exercise training on subjective visual, postural, and haptic perception of verticality in patients with scoliosis.

Conclusion: perception of verticality in AIS can be improved with core stabilization exercise therapy.

Come to your senses

The collection of bones stacked vertically upon one another to form the spine is what we know as the vertebral column.

A team of scientists in San Diego wanted to figure out exactly how we taste sourness. The scientists figured it out, and made a second discovery that it seems to me might suggest how the ability to taste sourness could have evolved. The same chemical receptor that detects acidity (sourness) on the tongue also detects acidity in the cerebrospinal fluid around the spine, and transmits that information to the brain.

Cerebrospinal fluid has four major functions: (1) physical support of neural structures, (2) excretion and "sink" action, (3) intracerebral transport, and (4) control of the chemical environment of the central nervous system. Cerebrospinal fluid provides a "water jacket" of physical support and buoyancy.

The CSF is also protective because its volume changes reciprocally with changes in the volume of intracranial contents, particularly blood. Thus, the CSF protects the brain from changes in arterial and central venous pressure associated with posture, respiration, and exertion.

The direct transfer of brain metabolites into the CSF provides excretory function. This capacity is particularly important because the brain lacks a lymphatic system. The lymphatic function of the CSF is also manifested in the removal of large proteins and cells, such as bacteria or blood cells, by bulk CSF absorption. The "sink" action of the CSF arises from the restricted access of water-soluble substances to the CSF and the low concentration of these solutes in the CSF. Therefore, solutes entering the brain, as well as those synthesized by the brain, diffuse freely from the brain interstitial fluid into the CSF (see going in or going out above).

Because CSF bathes and irrigates the brain, including those regions known to participate in endocrine functions, the suggestion has been made that CSF may serve as a vehicle for intracerebral transport of biologically active substances. For example, hormone releasing factors, formed in the hypothalamus and discharged into the CSF of the third ventricle, may be carried in the CSF to their effective sites in the median eminence. The CSF may also be the vehicle for intracerebral transport of opiates and other neuroactive substances (see the minimal shape of water above).

An essential function of CSF is the provision and maintenance of an appropriate chemical environment for neural tissue. Anatomically, the interstitial fluid of the central nervous system and the CSF are in continuity; therefore, the chemical composition of the CSF reflects and affects the cellular environment.

The composition of the CSF (and the interstitial fluid) is controlled by cells forming the interfaces, or barriers, between the "body" and the neural tissue. These semipermeable interfaces, the blood-brain barrier, the blood-CSF barrier, and the CSF-brain barrier, control the production and absorption of CSF and provide a fluid environment that is relatively stable despite changes in the composition of blood.

It has long been appreciated that we use sensory receptors to detect the chemical and physical properties of the world around us (exteroception). However, it has recently become clear that we also utilize the same molecular tools to monitor the composition of the world within us (interoception). Many sensory receptors, including olfactory receptors (ORs), taste receptors, and other sensory G protein–coupled receptors (GPCRs), as well as receptors that function as mechanosensitive or chemosensitive ion channels, have recently been shown to play key roles in organs and tissues traditionally thought of as "nonsensory." In the past few years, a large and diverse literature has developed documenting systems in which "sensory" receptors are exploited to serve in a wide variety of physiologic processes. The tongue's sour taste receptors, as already mentioned, are also called upon to sense pH in the spinal column, its bitter taste receptors also regulate bronchodilation and ciliary beat frequency in the lung in response to certain inhalants, and its sweet taste receptors regulate glucose transport in the gut. In addition to taste receptors, there are also numerous examples of ORs playing a variety of roles in tissues outside of the nose. The OR gene family, in fact, is the largest gene family in the genome, and thus forms an expansive repertoire of GPCR-based chemical detectors. In addition to odorant detection in the nose, ORs are now understood to also mediate chemical detection in other environments. For example, ORs play roles in muscle cell migration and sperm chemotaxis. Ligands for these receptors are often produced as a result of metabolic processes, implying that seemingly inert intermediate metabolites or by-products may have unappreciated signalling roles.

Receptors are biological transducers that convert energy from both external and internal environments into electrical impulses. They may be massed together to form a sense organ, such as the eye or ear, or they may be scattered, as are those of the skin and viscera. Receptors are connected to the central nervous system by afferent nerve fibres. The region or area in the periphery from which a neuron within the central nervous system receives input is called its receptive field. Receptive fields are changing and not fixed entities.

Receptors are of many kinds and are classified in many ways. Steady-state receptors, for example, generate impulses as long as a particular state such as temperature remains constant. Changing-state receptors, on the other hand, respond to variation in the intensity or position of a stimulus. Receptors are also classified as exteroceptive (reporting the external environment), interoceptive (sampling the environment of the body itself), and proprioceptive (sensing the posture and movements of the body). Exteroceptors report the senses of sight, hearing, smell, taste, and touch. Interoceptors report the state of the bladder, the alimentary canal, the blood pressure (carotid sinus - baroreceptor), and the osmotic pressure of the blood plasma. Proprioceptors report the position and movements of parts of the body and the position of the body in space.

Receptors are also classified according to the kinds of stimulus to which they are sensitive. Chemical receptors, or chemoreceptors, are sensitive to substances taken into the mouth (taste or gustatory receptors,), inhaled through the nose (smell or olfactory receptors), or found in the body itself (detectors of glucose or of acid-base balance in the blood - carotid body). Receptors of the skin are classified as thermoreceptors, mechanoreceptors, and nociceptors—the last being sensitive to stimulation that is noxious, or likely to damage the tissues of the body.

Internal calculator

Claude Bernard asserted that complex organisms are able to maintain their internal environment [extracellular fluid (ECF)] fairly constant in the face of challenges from the external world. He went on to say that "a free and independent existence is possible only because of the stability of the internal milieu". Walter Cannon coined the term "homeostasis" with the intent of providing a term that would convey the general idea proposed some 50 yr earlier by Bernard. Cannon's view focused on maintaining a steady state within an organism regardless of whether the mechanisms involved were passive (e.g., water movement between capillaries and the interstitium reflecting a balance between hydrostatic and osmotic forces) or active (e.g., storage and release of intracellular glucose).

Early physiology textbooks reflected this broad definition by briefly mentioning Bernard's concept of the constancy of the internal milieu, but the term "homeostasis" was not used in discussions of specific regulatory mechanisms.

This situation began to change in the mid-1960s, when a branch of biomedical engineering emerged that focused on applying engineering control systems analysis to physiological systems. Arthur Guyton was the first major physiology textbook author to include a control systems theory approach in his textbook, and his book included detailed attention to the body's many regulatory mechanisms. Hence, Guyton introduced many students to the concept of homeostasis as an active regulatory mechanism that tended to minimize disturbances to the internal environment.

Engineering control systems theory describes a variety of other mechanisms to maintain the stability of a system. Although many of these mechanisms may be found in biological systems, not all of them are components of homeostatic mechanisms. For instance, the ballistic system used by the nervous system for throwing a ball simply calculates in advance the pattern of commands needed to achieve some particular outcome based on previous experience. Here, there is no element involved that regulates the internal environment.

Homeostatic mechanisms originated to keep a regulated variable in the internal environment within a range of values compatible with life and, as has been more recently suggested, to reduce noise during information transfer in physiological systems. To emphasize the stabilizing process, we distinguish between a "regulated (sensed) variable" and a "nonregulated (controlled) variable".

A regulated (sensed) variable is one for which a sensor exists within the system and that is kept within a limited range by physiological mechanisms. For example, blood pressure and body temperature are sensed variables. Baroreceptors and thermoreceptors exist within the system and provide the value of the pressure or temperature to the regulatory mechanism. We call variables that can be changed by the system, but for which sensors do not exist within the system, nonregulated (controlled) variables. Nonregulated variables are manipulated or modulated to achieve regulation of the variable being held constant. For example, heart rate can be changed by the autonomic nervous system to regulate blood pressure, but there are no sensors in the system that measure heart rate directly. Hence, heart rate is a nonregulated variable.

To identify specific variables that may be homeostatically regulated, the five critical components illustrated in the model shown in Fig. 15 must be present. The list of widely recognized and clearly established regulated variables in humans includes a number of inorganic ions (e.g., H+, Ca2+, K+, and Na+), blood-borne nutrients (e.g., glucose), blood pressure, blood volume, blood osmolarity, and core body temperature.

Regulated Variable	Normal Range or Value	Sensor (Location If Known)	Control Center (Location)	Effectors	Effector Response
Arterial Po_2	75–100 mmHg	Chemosensors (carotid bodies and aortic body)	Brain stem	Diaphragm and respiratory muscles	Change breathing frequency and tidal volume
Arterial Pco_2	34–45 mmHg	Chemosensors (carotid bodies, aortic body, and the medulla)	Brain stem	Diaphragm and respiratory muscles	Change breathing frequency and tidal volume
K^+ concentration	3.5–5.0 meq/l	Chemosensors (adrenal cortex)	Adrenal cortex	Kidneys	Alter reabsorption/secretion of K^+
Ca^{2+} concentration	4.3–5.3 meq/l (ionized)	Chemosensors (parathyroid gland)	Parathyroid gland	Bone, kidney, and intestine	Alter reabsorption of Ca^{2+}, alter resorption/building of bone, and alter absorption of Ca^{2+}
H^+ concentration (pH)	35–45 nM (pH 7.35–7.45)	Chemosensors (carotid bodies, aortic body, and floor of the fourth ventricle)	Brain stem	Diaphragm and respiratory muscles	Change breathing frequency and tidal volume and change secretion/reabsorption of H^+/bicarbonate ions
		Chemosensors	Kidney	Kidney	

Figure 15

In 2007, a group of 21 biologists from a wide range of disciplines agreed that "homeostasis" was one of eight core concepts in biology. Two years later, the American Association of Medical Colleges and Howard Hughes Medical Institute in its report on the scientific foundations for future physicians similarly identified the ability to apply knowledge about "homeostasis" as one of the core competencies (competency M1).

Potential of Hydrogen

Whether something is perceived as acidic or alkaline depends on the hydrogen ion (H+) concentration in the solution. The pH value is defined, by the Sorenson Equation, as the negative logarithm of the H+ concentration in a given solution. In other words, at a high concentration, e.g. 1 mol/L = 100, pH = 0 (ACIDIC) at a low concentration, e.g. 10-14 mol/L, pH = 14 (ALKALINE).

Hence, different substances are objectively compared with each other, where pH 0 is extremely acidic, pH 14 extremely alkaline, and pH 7 neutral (the magic number 7). In the last few years the measuring of pH has gained in importance. In the control and regulation of chemical and biological processes, it has become indispensable to monitor the pH values.

By using Nernst equation, you can calculate that for each 1-unit change in pH, the measured mV value will change by 59.16mV at 25C. The equation is a fundamental to pH measurement. But pH = -log (H+), the Sorenson equation so at 25°C, by substituting constant values. In electrochemistry the Nernst equation calculates the equilibrium potential (also referred to as the Nernst potential) for an ion based on the charge on the ion (i.e., its valence) and its concentration gradient across the membrane. It was named after Walther Nernst, a German physical chemist who formulated the equation.

Somethin**k** (and no something). Symbols, letters & numbers in action...

$$E_{\text{red}} = E^{\ominus}_{\text{red}} - \frac{RT}{zF}\ln Q_r = E^{\ominus}_{\text{red}} - \frac{RT}{zF}\ln\frac{a_{\text{Red}}}{a_{\text{Ox}}}.$$

For a complete electrochemical reaction (full cell), the equation can be written as

$$E_{\text{cell}} = E^{\ominus}_{\text{cell}} - \frac{RT}{zF}\ln Q_r$$

Figure 16

$$E^{\ominus'} = E^{\ominus} + \frac{RT}{zF}\ln\frac{\gamma_{Ox}}{\gamma_{Red}}$$

the half-cell Nernst equation may be written in terms of concentrations as:

$$E_{\text{red}} = E^{\ominus'}_{\text{red}} - \frac{RT}{zF}\ln\frac{C_{\text{Red}}}{C_{\text{Ox}}}$$

Figure 17

$$E = \frac{RT}{zF}\ln\frac{[\text{ion outside cell}]}{[\text{ion inside cell}]} = 2.3026\frac{RT}{zF}\log_{10}\frac{[\text{ion outside cell}]}{[\text{ion inside cell}]}.$$

Figure 18

$$E_{\text{m}} = \frac{RT}{F}\ln\left(\frac{\sum_i^N P_{\text{M}_i^+}\left[\text{M}_i^+\right]_{\text{out}} + \sum_j^M P_{\text{A}_j^-}\left[\text{A}_j^-\right]_{\text{in}}}{\sum_i^N P_{\text{M}_i^+}\left[\text{M}_i^+\right]_{\text{in}} + \sum_j^M P_{\text{A}_j^-}\left[\text{A}_j^-\right]_{\text{out}}}\right),$$

Figure 19

Physical chemistry is the study of macroscopic, and particulate phenomena in chemical systems in terms of the principles, practices, and concepts of physics such as motion, energy, force, time, thermodynamics, quantum chemistry, statistical mechanics, analytical dynamics and chemical equilibrium.

The magic number seven

In 1956, Miller conjectured that there is an upper limit on our capacity to process information on simultaneously interacting elements with reliable accuracy and with validity. This limit is seven plus or minus two elements. The reason is founded in the consistency of information derived from relations among the elements. When the number of elements increases past seven, the resulting increase in inconsistency is too small for the mind to single out the element that causes the greatest inconsistency to scrutinize and correct its relation to the other elements, and the result is confusion to the mind from the existing information. The AHP as a theory of measurement has a basic way to obtain a measure of inconsistency for any such set of pairwise judgments. When the number of elements is seven or less the inconsistency measurement is relatively large with respect to the number of elements involved; when the number is more it is relatively small. The most inconsistent judgment is easily determined in the first case and the individual providing the judgments can change it in an effort to improve the overall inconsistency. In the second case, as the inconsistency measurement is relatively small, improving inconsistency requires only small perturbations and the judge would be hard put to determine what that change should be, and how such a small change could be justified for improving the validity of the outcome. The mind is sufficiently sensitive to improve large inconsistencies but not small ones. And the implication of this is that the number of elements in a set should be limited to seven plus or minus two.

Miller also found humans remembered chunks of information, interrelating bits using some scheme, and the limit applied to chunks.

In cognitive psychology, chunking is a process by which individual pieces of an information set are broken down (seperation-division) and then grouped together in a meaningful whole.

Brain waves & Meditation

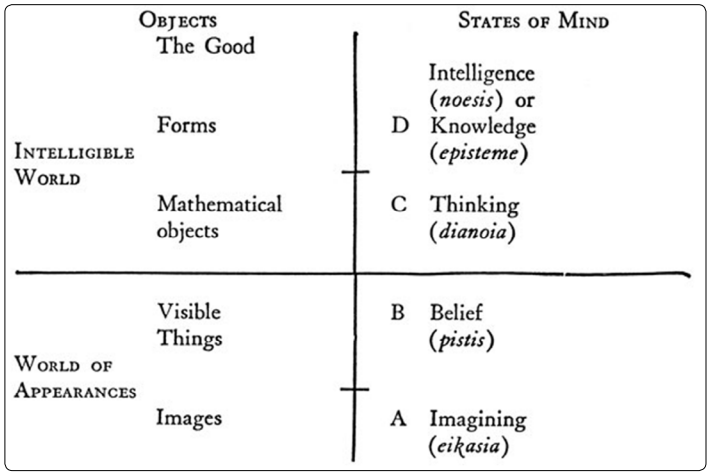


Figure 20

What is Meditation? In contemporary literature, as well as in day to day conversation, the term meditation is often used in a non-specific sense. Meditation is yet to be precisely defined. However, in its abstract definition, meditation is often described as "a fundamental method to purify the mind and to expand consciousness progressively proceeding towards the possibility of discovering the infinite and merging of the finite consciousness into it."

Contrary to popular belief, meditation is a very simple concept. Meditation was a very common practice in Ancient Greece. The Greek word for meditation was *μελέτη*. Melete was the term referring to disciplined study, a mental exercise or an exercise in thought. However, according to the Ancient Greeks every human action, or behavior had to have a higher purpose. As such, an exercise in thought, would be considered pointless if it were not for a certain goal.

In fact, in Greek mythology, they were often referring to three Muses, Melete being one of them. The other two were her sisters, Mneme (memory) and Aoide (song, voice). Our memory, our capacity to reflect upon, gives us the ability to understand situations and relationships, among what is past, present, and possible. Our spoken word gives us the ability to share with others that which is conceptualized.

If you contemplate on it for a moment, you will realize that these three sisters represent the three gifts of the human mind — that of mental exercise, reflection, and vocalization. Furthermore, they remind us that disciplined study of anything, without reflection or without the ability to vocalize our words is useless.

Another word for meditation in Greek is διαλογισμός, meaning to divide your thinking in two: intuitive versus intentional or analytical thinking. The idea is intuition to serve as a mind and sensory reduction mechanism (an act of subtraction), for the reason that division and subtraction as a combination of actions are to disengage the self (ego-system) from the burden of problem-solving and leave nature (eco-system) to take the control.

The problem is embedded archetype information within the infinite potentiality of the cosmos. It exists and simply waits the commencing kindling stimuli to surface. Imagine its unknown, aberrant behavior as a cluster of [0000000000's] that differentiates in space over time.

In this aberrant differentiation of zeroes, the appearance of ones in-between [0**1**000000000**1**0] have a binary function:

i. as a disruption, interruption, cut off for the problem's false patterning.

ii. as true value (1 - Boolean mathematics) network nodes.

I. Breaking down the problem (chunking) is divide and conquer through logical forms of valid inference. In arithmetic, long division is a standard division algorithm suitable for dividing multi-digit numbers that is simple enough to perform by hand. It breaks down a division problem into a series of easier steps.

II. Network science holds great promise for expanding our understanding of the human brain in health, disease, development, and aging. In functional brain networks a node represents some predefined collection of brain tissue, and an edge measures the functional connectivity between pairs of nodes.

Therefore, logically thinking, forget about crystals and candles, and about sitting and breathing in awkward ways. Meditation research explores how the brain works when we refrain from concentration, rumination and intentional thinking. Electrical brain waves suggest that mental activity during meditation is wakeful and relaxed.

"Given the popularity and effectiveness of meditation as a means of alleviating stress and maintaining good health, there is a pressing need for a rigorous investigation of how it affects brain function," says Professor Jim Lagopoulos of Sydney University, Australia. Lagopoulos is the principal investigator of a joint study between his university and researchers from the Norwegian University of Science and Technology (NTNU) on changes in electrical brain activity during nondirective meditation.

Whether we are mentally active, resting or asleep, the brain always has some level of electrical activity. The study monitored the frequency and location of electrical brain waves through the use of EEG (electroencephalography). EEG electrodes were placed in standard locations of the scalp using a custom-made hat

Participants were experienced practitioners of Acem Meditation, a nondirective method developed in Norway. They were asked to rest, eyes closed, for 20 minutes, and to meditate for another 20 minutes, in random order. The abundance and location of slow to fast electrical brain waves (delta, theta, alpha, beta) provide a good indication of brain activity.

During meditation, theta waves were most abundant in the frontal and middle parts of the brain.

"These types of waves likely originate from a relaxed attention that monitors our inner experiences. Here lies a significant difference between meditation and relaxing without any specific technique," emphasizes Lagopoulos.

"Previous studies have shown that theta waves indicate deep relaxation and occur more frequently in highly experienced meditation practitioners. The source is probably frontal parts of the brain, which are associated with monitoring of other mental processes."

"When we measure mental calm, these regions signal to lower parts of the brain, inducing the physical relaxation response that occurs during meditation."

Alpha waves were more abundant in the posterior parts of the brain during meditation than during simple relaxation. They are characteristic of wakeful rest.

"This wave type has been used as a universal sign of relaxation during meditation and other types of rest," comments Professor Øyvind Ellingsen from NTNU. "The amount of alpha waves increases when the brain relaxes from intentional, goal-oriented tasks.This is a sign of deep relaxation, -- but it does not mean that the mind is void."

Neuroimaging studies by Malia F. Mason and co-workers at Dartmouth College NH suggest that the normal resting state of the brain is a silent current of thoughts, images and memories that is not induced by sensory input or intentional reasoning, but emerges spontaneously "from within."

"Spontaneous wandering of the mind is something you become more aware of and familiar with when you meditate," continues Ellingsen, who is an experienced practitioner. "This default activity of the brain is often underestimated. It probably represents a kind of mental processing that connects various experiences and emotional residues, puts them into perspective and lays them to rest."

Delta waves are characteristic of sleep. There was little delta during the relaxing and meditative tasks, confirming that nondirective meditation is different from sleep.

Beta waves occur when the brain is working on goal-oriented tasks, such as planning a date or reflecting actively over a particular issue. EEG showed few beta waves during meditation and resting.

"These findings indicate that you step away from problem solving both when relaxing and during meditation," says Ellingsen.

Several studies indicate better relaxation and stress management by meditation techniques where you refrain from trying to control the content of the mind.

"These methods are often described as nondirective, because practitioners do not actively pursue a particular experience or state of mind. They cultivate the ability to tolerate the spontaneous wandering of the mind without getting too much involved. Instead of concentrating on getting away from stressful thought and emotions, you simple let them pass in an effortless way."

Nondirective meditation yields more marked changes in electrical brain wave activity associated with wakeful, relaxed attention, than just resting without any specific mental technique.

To the heart of the matter

The sun is essentially a giant ball of hydrogen gas undergoing fusion into helium gas. This process causes the sun to produce vast amounts of energy.

Nuclear fusion, the source of all the energy so generously radiated by the Sun, does two things: it converts hydrogen into helium (or rather, makes helium nuclei from protons) and it converts mass to energy.

The number of hydrogen atoms in one person is 4.7*1027.
pH is really a measure of the relative amount of free hydrogen and hydroxyl ions in the water. Your body works constantly to carefully control pH levels of blood and other fluids. The body's pH balance is also called the acid-base or acid-alkaline balance. The right pH levels are needed for good health.

But what does the sun represent on Plato's Allegory of the Cave? The sun represents what Plato calls the Form of the good. To fully understand this, you must understand that Plato draws a distinction between particular objects that we encounter and their corresponding Forms, which exist independently but that make particular objects the objects that they are.

So for example, there are skin mechanoreceptors, and there is the Form of skin mechanoreceptors, which all skin mechanoreceptors have (eg., Pacinian corpuscles, Meissner's corpuscles, Ruffini corpuscle, Merkel disc receptor). This, in fact, is why skin mechanoreceptors are skin mechanoreceptors: they all have the same Form. This applies to all objects, including good ones: good things like good health, as mentioned above in meditation, are all good because they all have the same Form GOOD. For any class of objects that we encounter, there will be a corresponding Form that they all share.

And the logical question that arises is: if someone wanted to give a form to good health, how this form would be? The sure thing is that it would be abstract, mind oriented. There is no doubt about it.

So let's go back to the start, to the abstract figure 1, with the changing form of the known arithmetic symbols. The sequence of the first row goes as follows: + × − = (addition, multiplication, subtraction, division/separation). The sequence of the second row goes as follows: = − | ||.

Now, if we look carefully, we will see that the symbol minus, which denotes subtraction, is changing orientation, and from horizontal in the first row, it becomes vertical in the second row. The same goes for the symbol of division/separation, which also changes orientation, and from horizontal parallel lines turns to vertical parallel lines. Subtraction and division/separation appear to operate as abstract monoaxial transition elements (eg., from a horizontal to a vertical axis).

Finally, the sequence of the third row goes as follows: || × + and ends with the starting symbol of addition, which closes the circle of actions.

This arithmetic symbols pattern can repeat itself in space and time, as long as a physical force or biological need is present. The red arrows (Fig.1) symbolize this drive upon every symbol. According to the vectoring, which can be at the specific moment any dominant or influential physiological mechanism (eg., parasympathetic nervous system activation returns the body to homeostasis), the form of it changes respectively, and so does its specific role of action and effect (eg., subtractions to reduce the increased metabolic activity and the internal energy of a system or an organ).

The vectors are two, one runs for the mind, and one runs for the body. They are a pair of entangled processes. Fusion, on the other hand, is a process that powers the sun and the stars. It is the reaction in which two atoms of hydrogen combine, or fuse, to form an atom of helium. Helium is an atom of two electrons, and hydrogen is an atom of one electron. Mind-body vectors, like electrons, don't have an absolute position and momentum simultaneously, because, in essence, they are not signs. They are not localized in space the way a symbol is. They are "fuzzy" as their smeared interplay. Your intuition has difficulty grasping this because there is nothing in the macroscopic world like this. If you think of things like vectors like arrows, you'll never understand their behavior and effect. However, the valuable insights of mathematics can be a helpful instrument for understanding. A Boolean or logical matrix (see introduction & brain waves and meditation) is a matrix with entries in which the values of the variables are the truth values true (1) and false (0). If we use the numbers as a reference to name the pair of vectors, we can have the following vector combinations along with an idea of their behavioral patterns:

a. 1 1 (true/ideal),
b. 1 0 or 0 1 (erratic/stress),
c. 0 0 (false/problem).

The proportion of zeros (0), respectively to ones (1), in an organized system, as it shows, defines the magnitude and the

direction (vector) of the force applied upon it. Vectors combination, as hydrogen atoms fusion, is the process that powers the mind (eg., locus coeruleus is a nucleus in the pons of the brainstem, and an important homeostatic control center of the body) and the body (eg., homeostasis), either positively/vertically (1 1) or negatively/horizontally (0 0).

Decision problems typically appear in mathematical questions of decidability. In logic, a true/false decision problem is decidable if there exists an effective method for deriving the correct answer. In logic, mathematics and computer science, especially metalogic and computability theory, an effective method or effective procedure is a procedure for solving a problem from a specific class.

A decision problem is a problem that can be posed as a yes-no question of the input values. A method for solving a decision problem, given in the form of an algorithm, is called a decision procedure for that problem. One such algorithm is long division (see brain waves and meditation). A decision problem which can be solved by an algorithm is called decidable.

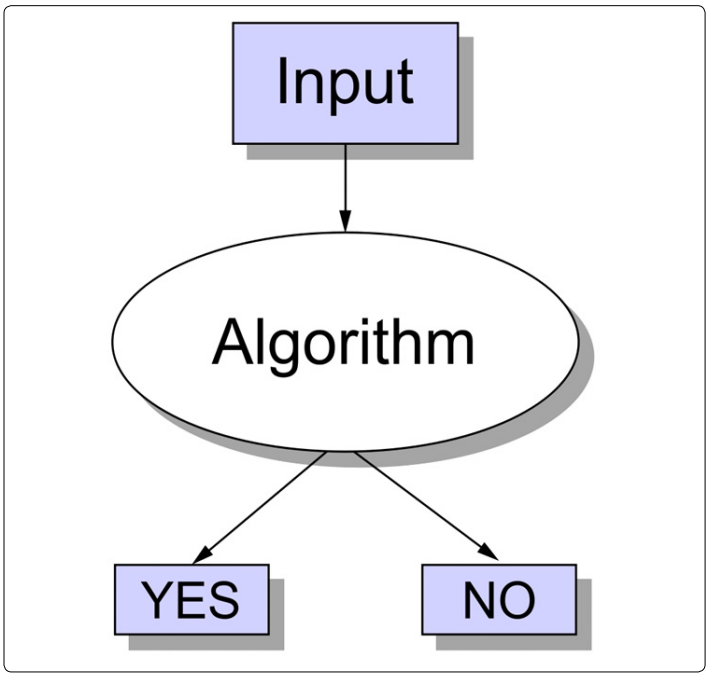


Figure 21

Figure 21 depicts the homeostatic mechanism: Incoming info (input) and receptors -> brain's control center and a decision procedure for that info (algorithm) -> effectors:

- Yes, B & T cells action needed for the invasion of a virus or bacteria (immunoprotection, true value - 1).
- No B & T cells attack wanted on healthy tissues and organs (autoimmune disease, false value - 0).

Regulatory T cells and B cells play a key role in immune homeostasis.

Shilly-shally situations (in-between yes and no) considered stressful (immune system fatigue).

But what if we attempt to replace the arithmetic symbols with Greek letters, and instead of a sequence of + × − = | to have a sequence of Gamma (γ), Beta (β), Alpha (α), Theta (θ) and Delta (δ) brain waves arranged from fastest to slowest. That is far more complicated to understand when various dynamics (vectors) will change or muddle the pitch of each frequency. And what if we connect the specific actions of the arithmetic symbols with the specific brain waves function and combine them altogether. That is impossible to comprehend, let alone handling it.

Thus, the attempt to create in our mind the form of good health looks a pretty difficult task to do so. Therefore, a cul de sac? As it shows, yes. Or no? A cul de sac is a dead-end street, particularly one with a circle for turning around at the end. The French cul de sac was originally an anatomical term meaning "vessel or tube with only one opening." It means "bottom of a sack," from the Latin culus, "bottom." The last is the opposite of top in vertical order; left to right goes for horizontal order.

So vertical is one (first thin line). Add to this another one (second thin line), another one (third thin line), multiply by three and combine them duly (fourth thick line), subtract when needed (fifth & sixth thinner lines), and separate/divide (spacing) accordingly. Before finishing, let the wave come in to choose the line upon which it will glide. The form of good health as it shows it looks like a barcode of accurate and valid encoded data (true values - 1), that brings forth as a result of its coherent format exemplar biological functions, along with a flow of peaks and dives that follow precisely the frequencies of balance, synchrony, and order [1-46].

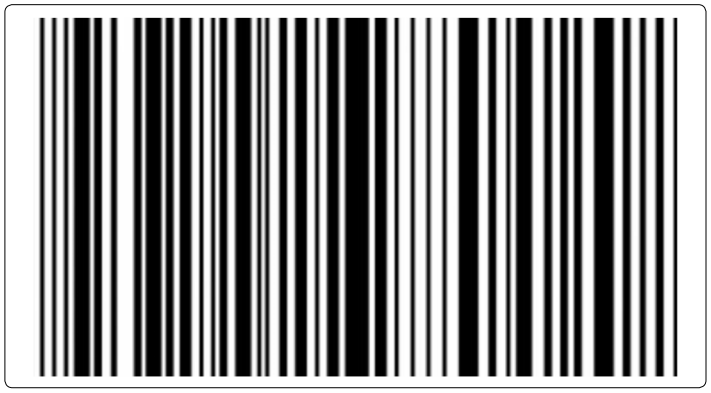


Figure 22

Cerebral cortex looks like a barcode. To the left, the groups of cells (thin lines); to the right, the systems of fibers (thick lines); in between them the spacing. Quite to the left of the figure a sensory nerve fiber is shown (initial vertical line). Cell body layers are labeled on the left, and fiber layers are labeled on the right. The neocortex, also called the neopallium and isocortex, is a set of layers of the mammalian cerebral cortex involved in **higher**-order brain functions.

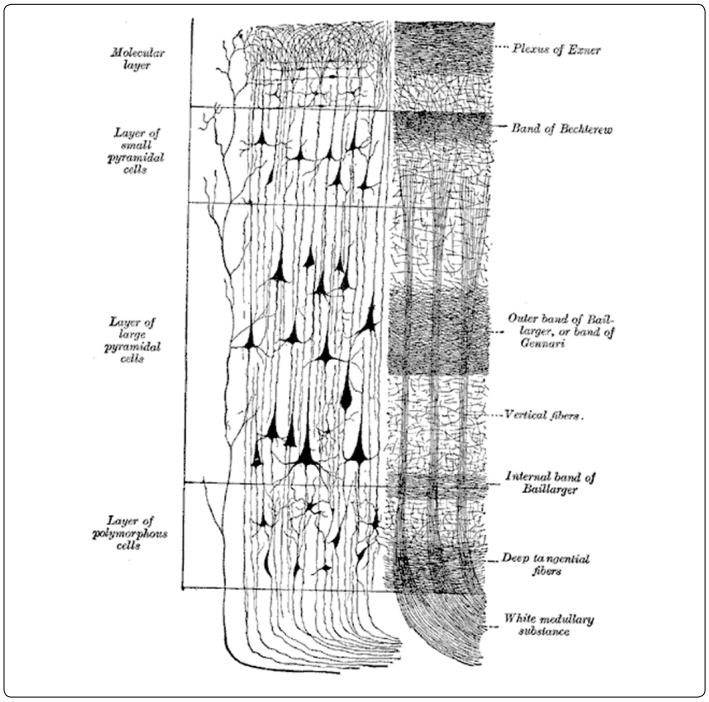


Figure 23

a 2-D line plot (x,y)

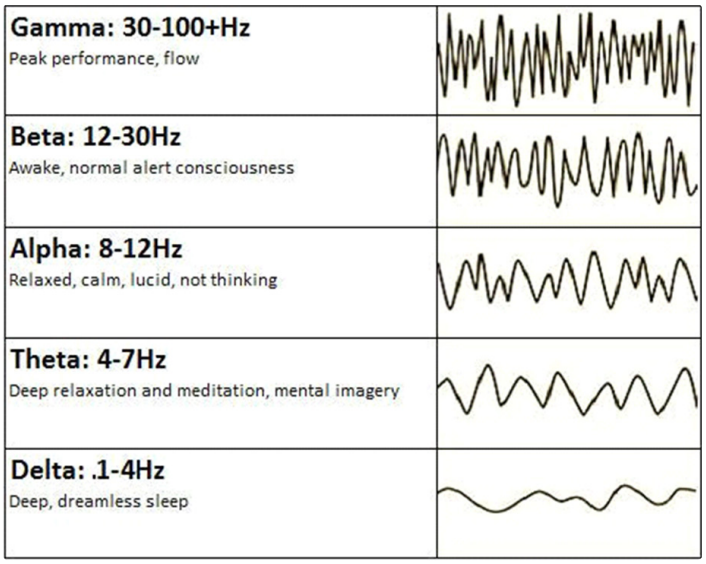


Figure 24

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