Vol. Two - Importance of Mineral Absorption

The Trehalose Handbook SERIES

Benefits of Trehalose and Mineral Absorption

Volume Two: Chapters 7 - 10

May this Vol. Two of *The Trehalose Handbook Series - Importance of Mineral Absorption* be a beneficial tool for you - be you professor, physician, pharmacist, nurse, research scientist, healthcare professional, politician, or one of the general public who seeks knowledge in the science of sugars and better healthcare. *The Handbook* that reveals a pathway for lowering healthcare costs.

An Educational Project of The Endowment for Medical Research
by J. C. Spencer

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An Overview of Chapters in Volume One

***The Trehalose Handbook* Vol. Two - Importance of Mineral Absorption** is written with the intent that my comments are easy to understand by the general public while supported with scientific evidence for the professional. This Handbook contains research data and scientific information for the physician, pharmacist, nurse, research scientist, educator, and healthcare professional.

Additional information can be obtained online at www.endowmentmed.org, in my textbook, ***Expand Your Mind - Improve Your Brain*** and through 14 hours of Continuing Medical Education (CME) and Continuing Educational Credits (CEU) quality Glycomics DVD Series.

- *The Trehalose Handbook Vol. Two - Importance of Mineral Absorption* is Interactive -

This Handbook may be downloaded, read offline, printed on 8 ½ x 11 pages, or read online. When read online or offline on a computer open to the internet, there are many hot links that will open to references and additional educational information. These Links are normally highlighted in blue.

- J. C. Spencer

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Life, all biological processes, and the elements of our whole planet are influenced and/or driven by the properties of these few priority minerals.

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Foreword

We need to make science a little easier to understand. Each generation of scientists must learn that a lot of past scientists reached a wrong conclusion. Relearning is vital as we reach for truth.

Some misunderstanding of science is that some words have double meaning which may even mean the opposite or something totally different. Sometimes, perhaps rare, it is the intent of the elite to purposely deceive. Some things were wrongly named out of ignorance. Some discoveries were made with false assumptions and conclusions. New discoveries may show very different conclusions. "Vitamin D" complexes are really not vitamins at all. They are hormones. Negative ions are really positive (beneficial) for your health. Positive ions are really negative (harmful) to your well being. Soda pop was initially made from baking soda and vinegar. It fizzled as a health drink. Coke was the real thing and there was a reason it was addictive. Soda pop evolved into today's bad-for-you acidic soft drinks. So, what do you mean when you say, "soda"? Soda is very much misunderstood. In reality, soda is an alkaline buffer against acid. Salt and soda or sodium are not the same. In science it is kinda like it is in real life. We park on driveways and drive on parkways. We call freight sent by ship: cargo. We call cargo sent by train car: shipment.

The solution is to know what the word means. A chemical compound can be the solution or it can compound the confusion. The solution can be a liquid compound or it can be the problem instead of the solution. Words with double meaning compound the problem. A resident of a compound, can delegate the problem to a delegate for finding the solution. And, that is how you compound confusion.

Mark Twain said, "*The difference between the right word and the almost-right word is the difference between the lightning and the lightning-bug*."

Are trace minerals considered by most no more important than a lightning-bug? After reading this book, you may agree with me, trace minerals are the lightning!

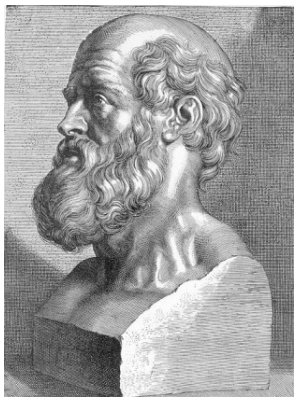
— J. C. Spencer

Trace minerals are the lightning!

Chapter 7

Brief Lesson on Importance of pH Balance in Human Cells

Discoveries in science come only through the portals of observation. How observant we are determines our outer limits of how we respond to this new found knowledge. From the time of the microscope we have continued to observe and postulate the functions going on within smaller and smaller areas. Observations of the remarkable functions of the human cell have opened up an expanding frontier that will forever change how we live if we choose to learn from these findings.



Scientists of old often had a clearer focus on the meaning and purpose of their observations than many scientists of today. We have grown in knowledge and too often missed the focus of what to do with it. Hippocrates [460 B.C. - 377 B.C.] is acclaimed as the Father of Medicine and he said simple, **"*Let food be your medicine and medicine be your food*."**

Even though we have partially kept the Hippocratic Oath to do no harm, today's medical practices are far removed from nutrition. In fact, medical students know basically nothing about the nutrients that fuel the body and run our organs.

The JOB OF SCIENCE. The father of pharmacology, Paracelsis (1493 - 1541), said, **"*Everything man needs to sustain health can be found in nature. It is the job of science to find it*!"** [Philippus Aureolus Theophrastus Bombast von Hohenheim thought he was greater than Celsus. So, as a clever campaign, he changed his name to Paracelsis meaning greater than Celsus.]

Regardless of where modern medicine has taken us, when you combine the statements of these two men, Hippocrates and Paracelsis, you have the outline for the best healthcare system possible. Every family should strive to move us back to this plan.

Everything man needs to sustain health can be found in nature. It is the job of science to find it! Let food be your medicine and medicine be your food.

The following is taken from Chapter 20 of ***EXPAND YOUR MIND - IMPROVE YOUR BRAIN*** with the author's permission.

Why pH is so important

Positive, negative, low pH, high pH, cationic, anionic - what do these words mean?

Earlier I mentioned that all batteries have a positive (+) and a negative (-) charge. In fact, all atoms, all cells, all matter, all systems in all creation, have a positive and negative charge because an atom by design must have a charge.

The pH balancing act: Positive (+) = acid = LOW pH, which is cationic (nucleophile). Negative (-) = alkaline = HIGH pH, which is anionic (electrophile). The pH is on a scale of 1 to 14. The pH scale measures how acidic or alkaline is a substance. A pH of 7 is neutral, less than 7 is acidic, and greater than 7 is alkaline.

A pH of 1 is like hydrochloric acid, and pH 13 is like caustic soda, sodium hydroxide, lye.

When I was a young boy on the farm in Missouri, I was in charge of a half-acre garden. I learned the importance of a good soil pH at an early age. Soil that is too acid or too alkaline cannot produce a good crop. If the soil is good, then good seed will produce a good crop.

Proper pH is a KEY to enjoying a long healthy life.

The pH scale is logarithmic, resulting in each whole pH value below 7 being ten times more acidic than the next higher value. For example: pH 4 is ten times more acidic than pH 5 and 100 times (10 times 10) more acidic than pH 6. The same equation holds true for pH values above 7, each of which is ten times more alkaline than the next lower

whole value. So pH 10 is ten times more alkaline than pH 9 and 100 times more alkaline than pH 8. The two extremes (less than pH 1 or greater than pH 13) are extremely corrosive. When the pH is 1, it is like hydrochloric acid, and pH 13 is like caustic soda, aka, sodium hydroxide, and lye.

7.4 to 7.5 pH is ideal for water, blood, and soil.

The term, pH, was originally coined by Søren Peder Lauritz Sørensen in 1909. The letters stand for pontus hydrogenii (Latin for "potential of hydrogen"). It was originally thought to be a measurement of the concentration of hydrogen ions in a liquid. Later, Sørensen discovered it was actually a function of the "activity" of hydrogen ions.

Frank Orme, Adjunct Biology Instructor at Merritt College, says blood pH must be kept at a slightly alkaline level of 7.4 in mammals. He says that a change of pH of 0.2 units in either direction is considered serious. Blood pH value below 6.9 or above 7.9 are usually fatal if they last for more than a short time.

A high pH may be the ounce of prevention that is worth a pound of cure.

A good pH balance for **water**, **blood,** and **soil** is 7.4 to 7.5. Most water, blood, and soil has a pH considerably lower than what is best.

The mind set of many people is finally moving away from the idea:

When it is broken, let the insurance pay the doctor to fix it.

According to the *Textbook of Medical Physiology* by Arthur C. Guyton, the accepted normal pH of blood running through arteries (large elastic-walled blood vessels that carry blood from the heart to other parts of the body) is 7.4; the pH of blood in the veins (vessels that transports blood to the heart) is about 7.35. The accepted normal urine pH averages about 6.0. Saliva has a pH between 6.0 and 7.4.

The pH value may be the single most important factor to regulate health and healing. **When the pH is not correct, none of the complex biochemical systems within your body will function properly.** Therefore, it seems advantageous to consume water that may have a higher pH even to 8.5 or 9. Remember, your body is almost always too acid and you need to lean toward more alkalinity to offset the already too acid state.

Ion channel physiology affects every cell of the body.

The pH value may be the single most important factor you need to regulate for a healthier body.

A researcher whose life was invested in the study of pH in the body and how it affected overall health was Dr. Carey Reams. He pushed for a pH of 7.5. I will discuss this in more detail in another chapter and in my newsletter.

Soil is home for the seed and gives LIFE to the seed when the right amount of water is added. For your body, LIFE is in the blood. And water is LIFE to the blood.

As a child, I envisioned one's soul as soil that needed to be prepared for the harvest of life. I pondered the importance of carefully seeding it with proper nutrition and thought. If the soil of the body is good, if it is sown with good seed, and if it is properly watered, a great harvest will result. How fascinating it is to know that a pH balance of 7.4 to 7.5 seems to be near perfect for **water**, **blood**, and **soil**.

A high pH may be the ounce of prevention worth a pound of cure. It is exciting to see the mind set of many people finally moving away from the concept: **When it is broken, let the insurance company or the government pay the doctor to fix it**.

Proper pH is a major KEY to your ability to enjoy a long healthy life. The body is best served when the pH of blood is 7.5, with that of saliva and urine about 6.4. Dr. Reams reminded us that some of the worst culprits affecting pH in our diets are refined sugars, grains, and the huge amount of acids in soft drinks.

Ion channel physiology affects every cell of the body. The neurotransmitter receptors regulate neuronal function by activating ion channels which excite or inhibit ionotropic responses. As an oversimplified example, think of a cell that is too acidic with + ions and the "help" that is coming is also + ions. The two + ions repel each other, but what is needed is ions that will bind. When a negatively-charged "helper" comes, it is much easier and more natural to obtain the beneficial ionotropic response. The receptor binding site now opens the gateway for the neurotransmitter and the transmembrane ion channel to "pour itself" into solving the problem at hand.

Without the charge of electrolytes, you could not live, move, nor think.

Capacity and Charge

Think of a high-storage-capacity battery that can hold enough energy to run your electric car from Dallas to Houston. Capacity along is insufficient for the trip. You have capacity, but you must also have charge. Without the charge of electrolytes, you could not live, move, or think.

The dictionary defines ***electrolyte*** as a liquid or gel which contains ions and can be decomposed by electrolysis. In other words, part of the battery is decomposed and must be replaced or simply discarded.

Dementia and aging occur as the battery gel is decomposed and not replaced. When your immune system and your hormonal system are working properly, your battery will remain charged and the decomposing gel will be restored.

Protein is the gel. Proteomics is the science of the proteins. Proteins consist of amino

Scientists discovered only a few years ago that every healthy cell is covered with glycoprotein receptor sites (made from specific sugars) for the purpose of communication. Glycoproteins signal the transfer of (1) more data (2) energy (3) nutrients or (4) chemicals to perform various functions.

acids. Nitrogen and two hydrogens comprise the amino group, and the acid entity is the carboxyl group. Amino acids link properly when the carboxyl group of one molecule reacts with the amino group of another molecule, creating a peptide bond releasing a molecule of water.

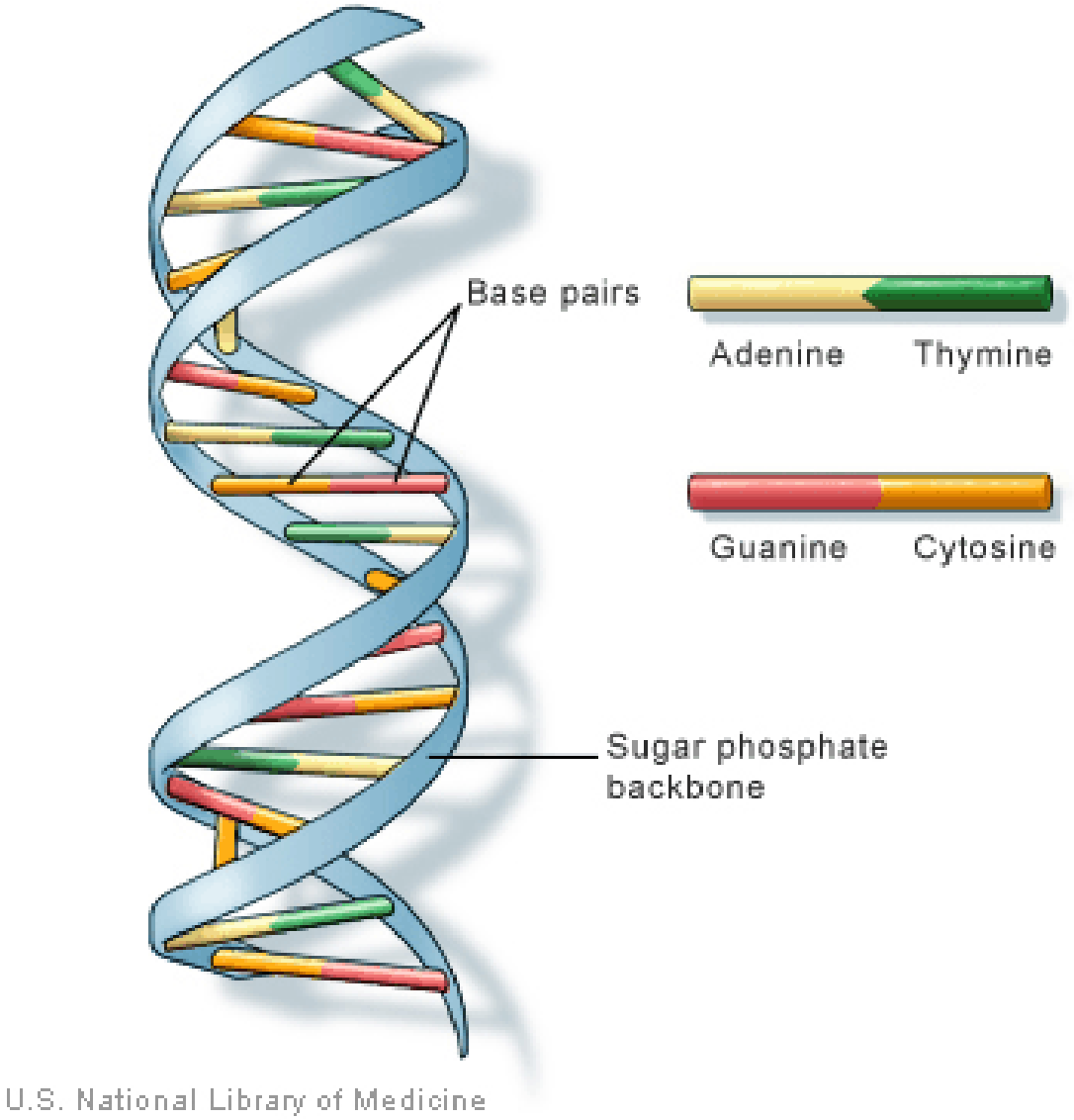
Amino acids are the basic building blocks of enzymes, some hormones, proteins, and body tissues. A peptide is a compound consisting of two or more amino acids. Oligopeptides have ten or fewer amino acids. Polypeptides and proteins are chains of ten or more amino acids, but peptides consisting of more than fifty amino acids are classified as proteins.

Until recently, scientists believes that the proteins held the key to nearly everything in human physiology. Then along came sugar (glyco) and glyco-proteins became very significant. Scientist discovered that every healthy cell is covered with glycoprotein receptor sites (containing chains of specific sugars) for communication requesting the transfer of (1) more data (2) energy (3) nutrients or (4) chemicals to perform various functions. Indeed, DNA, RNA, lipids are all important and have to work together to make healthy cells and healthy bodies. Glycoproteins make it all happen.

Genomics is the study of the genes. The massive coding system within the DNA gave birth to the genome project. The discovery that many aspects of communication involve glycoproteins gave birth to glycomics. The glycome project appears to be thousands of times more complex than the genome project. Glycomics, the operating system (OS) for the body is the new frontier of exploration that will truly help you ***Expand Your Mind - Improve Your Brain***.

Optimal health can only be achieved when the immune system is modulated and when the endocrine system is balanced. And, the immune system and the endocrine system can only be brought into the safe zone when the pH is around 7.4 to 7.5.

A science working closely with genomics and glycomics is epigenetics. The next chapter is a course on how epigenetics does not leave your future just to your DNA. Also included is a brief lesson that will enable you to better understand the workings of your DNA with the AT GC codes.



Chapter 8

Epigenetics is the Future of Healthcare for those who choose it

You can improve your cells, your body, your brain, and your mind through epigenetics.

Physics research can be carried out in the laboratory and is repeatable. Clinical science conducted in the human body results in many variables because each human is unique. Genetic diversity gives different propensities. Add to the genetic code the ability to alter gene expression through nanoparticles bonded to the double helix of the DNA and you can alter rather dramatically the health of the human being. It is the nanoparticles (contaminants or nutrients) that can upset or correct the equilibrium of the DNA's genetic expression.

Epigenetics deals with affecting the equilibrium of the DNA without genetically modifying the DNA. This lesson will give us a more clear understand of the impact of epigenetics in the human body.

Improvement of the species is possible as are mutations. Epigenetics through toxins are causing mutations all the time. We are, in this lesson, dealing with improving life through an epigenetic blue print. Add to the genetic code the ability to alter gene expression and you can alter rather dramatically the health of a human being.

We have learned that the DNA holds the blueprint of your genetics. What most people do not know is that you have a blue print outside of your DNA.

Regardless of the genetic, health, and behavioral propensity that your DNA gave you at birth, those characteristics can become enhanced or degradated and play a profound role in lives for generations to come.

This chapter will give you only a glimpse of epigenetics in my elementary presentation here. Hopefully, this introduction will lead to life changing possibilities. Do not limit the importance of the subject in relationship to the brevity of my notes.

If you accept the pre-programmed negative disposition caused by your DNA, you accept it as a fact and you compound that condition. If you do not accept it as the final verdict, you can change it. You can encourage a more positive correction of that condition. Too often we blame others or something for our own shortcomings and that can include our DNA.

In ***EXPAND YOUR MIND - IMPROVE YOUR BRAIN*** I dedicate time to altering the negative propensities of the body and mind. Overcoming negative patterns, habits, and addictions caused by your DNA can be corrected. We can seek positive dramatic events that can help overcome these negative influences. If left alone, the negative influences will compound themselves as they are relived in the mind over and over like grooves in an old vinyl record.

The health of the human cell, the human body, and the human mind is determined by the severity of epigenetic modification that without question can influence the pre-programmed traits for health and behavior, for better or for worse.

The epigenetic blue print is outside the DNA and can alter gene expression, the health of cells, and behavior of the human mind and body. The epigenetic blue print is of external origin to the DNA that causes a gradual change. The change is in gene expression, not in changing the DNA sequencing. Once the change is imbedded in the gene expression, this change can be transferred to embryo development. While the sequencing is not changed, some of the codes are turned off by toxins or some codes that are turned off may be turned back on by needed nanoparticles.

My first graphic example of epigenetics was when I was a child, I believe that I was five or six, and my father was giving me an early lesson of the damage caused by tobacco. He told me the story of a baby born into a family who used tobacco excessively through smoking and chewing. The little boy would not stop crying, day and night. When the father reached down to pick up his baby from the blanket on the floor, a plug of chewing tobacco fell out of his shirt pocket. The baby grabbed the plug of tobacco, put it in his mouth, chewed on it, and instantly stopped crying. The baby was born with addiction for tobacco.

An eight year Medical Survey was conducted on an Indian reservation in Canada with Fetal Alcohol Syndrome (FAS) children. These are children whose mother consumed enough alcohol during pregnancy to damage the development of the baby. The study indicated that gene expression was positively altered and these children's lives were saved with Royal sugars through what is now called the epigenetic blue print. A Stem Cell Survey CD is available in our Store Front on the website at www.endowmentmed.org This Stem Cell Survey CD reports on these Fetal Alcohol Syndrome children and the challenges they faced.

The epigenetic blue print is designed to influence the DNA. This blue print is not etched in stone but in the flexible tablet of nature. This change is caused by material elements and by our attitudes, desires and actions.

The DNA in each of your cells may be close to three feet long. It is coiled around itself into a tiny ball within the cell. When you are emotionally angry, your DNA is coiled tighter. When you are joyful, happy, and relaxed, so is the DNA inside your cells. Your emotion, your attitude, contributes moment by moment to your epigenetic blue print and your whole body is the beneficiary.

Your cells were designed to respond and adapt to their environment. The genome dynamically responds to the environment of stress, diet, toxins, behavior, nutrients, and especially the Royal sugars as described on our website and in my book ***EXPAND YOUR MIND - IMPROVE YOUR BRAIN***.

Your thoughts wrapped in the emotion of the moment, be they tranquil or chaotic, impacts your cells and your whole body.

Now, let us get more pragmatic with elements. Anger, worry, doubt, fear, and anxiety cause chemical toxins in your body. Junk food, smoking, poor quality air and water contribute to the toxins in your body. A few of these nanoparticles become bonded to the sugar phosphate double helix backbone structure of the DNA.

We have learned that the signals for switching on and off the gene expression is caused by nanoparticles on the double helix and when it is “tight” the switches are not activated as they are when they are more relaxed. Toxins alter the gene expression negatively. The proper nutrients and trace elements alter the gene expression in a very positive way.

Toxins in the air and water, as well as in the food, contribute to lower brain function. This fact is graphically testified by the mutation of frogs forming additional legs. The toxins in lakes and rivers are causing these mutations because they are altering the gene expression of the DNA in these frogs.

The research of David L. Busbee, PhD, who served on the Faculty of Genetics and Toxicology at Texas A&M University, showed that bottled water may compound the problem because of plasticizers leached from the water bottle itself. Dr. Busbee detected plasticizers in Texas water, including nonylphenol, diethyl hexyl phthalate,

diethyl phthalate, butyl benzyl phthalate, and dibutyl phthalate. These toxins alter gene expression.

Dr. Busbee has conducted cancer research with phytosugars and the impact of these Royal Sugars in Genetics. He was a presenter at the Glycomics Medical Conference where he presented his microarray research work in glycomics and cancer and altering gene expression. His training is included in the fourteen (14) hours of CME / CEU quality training available on DVD from The Endowment for Medical Research.

Karen H. Ash, MD, PhD, in her research at the University of Minnesota made some interesting observations. Her research addresses the molecular basis of memory loss and cognitive dysfunction in Alzheimer's disease. Her studies involved the creation of transgenic mouse models of Alzheimer's disease in order to understand how the amyloid-ß and tau proteins impair memory and cognition. The work has shown that the aggregates of amyloid-ß and tau proteins which define Alzheimer's disease neuropathologically do not cause cognitive deficits in mice. Her investigations led to the discovery of a form of the amyloid-ß protein called Aß star (Aß*) that disrupts cognitive function in mice and rats, and revealed a potential mechanism by which interactions with a neuronal receptor may impair memory.

Dr. Ash believes that successful strategies include: “1) *small molecules blocking the formation or action of Aß;* 2) *small molecules promoting the clearance or degradation of Aß; and* 3) *immune therapies against Aß. Oral agents are more practical than ones that need to be given intravenously, like therapeutic monoclonals* (antibodies).”

Remember, you are dealing with neurons, and those very neurons are trained to be receptive to your will. They are at your command. No one has the power to make you angry unless you give them that authority.

Not only can your memory be improved with mental exercise, but your quality of life can get better in more ways than one.

It is the nanoparticles of beneficial trace elements or toxins that turn on and off specific parts of the genes. The quality of the particles determine the results of the altered gene expression. When the trace element is harmful to the design of the cell, it lowers the expectation of the gene expression causing damage to the body. When the nanonutrient is beneficial to the design, it increases the expectation of the

gene expression and consequently the improved health condition of the body.

Yes, without question, the nanonutrients that the body needs deals with the epigenetics of the DNA. Epigenetics deals with the chromatin modification when a cell divides. There is interesting possibility that trehalose may be able to help play an interesting role in cell division. Obviously more research is needed; however, research shows the sugar O-Linked β-*N*-acetylglucosamine (O-GlcNAc) plays a role in cell division. N-Acetylglucosamine (N-acetyl-D-glucosamine, or GlcNAc) is a monosaccharide derivative of glucose and one of the building blocks for glycoproteins. It is an amide between glucosamine and acetic acid.

Understanding these newly discovered sugar switches reveals that the cellular circuitry is much more complex than previously thought. GlcNAc is generally not elongated or modified to form the more complex sugar structures. O-GlcNAc is attached and removed multiple times in the life of a polypeptide, often cycling rapidly and at different rates at different sites on a polypeptide.

The chemical changes act more like "dimmer" switches, than simple on/off switches. The communication between O-GlcNAc and phosphorylation is a paradigm-shift in terms of signaling. So says Gerald Hart, PhD director of biological chemistry at Johns Hopkins School of Medicine. He added, "*I think of phosphorylation as a micro-switch that regulates the circuitry of cell division, and O-GlcNAcylation as the safety switch that regulates the microswitches*,"

So, as you can see, we can have healthy cell division and unhealthy cell division. Your cells are constantly dividing and it is vital for a healthy body that you reproduce more healthy cells. Royal sugars are required for healthy cells and properly functioning DNA and RNA. The actual DNA double helix is made of sugar phosphate.

There are two types of polymer type nucleic acids found in all living cells. DNA (Deoxyribonucleic Acid) is found mainly in the nucleus of the cell, while the RNA (Ribonucleic Acid) is found mainly in the cytoplasm of the cell although it is usually synthesized in the nucleus. There are two types of pentose sugars found in nucleic acids, deoxyribose and ribose. A pentose sugar is a monosaccharide with five carbon atoms. Pentose monosaccharides include Ketopentose (Ribulose, Xylulose), Aldopentose (Ribose, Arabinose, Xylose, Lyxose), and Deoxy sugar (Deoxyribose).

Here is a very brief lesson about DNA. The National Institutes of Health on their website at http://ghr.nlm.nih.gov/handbook/basics/dna published an excellent review entitled "What is the DNA?" from the handbook "*Your Guide to Understanding Genetic Conditions*."

Quote:
DNA, or deoxyribonucleic acid, is the hereditary material in humans and almost all other organisms. Nearly every cell in a person's body has the same DNA. Most DNA is located in the cell nucleus (where it is called nuclear DNA), but a small amount of DNA can also be found in the mitochondria (where it is called mitochondrial DNA or mtDNA).

The information in DNA is stored as a code made up of four chemical bases: adenine (A), guanine (G), cytosine (C), and thymine (T). Human DNA consists of about 3 billion bases, and more than 99 percent of those bases are the same in all people. The order, or sequence, of these bases determines the information available for building and maintaining an organism, similar to the way in which letters of the alphabet appear in a certain order to form words and sentences.

DNA bases pair up with each other, A with T and C with G, to form units called base pairs. Each base is also attached to a sugar molecule and a phosphate molecule. Together, a base, sugar, and phosphate are called a nucleotide. Nucleotides are arranged in two long strands that form a spiral called a double helix. The structure of the double helix is somewhat like a ladder, with the base pairs forming the ladder's rungs and the sugar and phosphate molecules forming the vertical sidepieces of the ladder.

An important property of DNA is that it can replicate, or make copies of itself. Each strand of DNA in the double helix can serve as a pattern for duplicating the sequence of bases. This is critical when cells divide because each new cell needs to have an exact copy of the DNA present in the old cell.
Unquote

Implications yet unknown, beyond the normal environmental factors of diet, stress, and lifestyle alter our gene expressions. New paradigms of healthcare will take us further into quantum physics, energy fields, and faith that can directly affect your health and well-being. We now know that your DNA is not fixed as science previously thought. Emerging ideas are challenging conventional medicine and

epigenetics will play a leading role in tomorrow's healthcare.

There is good news, bad news, and questionable news about epigenetics.

The three epigenetic pathways:

One pathway is to **acquiesce**. Accept status quo, do nothing to prevent the toxins from continuing to negatively alter gene expression. We have explained how this happens to the DNA.

Second pathway is to **take charge** of your own health and that of your family by (1) interrupt the flow of toxins into the body by no longer smoking or putting into your body bombs of self destruction packaged in bad foods, poor quality air and water, and negative thoughts of worry, doubt, fear, anxiety, anger, and bitterness which produce and compound toxins in the body; and (2) replace the negative influence on the body and mind with that which is good.

The third pathway is **let the doctor or someone else fix it**. Drug companies are, at this moment, compounding new gene altering drugs that will start and stop specific gene expressions with a pill or a shot. Some will work, some will maim, and some will kill. There may always be a new drug with the proverbial LD50 level.

My desire for you is that you understand and take advantage of the opportunity for improving your cells, your body, and your mind through upgrading your DNA through epigenetics. It is your choice that greatly effects your DNA every step of the way.

Review the three epigemetic pathways:

ACQUIESCE and accept status quo, do nothing to prevent the toxins from continuing to negatively alter gene expression.

TAKE CHARGE of your own health and that of your family.

LET THE DOCTOR OR SOMEONE ELSE FIX IT. Drug companies are, at this moment, compounding new gene altering drugs that will start and stop specific gene expressions with a pill or a shot. Some will work, some will maim, and some will kill. There may always be a new drug with the proverbial LD50 level.

Chapter 9

Trehalose interaction with Alkaline-earth Metal Ions

There is scientific evidence that when certain trace minerals are present that trehalose forms functional metal complexes. The bond, the glycosidic linkage, of the two glucose molecules that form trehalose makes it a functional food unlike any other.

With trehalose as the base of a compound for minerals, let us look at the possibilities to 1) DO NO HARM; 2) see the benefit of trace minerals; 3) make it easier for the minerals to actually enter the cells; and 4) while we are at it, raise the pH of the human cells for improved health conditions regardless of where the person is on the wellness scale.

The first trehalose adjunct we will discuss is alkaline-earth metal ions. In the following chapter I will discuss the specific trace minerals. In Chapter 6 in Vol. One of *The Trehalose Handbook Series Vol. One* we discuss sodium and how it penetrates the cell membrane.

Most sugars are harmful and compound the acidic condition of the human body. It is reported that cancer cells use twenty times more glucose than normal cells. Trehalose has unique characteristics that give it interesting capabilities to work within acids and a wide range of environmental conditions including high and low temperatures. Trehalose is stable at low pH (high acid) levels.

Here is a very quick review of pH: Positive (+) = acid = LOW pH, which is cationic (nucleophile). Negative (-) = alkaline = HIGH pH, which is anionic (electrophile). The pH is on a scale of 1 to 14. The pH scale measures how acidic or alkaline a substance is. A pH of 7 is neutral, less than 7 is acidic, and greater than 7 is alkaline.

An overly simplistic explanation of increasing the pH of the cell may be: The negative charge of the mineral sodium is used to draw it into the more acidic cell. The trace elements are the transporters of electrical potential in the cell which enables the other parts of the design to function properly including anti-bacterial and anti-viral possibilities. Cation transport occurs in a cycle of conformational changes which appears to be triggered by phosphorylation of the pump. The ionic transport conducted by sodium pumps creates both an electrical and chemical gradient across the plasma membrane. This is critical not only for that cell but, in many cases, for directional fluid and electrolyte movement across epithelial sheets. The sodium is pumped in, does some cleaning and other work and is then pumped out, leaving a

cleaner and higher pH cell.

Glycolipids

Research shows that glycolipids formed from trehalose have a direct result in enhancing resistance to infection in neutropenic patients. Neutropenia is a blood disorder often cause as a side effect of a drug, or exposure to certain poisons. People often get neutropenia when treated for cancer with chemotherapy drugs. In traditional cancer chemotherapy the white blood cell count is lowered and the immune system is compromised to the extend that chemotherapy is often discontinued until the immune system is brought back. The Armed Forces Radiobiology Research Institute in Bethesda, Maryland reported that ***Trehalose dimycolate enhances resistance to infection in neutropenic animals***.
http://www.ncbi.nlm.nih.gov/pmc/articles/PMC313476/?tool=pubmed

If it is true that cancer cannot survive in a little higher pH state, we should educate ourselves on the importance of pH.

If it is true that cancer cannot survive in a little higher pH state, we should educate ourselves on the importance of pH. In my textbook ***Expand Your Mind - Improve Your Brain*** I discuss the significant aspects of reaching and maintaining a high pH factor in the human cells.

In this chapter you will learn how trehalose with sodium and trace minerals can play a role in helping attain and maintain the higher desired pH.

There is considerable research that substantiates that cancer cannot survive in a high pH environment. High pH therapy for cancer in mice and humans is well documented; however, the public is mostly unaware of this science.

The Endowment for Medical Research appreciates the works of other organizations or scientists referenced here. You may find these works to be of interest and, of course, educational. We must always remember that it is the job of science to discover and verify. We have discovered much during the last number of years and much of what we had earlier learned is proven wrong as new discoveries are made.

There are various pathways to attaining a higher pH. I am not recommending nor rejecting other pathways. What I am recommending is that each individual needs to become educated on what is available and needs to take authority over his and her own health.

A number of doctors in different countries are treating cancer patients with high pH therapy. High pH simply means a more alkaline system. In cancer treatment some doctors are using cesium chloride or sodium bicarbonate therapy. These doctors report that sodium works well with advanced cancers and metastases, and may eliminate tumors within weeks and pain within days. Cesium chloride and sodium bicarbonate work in different ways.

These same doctors report that the bicarbonate treatment is an easier method and should be used first. If not fully successful, either repeat it a month later or try cesium chloride. These methods seem to be most effective with fast-growing tumors and metastases. Reports are that dormant tumors do not respond very well. The doctors say to not use high pH therapy at the same time with any other tumor-destroying method to avoid overloading the organs of elimination. A high pH should be continued even after tumors have disappeared. A high pH in your body should become the objective, should become the environment and lifestyle from this moment in time forward.

Research indicates that trehalose (two glucose molecules) is channeled into cells through a sodium-dependent transport system. Therefore a lot of sodium enters these cells, which needs to be pumped out again. A high intake of sodium bicarbonate creates an alkaline lymph fluid with a high sodium concentration surrounding the cancer cells. The idea is for lots of clean water to help the flow of sodium in and out of the cells.

Here is the Abstract entitled: **Interaction Between Trehalose and Alkaline-earth Metal Ions.**

We investigated the interaction between trehalose and alkaline-earth metal ions. The nuclear relaxation times of carbon atoms of trehalose were shortened by addition of the alkaline-earth chloride salts, MgCl2, CaCl2, and SrCl2, indicating that trehalose formed metal-complexes with the alkaline-earth metal chlorides. From the data of the 1H-1H coupling constants of trehalose in the presence of the alkaline-earth chlorides, it appeared that trehalose formed complexes with MgCl2, and CaCl2 at the various complexing sites: Mg2+ was coordinated to O-4 and O-4' of trehalose, and Ca2+ to O-2 and O-3. We succeeded in the preparation of two types of crystals of the trehalose/ CaCl2. One was a crystal consisting of trehalose, CaCl2, and water in a ratio of 1:1:1. The other was an anhydrous crystal containing trehalose and CaCl2 in a ratio of 1:2. Several applications of the complexing between trehalose and the metal ions for food processing are proposed.

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http://www.ncbi.nlm.nih.gov/pubmed/15665460?itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVDocSum&ordinalpos=1&log$=free

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When cancer cells become alkaline, they lose their membrane potential, swell up, and die. It is believed that trehalose is much kinder to the cell and cell membrane than straight glucose in helping induce cells to take in the sodium while potentially strengthening the cell membrane.

In chapter 10 we will discuss some of the trace minerals and question their benefit to the human body: antimony, barium, beryllium, bismuth, boron, bromine, calcium, carbon, cerium, cesium, chloride, chromium, cobalt, copper, dysprosium, erbium, europium, fluorine, gadolinium, gallium, germanium, gold, hafnium, holmium, indium, iodine, iridium, iron, lanthanum, lithium, lutetium, magnesium, manganese, molybdenum, neodymium, niacin, nickel, niobium, osmium, palladium, phosphorous, platinum, potassium, praseodymium, rhenium, rhodium, rubidium, ruthenium, samarium, scandium, selenium, silicon, silver, sodium, strontium, sulfur, tantalum, tellurium, terbium, thallium, thorium, thulium, tin, titanium, tungsten, vanadium, ytterbium, zinc, zirconium in a fulvic acid phytochemical compound.

Chapter 10

A Quick Study of the Importance of Trace Minerals in the Human Body

The unfathomed functions of trace minerals are yet to be discovered. Scientists group minerals in three categories: Essential Minerals, Essential Trace Elements, and nonessential contaminant minerals. We will someday discover that tiny amounts of what today are called nonessential is more important than we thought. We do know that all biological processes are influenced by the properties of these minerals. We just don't know exactly how they accomplish what they do.

Nearly everyone is deficient in minerals and trace elements because of consumption of so much bad sugars, sweeteners, and carbohydrates [that turn to sugar] that have helped discard them from the body. Eating processed foods also discards many of the needed minerals while the added "fortified" minerals to not properly assimilate in the body because they are not bio-available. And, even most organic foods are grown in soil that is depleted of many of the minerals.

For the trace minerals, there is great importance to the valence electrons, the electron affinity, the atomic number, the atomic weight, the molar volume, the stability of the isotopes, the ionization energies (the least required energy to release a single electron from the atom), electron configuration, the electro-negativity, the ionic radius and other factors.

What scientist see as the most important elements may be because more of these elements are used. It may very well be that elements that are not required in trace amount and considered non-essential may be as important in a different context. Today's science deem Essential Minerals to include: calcium, chloride, magnesium, phosphorus, potassium, sodium, and sulfur. Essential Trace Elements include: chromium, copper, cobalt, fluorine, iodine, iron, manganese, molybdenum, selenium, vanadium, and zinc.

Trace minerals, the tiny particles of minerals are – mineral nanoparticles or nanopowders. Our atmosphere, water in our oceans, lakes, and rivers and the soil contain these nanoparticles. **Life, all biological processes, and the elements of our whole planet are influenced and/or driven by the properties of these minerals.**

The relevance of natural nanoparticles is greater than previously believed and more complex than previously thought. The University of Utah developed an interactive website about particle size. You can graphically compare sizes by moving the sliding scale. Access this site from our HOTS Links of interest in the top navigation bar at www.endowmentmed.org

We are going to discuss a few trace mineral nanomaterials. The biology and physics of nanomaterials are some of the fastest growing areas of research and have vital scientific influences. There is still much to learn and I will take the opportunity to discuss briefly some of my thoughts about future research and what I believe some of the discoveries will be. Nanominerals can move and remove radioactive substances in the human body.

Nanopowder trace minerals have unique functionality because of their transitional electron orbit capabilities. Optimum health is impossible when the body is missing these required minerals. When the human body is deficient in trace minerals, mineral substitution occurs which may be the major cause for autoimmune diseases and other health problems. When vital molecules do not have the correct building blocks, they substitute with a lesser quality building material probably made from bad sugars and other junk foods. Regardless of what poor quality substitute building blocks are used, the end result is that the molecules are built wrongly and the function is wrong.

As you read the benefits of each trace mineral and see how they work together, keep in mind the tiny power plant within each cell of your body called the mitochondria. The mitochondria are the cells' power sources and consequently your body's power sources. As we learn more about the mitochondria we may discover this is a more sophisticated electrical power plant than any nuclear plant ever built by man. I dedicate a section to the study of the mitochondria in the e-textbook ***EXPAND YOUR MIND - IMPROVE YOUR BRAIN***. Originally, I thought there was one mitochondria in each cell of the human body.

Amazingly, there are hundreds and even thousands of mitochondria in some cells of your body. The British Society for Cell Biology confirms that there may be 1,000 to 2,000 mitochondria in each liver cell. E. D. Robin and R. Wong at the Department of Medicine at Stanford University School of Medicine in California wrote a paper entitled *Mitochondrial DNA molecules and virtual number of mitochondria per cell in mammalian cells*. These mitochondria are at work to supply you with energy to

power your body. Obviously, with the large number of these dynamos in a cell, they are quite small but synergistically effective.

Research provides evidence that higher amounts of some trace minerals improve health in the human body even when that body is in a wellness state. Providing our bodies a richer source of materials enable us to better withstand stress. A small amount of trace minerals can go a long way. When we operate in the sickness state the metabolism is significantly altered and we may need more trace minerals. In this illness state, our bodies cannot naturally heal and repair themselves when they do not have enough of the vital building blocks.

Poor Immune System, Illness, and Viruses respond to Trace Minerals

Overcoming a poor immune system, illnesses, and viruses including HIV can better be addressed when vitamin, mineral, and trace element deficiencies are replenished. If a healthy body needs these trace minerals, a compromised body need them EVEN MORE.

Let us consider viruses for a moment. When a person has a poor immune system and illness we have seen that the virus itself can benefit directly from these mineral deficiencies, enabling the virus population to grow. This shows us conclusively how vital it is to avoid and overcome these deficiencies. Without question, when we give our bodies the building blocks necessary that we improve of opportunity winning the battle against viral proliferation in our own bodies.

In the early stages of HIV infection, many vitamins, minerals, and trace elements are deficient.

As an oversimplification expression to say, "*A virus is a wadded up, misfolded protein*." However, the sugar trehalose is known for helping the proteins in their correct folding process. See references, abstracts, and articles about trehalose in the News Section and in the Sugar Science Forum at www.endowmentmed.org

Often an infection causes a person to eat less, receive less proper nutrients, and helps prevent absorption of the needed nutrients. This is the reason viral infection is often associated with vitamin and mineral depletion.

Even in the early stages of HIV infection, many vitamins, minerals, and trace elements are deficient. This has been well documented even in people who eat an excellent, well-balanced diet showing us that fortification is common sense.

Reducing viral infection is obviously an important step toward wellness. The regulation of mineral balance in the body is essential to surviving and thriving. This is accomplished through each cell which maintains the internal environment of your body. A major key toward wellness is the ability to transport trace minerals through cell membranes which can enable the body to perform its designed functions. Trace minerals initiate electrical activity which controls your heart beat, your neurological system and your cellular communication. Without these trace minerals, your muscles would not respond. Your blood vessels would not relax and tighten when instructed and your body's hydration would not be maintained.

Trace minerals are generally needed in the human body in quantities of only a few milligrams (mg) or micrograms (mcg) per day. Although most people know minerals are important to their health, few people know why they are important. Most people think of minerals as inorganic rock or chemical elements not attached to a carbon atom. In fact, that is the basic scientific understanding of minerals. When these minerals are grown and are bio-available, they are more readily accepted by the body as food.

The distinction between minerals and trace minerals or often called trace elements, is that when the body requires more than 100 milligrams, it is labeled a mineral. If the body requires less than this, it is labeled a trace mineral. Trace minerals are generally needed in quantities of only a few milligrams (mg) or micrograms (mcg) per day.

It is increasingly evident that keeping a balanced level of minerals in every organ, tissue and cell of the human body is the prominent key to health. Natural minerals come in organic and inorganic form. Even in their inorganic state bio-active trace minerals are nanoparticles in size capable of passing the blood brain barrier.

When are minerals not minerals in the inorganic sense? When minerals are grown in a plant, they become bio-active, more easily absorbed into the human cell. Another pathway is for the cell to accept the ions of that trace mineral and thereby receive a function. When the charge inside the cell attracts the needed nutrient, that nutrient is drawn into the cell. A scientist visualized this graphic picture of how long

chain molecules can be encouraged to enter and help bring nutrition to the cell. He described it to me this way:

> **Look at the human cell as if it were a large ball with the outer membrane like a chainlink fence covering it completely. You throw particles against it but they will not easily go through the cell membrane. Think of certain long chain molecules like a chain thrown against the chainlink fence. It is obviously a major challenge to get the chain through the cell wall. Now, change the charge within the cell to "attraction" so it "magnetically" pulls on one end of the chain. It turns the molecule so it is drawn easily through the chainlink fence.**

Trace minerals are crucial for body functions in every aspect of life and maintenance and in the repair of tissues and bones. Scientists do not yet understand the function of all the trace minerals because some are used in extremely small amounts to do extremely important functions in their reacting with each other. We witness this in different parts of the cell. Let us look at some of the minerals and what they help you accomplish. This is only a brief overview of the importance of trace minerals in your body. Non of the mineral descriptions is intended to be exhaustive. Many books can be written about the importance of these trace elements in the human body.

Some of the data about the trace elements listed in this chapter are more defined than others. I will not be this detailed with all of the trace minerals. While we still do not really understand the benefits of most of the trace minerals, we do know that a revolutionary new mineral science is emerging.

The following information is a teaser of knowledge about bio-active minerals that your body may utilize in phytochemical form in ways that we do not yet know. We are beginning to understand the effects that are made on the cell and consequently the whole body through ion exchange and magnetic conditioning to the trace mineral's immediate environment. When we better understand the mitochondria, we will know more of the true reason for the different trace minerals.

There is greater importance to the valence electrons, the electron affinity, the atomic number, the atomic weight, the molar volume, the stability of the isotopes, the ionization energies (the least required energy to release a single electron from the atom), electron configuration, the electronegativity, the ionic radius and other factors. We may know very little about what all this means and exactly how they can impact the cell and consequently the human body.

For now, we can be sure nanoparticle trace minerals play some of life's major roles through the electrolyte soup that runs the electrical system of our bodies. While all trace minerals are "natural", most are from rock but should be obtained from plant source naturally ionized because they have been alive.

You will discover research shows that viruses are affected, inhibited from proliferation, or killed by some of the trace minerals. When properly utilized, trace minerals may prove to be one of the most significant scientific discoveries of modern time. This will not be a revolution. This is a renaissance. Balance is the key. An imbalance of too much of any nutrient is to be corrected. Modulation and balance is attained by trace elements and proper nutrition. I hope you enjoy learning about this significant science as much as I enjoyed studying and compiling this research.

These Trace Minerals [trace elements] are nanoparticles or nanopowders

Antimony Sb
has no known biological benefit. It rarely occurs in its native metallic form in nature. It easily combines with other elements, usually including sulfur, to form over 100 different minerals. Antimony is found naturally in the environment. Alone may be harmful. We consume small amounts every day, primarily in food, drinking water, and air.

Barium Ba
has no known biological benefit and is classified as an "Alkaline Earth Metal".

Beryllium Be
is a trace mineral and has no known biological benefits. Alone may be harmful. The addition of 2% to 3% of beryllium to copper makes a nonmagnetic alloy six times

stronger than pure copper.

Bismuth Bi

is a naturally phytonutrient (plant source) trace mineral. Some bismuth may not be from a plant source that is used in medicines to treat diarrhea, nausea, and indigestion. It is the stuff from which Pepto-bismal is made.

Physics of Bismuth: (Bi) (Atomic Number: 83; atomic weight: 208.980380; Nitrogen family; Molar Volume: 21.37 cm^3/mole; Valence Electrons: $6p^3$ Electron affinity: -110 kJ/mol; Isotopes: 32 + 1 Stable; Ionization energies: 703 kJ/mol or 7.289 eV; Electron configuration: $[Xe]6s^24f^{14}5d^{10}6p^3$, another electron configuration was reported as $1s^22s^22p^63s^23p^63d^{10}4s^24p^64d^{10}5s^25p^64f^{14}5d^{10}6s^26p3$; Pauling electronegativity: 1.9 or one report was Electronegativity: 2.02 (Pauling); 1.67 (Allrod Rochow); Vapor Pressure: 0.000627 Pa @ 271.52°C; Density: 9.80 g/cm^3, another calculation was Density: 9.75 g/cm^3 @ 300°K; Specific Heat: 0.12 J/g°K; Heat of Vaporization: 104.8 kJ/mol; Heat of Fusion: 11.3 kJ/mol; Covalent radius: 1.52 angstroms or atomic radius: 155 pm, another report gave us Atomic Radius: 1.63Å; Ionic radius: 0.98 angstroms (+1), 0.96 angstroms (+3), 0.74 angstroms (+5), another report gave us Ionic Radius: 1.03Å; Standard state: solid at 298 K; CAS Registry ID: 7440-69-9; Group in periodic table: 15; Group name: Pnictogen; Period in periodic table: 6; Block in periodic table: p-block; Color: lustrous reddish white; Classification: Metallic.

Boron B

is not yet considered an essential nutrient for humans, it is not clear whether deficiencies occur. People who eat adequate amounts of produce, nuts, and legumes are likely getting enough boron. Whether the average person would benefit by supplementing with this mineral remains unclear.

Physics of Boron: (B) (Atomic Number: 5; Atomic Weight: 10.811000; Molar Volume: 4.68 cm^3/mole; Valence Electrons: $2p^1$; Electrons Energy Level: 2, 3; Isotopes: 9 + 2 Stable; Heat of Vaporization: 489.7 kJ/mol; Heat of Fusion: 50.2 kJ/mol; Density: 2.34 g/cm^3 @ 300°K; Specific Heat: 1.02 J/g°K; Atomic Radius: 1.17Å; Ionic Radius: 0.23Å; Electronegativity: 2.04 (Pauling); 2.01 (Allrod Rochow); Vapor Pressure: 0.0000143 Pa @ 961°C. Okay, so I will not report in such detailed on all of the other elements. Perhaps I will get detailed with samarium. You will see why.

Bromine Br

is a chemical element, one of nature's building blocks but alone is harmful. It is so common in nature that it is found in our bodies and in the foods we eat. Bromine derivatives are ingredients in many drugs. Bromine Isotopes are used in nuclear medicine.

Calcium Ca

is essential for developing and maintaining healthy bones and teeth. It is the most abundant mineral in the human body. The body requires calcium ions for the transmission of nerve impulses, muscle contraction, blood coagulation, cardiac functions, and other processes. Too much calcium without the other minerals can result of too much calcium depositing and accumulating in the soft tissue of the brain. Calcifications can happen all over the body. In cases where calcium has built up in the brain, people show various brain dysfunctions. Calcium works closely with phosphorus. The balance between calcium and phosphorus is necessary for proper bone density and prevention of osteoporosis. Calcium assists in blood clotting, muscle contraction, nerve transmission, oxygen transport, cellular secretion of fluids and enzyme activity, and the prevention of osteoporosis. When sickness overcomes the body, phosphorus and calcium may have become low. Also, should you lose too much weight, it may be wise to monitor your phosphorus level.

Carbon C

is the building block of life. It has one of the greatest capacities, of all the elements, to bond to itself and nearly all other non-metallic elements. Therefore, it can trap toxins in the body. Most of the human body is made up of water, H_2O, with cells consisting of 65-90% water by weight. Carbon, the basic unit for organic molecules, comes in second to water. 99% of the mass of the human body is made up of just six elements: oxygen, carbon, hydrogen, nitrogen, calcium, and phosphorus. Drinking plenty of water can help flush the toxins out of the body.

Cerium Ce

is the most electropositive and most alkaline of the stable chemical elements. It has next to the lowest ionization potential of all the elements, which means that it readily loses its outermost electron to become an ion. (Ionization potential is the energy

needed to remove an electron from the atom's outermost shell.) There are unsubstantiated reports that claim that cerium oxide has been tested and used in medicine to treat diseases highly associated with free radical damage and inflammation, such as neurology disorders like Alzheimer's. Cerium oxide has high absorption of ultraviolet radiation, which makes it a great UV blocker, while it is transparent for visible light and works nicely in cosmetic skin care formulations where tactile and visual considerations come first, so it is a possible replacement of zinc oxide and titanium dioxide in sun screens, with projected lower photo-catalytic activity and a wider range of spectra UV protection. Articles indicate that cerium has clinically-demonstrated health benefits in brain function and other neurodegenerative challenges including spinal cord, trauma, Alzheimer's, Parkinson's, Huntington's, ALS, MS, stroke, arthritis, atherosclerosis, cardiovascular disease, diabetes, allergies, asthma, pulmonary disease, respiratory dysfunction, autoimmune diseases, inflammation, and UV and radioactive induced inflammation.

Cesium Cs

is an alkali metal with no known biological benefit. It is used in photoelectric cells.

Chloride Cl

is the major anion (negatively charged substance) in the blood and extracellular fluid (the body fluid that lies outside cells). Blood and other body fluids have almost the same concentration of chloride ion as sea water. The balance of chloride ion (Cl^-) is closely regulated by the body.

Chromium Cr

helps insulin perform so your cells can utilize glucose and help maintain normal levels of glucose in the blood thereby playing a major role in blood sugar maintenance and in pancreatic health. When chromium is deficient, your blood sugar levels become elevated. Cholesterol and triglyceride levels rise too. Peripheral neuropathy has been reported, as has weight loss. Chromium is used up through heavy exercise, infections, and injuries. It is reported that the American diet contains about half of what we should have in our bodies. Chromium is a mineral that humans require, although its mechanisms of action in the body and the amounts needed for optimal health are not well defined. Chromium is depleted out of the body by regular table sugar. Chromium is one of the monatomic elements along

with gold, iridium, rhodium, silver, and platinum. See the notes about monoatomic or monatomic elements and their role in the DNA.

Cobalt Co

promotes the formulation of red blood cells and is a component of vitamin B-12 which is essential for producing red blood cells and maintaining the nervous system and the prevention of pernicious anemia. Cobalt serves some of the same purposes as manganese and zinc in the activation of several enzymes. Cobalt also participates in the biotin-dependent Krebs-cycle, the process that the body uses to break down sugars into energy.

Copper Cu

is essential to normal red blood cell formation and connective tissue formation. It acts as a catalyst to store and release iron used to form hemoglobin. Copper and other minerals contribute to function of your central nervous system. Copper is a necessary part of some of the enzymes for antioxidant protection which helps stop free radicals. Copper-containing enzymes are involved in immune function. Cooper helps the metabolism of iron. While deficiencies may be rare, poor absorption can be caused by illness, by high-dose zinc supplementation, and by antacids. Measurement is difficult. Excesses can be harmful and can lead to liver problems. Copper may play a role in killing viruses but more research is needed. Copper deficiencies have been reported in AIDs patients. Further depletion of copper is reportedly caused by treatment of HIV. Another study showed higher levels of copper in those with HIV; however, it is not clear if these patients were supplementing copper. The USDA published a work entitled Nutrition and Brain Function - Metals Essential to the Brain's Hardwiring from studies at the Grand Forks Human Nutrition Research Center that have shown copper and zinc are important for brain function. Associations between copper deficiency and impaired brain function were noted nearly 75 years ago. The owner of a sheep station in Australia found that his lambs had become uncoordinated to the point of falling. Eventually, it was found that the lambs — all of which died — were born from mothers that had been pastured during pregnancy on forage with extremely low copper content.

Dysprosium Dy

and its compounds are among the most highly susceptible to magnetization of all

substances and are used in special magnetic alloys. The author believes that future research will show how this and other micro-nutrient trace minerals play a far more significant role in health that currently understood.

Erbium Er

is a trace mineral found throughout in the human body but there is no known benefit.

Europium Eu

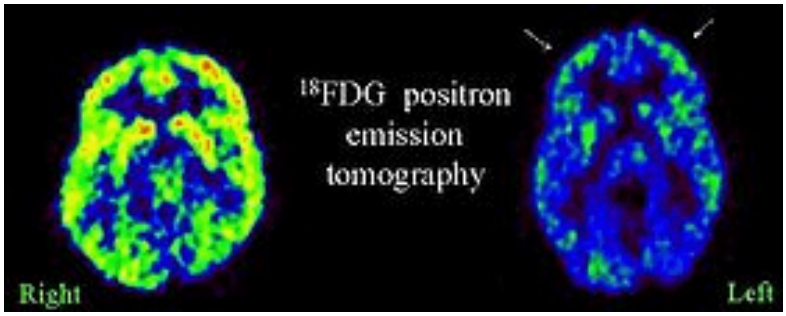
has no known biological benefits for life processes in plants or animals.

Fluorine

is too reactive to have any natural biological role when isolated. Fluorine is the most electronegative and reactive of all elements. Fluorine, as natural calcium fluorine, differs from the synthetic fluoride compound that is added to drinking water. Fluoride is not an essential nutrient. Naturally occurring organofluorine compounds are rare. It is reported that the most notable organofluorine is fluoroacetate found in some forty (40) plants in Australia, Brazil and Africa.

Gadolinium Gd

has no known biological benefits for life processes in plants or animals. It is a malleable and ductile rare-earth metal. Gadolinium has exceptionally high absorption of neutrons and therefore is used for shielding in neutron radiography and in nuclear reactors. Because of its paramagnetic properties, solutions of organic gadolinium complexes and gadolinium compounds are



Gadolinium-153 helps calibrate positron emission tomography (PET) systems that are used in nuclear medicine for functional imaging. This PET image of the human brain shows the difference between a normal brain and the clinically depressed patient. The blue color indicates less glucose metabolism in a normal brain. The green, yellow, and red colors indicate areas of higher glucose metabolism characteristic of a depressed patient.

the most popular intravenous MRI contrast agents in medical magnetic resonance imaging.

Gallium Ga

is not known to be essential in biology, but because of the biological handling of gallium's primary ionic salt gallium(III) as though it were iron(III), the gallium ion localizes to and interacts with many processes in the body in which iron(III) is manipulated. These processes include inflammation, which is a marker for many disease states, several gallium salts are used, or are in development, as both pharmaceuticals and radiopharmaceuticals in medicine. Bio-active gallium may have benefits not yet documented.

Germanium Ge

is a metalloid element, like silicone, is a semi-conductive material. It is reported that it has an effects in correcting imbalance in electric potential. Germanium is found in soil and plants including Korean ginseng where it has a concentration of 4,189 ppm; 754 ppm in garlic, and 152 ppm in comfrey. It is hypothesized by some that germanium suppresses the activities of cancer cells by lowering the electric potentials of rapidly producing cancer cells. Germanium stays in the body about one day as it helps to alkalinize the discharge waste from its acidic state which promotes a better metabolism.

Gold Au

is one of the **monoatomic elements** along with iridium, rhodium, silver, platinum and chromium. See the notes about monoatomic or monatomic elements and their role in the DNA.

Hafnium Hf

has no known biological benefits for life processes in plants or animals. It resembles zirconium.

Holmium Ho

has no known biological benefits for life processes in plants or animals. Holmium has the highest magnetic strength of any element. It is used to create the strongest artificially-generated magnetic fields. It can absorb nuclear fission-bred neutrons and is used in nuclear control rods.

Indium In

has no known biological benefits for life processes in plants or animals.

Iodine I

is a necessary trace element and gives us an excellent example of just how important a tiny amount is to the human body. Iodine is vital to the thyroid where it is converted to thyroxin which is used to regulate the activity of vital organs. It controls the rate of growth and may determine how long a person lives and the condition of the skin. Deficiency of iodine in a pregnant mother can cause major problems throughout the life of the offspring. It is the author's belief that we do not yet understand the importance of most trace minerals and how such a small amount controls the health of the body. Iodine gives us a better understanding of the critical balance of nature and just how vital an element can be. Iodine gives us a remarkable lesson in a trace element that toxic yet vital in small amounts. It is the frequency, the radiation, the ions, the isotopes of a trace minerals that accomplishes a vital work in the human body. In fact, Iodine-129 ^{129}I has a reported half-life 15.7 million years and is a product of cosmic ray spallation on various isotopes of xenon in the atmosphere, in cosmic ray muon interaction with tellurium-130, and also and uranium and plutonium fission, both in subsurface rocks and nuclear reactors.

Iridium Ir

has no known biological benefits for life processes in plants or animals and is present in very small amounts near 0%. Iridium is one of the monoatomic elements along with gold, rhodium, silver, platinum and chromium. See the notes about monoatomic or monatomic elements and their role in the DNA.

Iron Fe

is necessary for red blood cell formation and is required for transport of oxygen throughout the body. Iron is important for brain function. It can function as an antioxidant. Vitamin C promotes its absorption. Deficiency leads to anemia. When present in excess, it can work against you. Iron is frequently sequestered in the body to prevent its use by bacteria as a source of fuel. Increasing iron inappropriately might lead to increased infection.

Iron attaches to proteins; it is first stored and then carried throughout the body by these proteins. In chronic illnesses, the supply of these proteins is reduced which limits storage capacity. When the body runs out of safe places to put its iron, it is deposited in tissues. Too much iron in these tissues can alter their function which can damage the cells, especially in the liver and heart.

Loss of blood is the only know way to reduce iron. If you are healthy, giving bloods is beneficial to others and yourself. In one virus study, higher levels of iron were indicated in HIV-positive subjects than in HIV-negative subjects. This is interesting to me but confusing in that we do not yet understand why. It may be that the iron is simply not being utilized as it should be and is accumulating in the AIDS patients. It may be caused by the body's request for the iron to be sequestered to prevent its use by bacteria that are causing infection and are seeking the iron as a source of fuel.

Lanthanum La

some papers say, has no known biological benefits for life processes in plants or animals and is present in very small amounts near 0%. It is used in medicine in that it reduces serum phosphate in patients with end-stage kidney disease. Lanthanum Carbonate is found to be a phosphate binder. It works by blocking the absorption of phosphate, which reduces phosphate and calcium phosphate levels in the blood.

Lithium Li

in its natural bio-active state (not the drug) is needed for proper mental and physical health. The lithium most people know anything about is the pharmaceutical drug forms of lithium, lithium carbonate and lithium citrate which can be toxic and have serious side effects. These drugs are typically prescribed for treatment of mood disorders like bipolar disorder. Bio-available lithium can cross the blood brain barrier

and is non-toxic and known to be safe. Lithium protects the brain, aids in regeneration of cells may provide anti-aging benefits to the brain, as well as protecting the brain from toxins.

Lutetium Lu

has no known biological use except to stimulate the metabolism. It is used to treat cancer and reduce tumor growth.

Magnesium Mg

activates over 100 enzymes and helps nerves and muscles function. It helps maintain the integrity of cell membranes and stabilizes the cell electrically and is critical for proper heart function. Magnesium plays an active role in the metabolism of sodium, potassium, and calcium. It acts on your heart and blood vessels, your nerves and muscles, and your gut. Most magnesium is concentrated in tissue with only little showing up in the blood. Alcohol, diuretics, and antibiotics may deplete magnesium as does infection. Illness when accompanied with infections cause tissue damage and the release of the magnesium which cause rapid depletion which is difficult to monitor. Calcium deficiency may be caused by magnesium depletion and supplementation may not help increased magnesium. Unlike calcium, there appears to be no need for worry about too much magnesium. And, unlike calcium, your body has no reserves in bone to draw on when your magnesium supply gets low. It has been shown to increase the speed of recovery from open surgeries, and to improve infections. Magnesium is the mineral that is easy to lose, normally difficult to get into the system, you cannot seem to get too much, and too much will not hurt you. The exception to the rule of too much is in the case of kidney failure. If you can't excrete it in the urine, it can build up.

Manganese Mn

is a key component of your enzyme systems, including oxygen-handling enzymes. It supports brain function and reproduction and is required for blood sugar regulation and bone structure.

Molybdenum Mo

contributes to normal growth and development and is a key component in many

enzyme systems including enzymes involved in detoxification.

Neodymium Nd

is reported to have no known biological benefits for life processes in plants or animals. Neodymium is obtained from monazite and bastnasite. The author believes it is another one of the trace elements that may have more importance that science currently gives it credit. We do not yet understand all of the functions of the mitochondria and other parts of the human cell. Today many electronic devices use strong permanent magnets made possible by neodymium in the form of Neodymium-Iron-Boron (NdFeB) permanent magnets that allow for the miniaturization of a variety of technologies.

Niacin Ne

natural niacin can have great benefits to the human body. Niacin plays a key role in over 100 functions necessary for health and is especially important for energy production and, as a vasodilator, blood circulation. It is also needed for red blood cell formation, the health of skin and the digestive tract, healthy nervous system functioning and brain activity, and for the synthesis of the sex hormones estrogen, progesterone, and testosterone. Niacin opens blood vessels wider and when used properly, offers benefits in terms of cholesterol reduction, as well as detoxification including detoxification of fatty tissues. It is reported that niacin made in the form of niacinamide - a form of vitamin B3 does NOT cause dilation of the blood vessels.

Nickel Ni

has an association to Vitamin C similar to the association of cobalt to Vitamin B12 as far as excess and deficiency symptoms and their interaction with other nutrients is concerned. As an example, iron deficiency anemia is often found in the presence of low nickel, and it is a well-known fact that Vitamin C assists in iron absorption. Vitamin C and nickel is effective with cirrhosis of the liver, hypoadrenalism, and to improve insulin production.

Niobium Nb

has no known biological benefits for life processes; however, there are trace amounts in the human body equal to about 0.000002 %. Niobium is present in many

other minerals.

Osmium Os

is in seawater as are many of the other minerals. We know of no known biological benefit in plants or animals. It is reported that anticancer drugs based on osmium could prove more effective than current drugs. Osmium is the densest natural element, twice as dense as lead. Osmium can withstand compression better than any known material even beyond that of a diamond. Osmium has the lowest vapor pressure of any of the platinum group of metals. Osmium tetroxide has recently been used to detect fingerprints and as an aid to stain fatty tissue for microscope slides. The author believes that osmium and other trace elements may play a more significant role in cell function of the human body through their naturally occurring isotopes.

Palladium Pd

may have no known biological function in plants or animals according to traditional science. However, palladium has an uncommon affinity for hydrogen. At room temperatures is can absorb up to 900 times its own volume of hydrogen. Palladium, in cooperation with conductive materials, proves to be an excellent electrocatalyst for oxidation of primary alcohols in alkaline media. The great many reactions in which palladium compounds serve as catalysts are collectively known as palladium coupling reactions. Trace elements of palladium in the human body holds many possibilities for research. Current research indicates that palladium was effective to enhance the Krebs cycle dehydrogenases, and mitochondrial electron transport chain complexes. The unique electronic and redox properties of palladium alpha-lipoic acid complex appear to be a key to this physiological effectiveness. The results suggest that this might be effective to protect the aging associated risk of cardiovascular and neurodegenerative diseases.

Phosphorous P

works in cooperation with calcium to develop and maintain strong bones and teeth. Next to calcium, phosphorus is the most abundant mineral in the body. It is present in cells and tissues throughout the body with about 85% of phosphorus in the body found in bones and teeth It enhances use of other nutrients and plays a key role in cell membrane integrity and intercellular communication. It is critical for proper

energy processing in the body. Phosphorus helps filter out waste in the kidneys and plays an essential role in how the body stores and uses energy. It also helps reduce muscle pain after a hard workout. Phosphorus along with certain sugars are needed for the growth, maintenance, and repair of all tissues and cells, and for the production of the genetic building blocks, DNA and RNA. The DNA backbone double helix is actually constructed from a sugar phosphate. Phosphorus is also needed to help balance and use other vitamins and minerals, including vitamin D, iodine, magnesium, and zinc. Alcohol, diabetic challenges, and certain medications may leach phosphorus from the body and make it difficult for the body to absorb nutrients.

Platinum Pt

may have no known biological function in plants or animals according to traditional science. In clinical oncology use of platinum based chemotherapy is considered the gold standard in some areas. Platinum is one of the monoatomic elements along with gold, iridium, rhodium, silver, and chromium. See the notes about monoatomic or monatomic elements and their role in the DNA.

Potassium K

is used to help regulates heartbeat, maintains fluid balance, and help your muscles contract. Potassium with sodium flows back and forth across cell membranes to maintain homeostasis in the cell. It is vital for the body to store, regulate, and maintain sodium and potassium.

Praseodymium Pr

is a trace mineral. It has no known biological function in plants or animals according to traditional science. It is the author's belief that there are many trace elements that currently have no known function in the human body but are vitally important. Often because the amount is so small that science has yet to determine what, if any, functionality the mineral plays. It is a rare-earth metal of the lanthanide series. A major use of the metal is in a pyrophoric alloy used in cigarette lighter flints, but it need not be purified for this application. Praseodymium compounds have many uses. The oxide is used in carbon electrodes for arc lighting. The salts are used to color enamels and glass. Didymium glass used in glassblower's goggles contains praseodymium; this glass absorbs the yellow sodium glare of light from the torch

flame.

Physics of praseodymium: Naturally occurring praseodymium is composed of one stable isotope, ^{141}Pr. Thirty-eight radioisotopes have been characterized with the most stable being ^{143}Pr with a half-life of 13.57 days and ^{142}Pr with a half-life of 19.12 hours. All of the remaining radioactive isotopes have half-lives that are less than 5.985 hours and the majority of these have half-lives that are less than 33 seconds. This element also has six meta states with the most stable being ^{138m}Pr ($t_{½}$ 2.12 hours), ^{142m}Pr ($t_{½}$ 14.6 minutes) and ^{134m}Pr ($t_{½}$ 11 minutes). The isotopes of praseodymium range in atomic weight from 120.955 u (^{121}Pr) to 158.955 u (^{159}Pr). The primary decay mode before the stable isotope, ^{141}Pr, is electron capture and the primary mode after is beta minus decay. The primary decay products before ^{141}Pr are element 58 (cerium) isotopes and the primary products after are element 60 (neodymium) isotopes.

Rhenium Re

may have no known biological function in plants or animals according to traditional science. It does not form minerals of its own, but it does occur as a trace element in columbite, tantalite and molybdenite.

Rhodium Rh

is found throughout in the human body but there is no known benefit. Rhodoum is one of the monoatomic elements along with gold, iridium, silver, platinum and chromium. See the notes about monoatomic or monatomic elements and their role in the DNA.

Rubidium Rb

is from the alkali metal group and as of yet has no known biological role. It is said to be non-toxic. It is slightly radioactive and so has been used to locate brain tumors. It collects in tumors but not in healthy tissue. Rubidium is used little outside research. It is easily ionized so was considered for use in ion engines, but was found to be less effective than caesium. It has been proposed for use as a working fluid for vapor turbines and in thermoelectric generators. It is used as a photocell component and in special glasses.

Ruthenium Ru

effects on the DNA is ongoing research in a number of universities. It is reported that ruthenium at the ends of a strand of DNA causes the electrons to flow over the DNA much faster which increases the speed of cellular communications. Rhodium is found in Essiac Tea. Aloe vera, carrots and grapes grown on mineral rich soil are also high in Rhodium.

Samarium Sm

is a rare earth metal that appear to have no biological benefits to the human body. However, let us analyze samarium more closely because it can do some strange performances. This trace element may someday be discovered to be more beneficial in strange ways. Samarium can encapsulated by a buckyball. Prior to the advent of ion-exchange separation technology in the 1950s, samarium had no commercial uses in pure form. Samarium is not found free in nature. Like other rare earth elements, it is contained in many minerals including monazite and bastnaesite and is used in electronics industries. While it is reasonably stable in air; it ignites in air at 150°C. It has a bright silver luster. Long-term storage is under mineral oil and it can be preserved by sealing it under an inert gas. Samarium is quite electropositive and reacts slowly with cold water and quite quickly with hot water to form samarium hydroxide. Three crystal modifications of the metal exist, with transformations at 734 and 922 °C, making it polymorphic (having multiple forms). Individual samarium atoms can be isolated by encapsulating them into fullerene molecules. (A series of “fullerene” molecules is a short er expression for buckminsterfullerene named after Buckminster Fuller. The first fullerene molecule was discovered in 1985 in the UK and the US by Kroto, Smalley and Curl. They were awarded the Nobel Prize in 1996. Carbon molecules, that form a closed nano size cage with the geodesic look, have become known as buckyballs after the American architect Fuller, whose geodesic dome construction used the same structural concept. The elongated relative of the buckyballs, carbon nanotubes, were identified in 1991 in Japan by Sumio.) Because samarium has polymorphic capabilities and can be caged in nanosize buckyballs and nanotube cylinders, it is indeed special.

Physics of Samarium: (Data obtained from a number of sources including the National Nuclear Data Center.) The half-life range of the samarium isotopes range from many years to a few minutes, to a few seconds to milliseconds. One of its isotopes has a very high cross section for the capture of neutrons, and therefore

there has been some interest in samarium in the atomic industry for use as control rods and nuclear poisons.

Sm; Atomic number: 62; Atomic weight: 150.36;

Mass Number	Natural Abundance	Half-life
144	3.07%	Stable
147	14.99%	1.06×10+11 years
148	11.24%	7×10+15 years
149	13.82%	> 2×10+15 years
150	7.38%	Stable
152	26.75%	Stable
154	22.75%	Stable

All Known Isotopes of the Element Samarium

Mass Number	Half-life	Decay Mode	Branching Percentage
130	No Data Available	Electron Capture	N o Data Available
131	1.2 seconds	Electron Capture	100.00
		Electron Capture with delayed Proton Emission	> 0.00
132	4.0 seconds	Electron Capture	100.00

		Electron Capture with delayed Proton Emission	No Data Available
133	3.7 seconds	Electron Capture	100.00
		Electron Capture with delayed Proton Emission	> 0.00
134	10 seconds	Electron Capture	100.00
135	10.3 seconds	Electron Capture	100.00
		Electron Capture with delayed Proton Emission	0.02
136	47 seconds	Electron Capture	100.00
137	45 seconds	Electron Capture	100.00
138	3.1 minutes	Electron Capture	100.00
139	2.57 minutes	Electron Capture	100.00
139_m	10.7 seconds	Isomeric Transition	93.70
		Electron Capture	6.30
140	14.82 minutes	Electron Capture	100.00
141	10.2 minutes	Electron Capture	100.00
141_m	22.6 minutes	Electron Capture	99.69
		Isomeric Transition	0.31

142	72.49 minutes	Electron Capture	100.00
143	8.75 minutes	Electron Capture	100.00
143_{m}	66 seconds	Isomeric Transition	99.76
		Electron Capture	0.24
143_{m2}	30 milliseconds	Isomeric Transition	100.00
144	Stable	-	-
145	340 days	Electron Capture	100.00
145_{m}	0.96 microseconds	Isomeric Transition	100.00
146	10.3×10+7 years	Alpha Decay	100.00
147	1.06×10+11 years	Alpha Decay	100.00
148	7×10+15 years	Alpha Decay	100.00
149	> 2×10+15 years	Alpha Decay	N o Data Available
150	Stable	-	-
151	90 years	Beta-minus Decay	100.00
152	Stable	-	-
153	46.284 hours	Beta-minus Decay	100.00
154	Stable	-	-

155	22.3 minutes	Beta-minus Decay	100.00
156	9.4 hours	Beta-minus Decay	100.00
157	482 seconds	Beta-minus Decay	100.00
158	5.30 minutes	Beta-minus Decay	100.00
159	11.37 seconds	Beta-minus Decay	100.00
160	9.6 seconds	Beta-minus Decay	100.00
161	4.8 seconds	Beta-minus Decay	100.00
162	≈ 2 seconds	Beta-minus Decay	No Data Available
163	≈ 1 seconds	Beta-minus Decay	No Data Available
164	≈ 0.5 seconds	Beta-minus Decay	No Data Available
165	≈ 0.2 seconds	Beta-minus Decay	No Data Available

Scandium Sc

has no biological role. Only trace amounts reach the food chain, so the average person's daily intake is less than 0.1 microgram and it appears to be non toxic.

Selenium Se

is an essential component of an antioxidant enzyme, necessary for normal growth and development and play a role in detoxification of heavy metals, including mercury. It plays a role in production of antibodies by the immune system and is a component of your teeth. Selenium deficiency is associated with heart disease and with anemia. It has been found to be depleted in both the tissues and the blood of individuals with AIDS, suggesting a long standing deficiency. Selenium deficiency has been found in patients with and without diarrhea and malabsorption. Eighteen

percent (18%) of the men in one HIV study, all asymptomatic, were found to be selenium deficient. As the virus progresses, the levels of selenium go down. Selenium levels correlate with markers of immune function including albumin levels, lean body mass, and total lymphocyte count. Supplementation has been shown to improve symptoms and blood levels, but not these other markers. Infection and increased metabolic rates compound the loss of selenium. Some patients report that their thrush goes away when they start selenium supplementation.

Silicon Si

is an essential mineral used in structural and functional integrity of the connective tissue and skeletal system. Only small amounts of silicon are present in the tissues and the actual amount required by the body has not yet been determined. Sugars, mucopolysaccharides, form much of the substance or the material matrix of bone and collagenous tissues in the human body. These compounds contain silicon and cooperate with structural proteins that indicates it is used for functional strength and stability of the tissues. All of the tissues in the human body that contain high concentrations of silicon gives an idea of how important silicon is to the maintenance of human health. Mucopolysaccharides are long chains of sugar molecules that are found throughout the body, often in mucus and in fluid around the joints. They are more commonly called glycosaminoglycans. These sugars serve essential functions with silicon for the rapid healing of tissues, chemical regulations involving the transfer of nutrients and water in the membranes of the connective tissues as well as embryonic development and growth. Silicon helps control nerve impulses. It contributes to the strength and integrity of bones, growth of hair, nails, and teeth. It makes the eyes bright and protects the skin from becoming flabby. It is beneficial in all healing processes and protects the body against many diseases, such as tuberculosis, irritations in the mucous membranes, and skin disorders.

Silver Ag

is one of the monoatomic elements along with gold, iridium, rhodium, silver, platinum and chromium. See the notes about monoatomic or monatomic elements and their role in the DNA.

Sodium Na

is an electrolyte and one of its functions is to pass through the cell membrane. In

Volume One, Chapter 6 I discussed the Structure Function of sodium and how it plays a deciding role in cellular metabolism. Sodium, an inorganic nutrient, unlike other minerals, penetrates the cell membrane and modulates the pH which is vital to all metabolism. Other inorganic minerals do not easily absorb into the human cell. Sodium is unique and vital. Because sodium is an electrolyte, one of its functions is to pass through cell membranes. About 95% of consumed sodium is absorbed by the body, with the remaining 5% being excreted through the intestines while the excess sodium is excreted by the kidneys. Several fundamental pathways are used for sodium absorption across the intestinal mucosa (mucosal cells are any membrane or lining, which contain mucus-secreting glands for lubrication). You may wish to go back and reread Chapter 6 in Volume One because of its importance and synergistically function with the other trace minerals. Sodium is an alkali metal; has a very low density, lighter than water. (Na); atomic number 11; atomic weight: 22.98976928; Positive charge +1. Sodium with potassium flows back and forth across cell membranes to maintain homeostasis in the cell. It is vital for the body to store, regulate, and maintain sodium and potassium. Salt and sodium are not the same thing. Table salt is 40 percent sodium and 60 percent chloride. Sodium bicarbonate contains no chloride. Sodium may have received a bad name because of it partner in salt. It may actually be the chloride with the sodium that causes more problems. Calcium chloride which is used to preserve color significantly raises the blood pressure in some people sensitive to calcium chloride. Sodium chloride raises the blood pressure of salt-sensitive people. Food intake for optimal benefits is an individual balancing act. Sodium balance is brought by other minerals and tract minerals including potassium, magnesium, and calcium. The balance of sodium and water in the body can be disrupted if there is not enough water. We know conclusively that sodium is an absolutely necessary mineral for the human body. Without it, nerves and muscles would cease to function, the absorption of major nutrients would be impaired, and the body would not be able to maintain adequate water and mineral balance.

Strontium Sr

is an alkaline earth metal. Trace amounts of strontium are found in the human skeleton. The influence of strontium on bone metabolism is has been researched where studies indicate that it positively effects bone metabolism to promote bone formation and decrease bone resorption, leading to normalized bone density to help maintain strong healthy bones. Depending on the soil content, strontium is present in foods and drinking water. Some of the benefits of strontium are that it has been

shown to prevent osteoarthritis and lessen the risk of dental cavities. Strontium supports the function of osteoblasts causing cells to form new bone. It has also been show to reduce bone pain and lesions on the skin that may occur in certain conditions. Strontium is used in the treatment of some cancers, to ease the pain of patients. Natural strontium may not be radioactive while strontium 90 is radioactive. Strontium was named after a village in Scotland called Strontian.

Sulfur S

is a constituent of the cytokine and methionine. It plays an important role in the structural conformation of almost all proteins and enzymes found in the body including muscles and hair. Sulfur represents about 0.25 percent of our total body weight. The body contains approximately 140 grams of sulfur, primarily in the proteins, although it is distributed in small amounts in all cells and tissues. It plays a critical role in liver detoxification, important functions in antioxidant nutrients and oxygen handling, and in growth. (S); Atomic number 16; atomic weight 32.066.

Tantalum Ta

may be one of a number of minerals used in the body in ways we have not yet learned. It is the authors belief that some of these rare minerals provide the fuel needed by the mitochondrial electron transport chain complexes. In other uses outside the human body, tantalum is used in nuclear reactors, electronics, and missile parts. Tantalum is completely immune to body liquids and is a nonirritating metal. It has, therefore, found wide use in making surgical appliances. Tantalum oxide is used to make special glass with high index of refraction for camera lenses.

Tellurium Te

has no known benefit to humans, so current science tells us. Tellurium, however, has a strange effect on some humans. When ingested beyond trace amounts, tellurium causes a garlic-smelling breath and body odor. It is probably tellurium in garlic that gives garlic the garlic odor. Reactions between trace minerals are fascinating. Garlic contains tellurium and is also an excellent source of vitamins A, B-complex, and C while providing a good supply of other minerals like manganese, phosphorus, calcium, copper, potassium, iron and copper. Plus, garlic provides amino acids, essential oils, glycosides, and the rare essential trace minerals like

germanium, selenium along with the tellurium. Oh, the wonders of how they work together. The name tellurium comes from the Latin word tellus meaning earth. Various trace elements interact with each other is ways not yet understood by the greatest of scientists. Tellurium is used in interesting ways. Iodine gives us a remarkable lesson in a trace element that toxic yet vital in small amounts. It is the frequency, the radiation, the ions, the isotopes of a trace minerals that accomplishes a vital work in the human body. In fact, Iodine-129 ^{129}I has a reported half-life 15.7 million years and is a product of cosmic ray spallation on various isotopes of xenon in the atmosphere, in cosmic ray muon interaction with tellurium-130, and also and uranium and plutonium fission, both in subsurface rocks and nuclear reactors.

Terbium Tb

is a naturally occurring, plant-derived trace mineral. We believe terbium and many other trace minerals activate enzymes necessary for functions in the body.

Thallium Tl

is another trace mineral with questioned function. It may have some local benefit in trace amount that are not yet determined. In larger amounts it is toxic and used in nuclear perfusion studies. Thallium is odorless and tasteless and has no known beneficial to plants or animals. Thallium sulfate in 1975 was prohibited as rat poison and ant killer. Its electrical conductivity changes with exposure to infrared light and is used in photocells. Thallium was found in 7,604 of the 8,024 people tested in CDC biomonitoring studies. Thallium is radioactive and when injected into the bloodstream, these substances collect in the portions of heart muscle that have good blood flow. If one of the coronary arteries (the arteries that supply blood to the heart muscle) is blocked or partially blocked, relatively little thallium accumulates in the muscle supplied by that blocked artery. An image of your heart can then be made to see the thallium. From these pictures, the parts of the heart that are not receiving normal blood flow (because of blockage in the coronary arteries) can be identified. This procedure is called noninvasive. Invasive is when they open up the chest to look at the heart. It is reported that these studies are very safe. Their only drawback is that radiation is used. The level of radiation the patient receives is believed to produce a small risk, and for appropriately selected patients the potential for benefit far outweighs this risk.

Thorium Th

is a radioactive trace mineral with questioned function. It may have some local benefit in trace amount that are not yet determined. It is more abundant in nature than uranium and can be used as a nuclear fuel through breeding to uranium-233. Thorium continues to be a tantalising possibility for use in nuclear power reactors. India has been a sponsor of major research efforts for using thorium. Proponents for thorium say that it has multiple advantages over uranium fuel. It is consumed more slowly in nuclear reactions than uranium, it has the potential to cut the volume of nuclear waste produced in half. Unlike a uranium reaction, a thorium fuel reaction does not produce usable weapons quality plutonium, which could address concerns about developing countries pursuing nuclear weapons under the pretext of nuclear energy.

Thulium Tm

is a trace mineral.

Tin Sn

is the trace mineral that will surprise you. You normally do not hear a doctor say that you are low on tin. However, it has been established that tin is an essential trace element for some animals. They do not grow well without tin. Rat studies have shown that tin-deficient diets resulted in poor growth, reduced feeding efficiency, hearing loss, and bilateral (male pattern) hair loss. Tin has been examined in human tissue after accidental deaths. They noted that tin was found in the aorta, brain, heart, kidney, liver, muscle, ovary, spleen, pancreas, testes, stomach, and uterus, but none was found in the thyroid of any victim, while the prostate, which usually showed no other trace element but tin.

Titanium Ti

is non-toxic even in large doses and science does not believe it plays any natural role inside the human body. An estimated 0.8 milligrams of titanium is ingested by humans each day but most passes through without being absorbed. It does seem to have a tendency to accumulate in tissues that contain silica. An unknown mechanism in plants may use titanium to stimulate the production of carbohydrates and encourage growth. This may explain why most plants contain about 1 part per million (ppm) of titanium, food plants have about 2 ppm, and horsetail and nettle

contain up to 80 ppm. While titanium itself may not appear to play a role in the human body, let us examine some of its basic characteristics and examine what it might possibly achieve in its way through the body. Remember, if the titanium is bio-active from a plant in a phytochemical soup, it may be there for a higher purpose that we have not yet discovered.

Physics of Titanium: Titanium is a white, silvery metal that has a high strength-to-weight ratio and is conditionally corrosion resistant in a wide range of environments. Atomic No. 22; Atomic Wt. 47.867; Atomic volume: 10.64 cm^3/mol; Titanium has 18 isotopes whose half-lives are known, with mass numbers 39 to 57. Of these, five are stable, ^{46}Ti, ^{47}Ti, ^{48}Ti, ^{49}Ti and ^{50}Ti. The most naturally abundant of these isotopes is ^{48}Ti at 73.8%; 1st ionization energy: 658 kJ mol^{-1}; 2nd ionization energy: 1310.3 kJ mol^{-1}; 3rd ionization energy: 2652.5 kJ mol^{-1}; Electron affinity: 7.6 kJ mol^{-1}; Electronegativity (Pauling Scale): 1.54; Shells: 2,8,10,2; Atomic radius: 140 pm; Ionic radius (1+ ion): 128 pm; Ionic radius (2+ ion): 100 pm; Ionic radius (3+ ion): 81 pm; Ionic radius (2- ion): pm; Ionic radius (1- ion): pm; Thermal conductivity: 21.9 W m^{-1} K^{-1}; Electrical conductivity: 2.6 x 10^6 S m^{-1}; Electron configuration: [Ar] $3d^2$ $4s^2$; Specific Gravity 4.54; Melting Point 1668°C; Coefficient of Thermal Expansion 8.6 X 10^{-6}/°K; Specific Heat 0.125 cal/g/°K; Ultimate Tensile Strength (Room Temperature, Annealed) 50 ksi; Yield Tensile Strength (Room Temperature, Annealed) 40 ksi; Poisons Ratio 0.32; Modulus of Elasticity 14.9 X 10^6 psi; Recrystalization Temperature 700°C to 750°C.

Tungsten W

is a trace mineral.

Vanadium V

is a trace mineral that is needed by the human body in small amounts. It is present in the brain. Vanadium is an trace mineral found in the human diet and the human body. It is in vegetables and seafood. In its natural form, Vanadium is very colorful and is found in very small amounts in a wide variety of foods. The presence of it in the brain inhibits cholesterol from forming in blood vessels. Vanadium is also take part or is active in various chemical reactions that occur inside the human body. It is believed to be involved in energy production, a cofactor of enzymes to accelerate chemical reactions in the body, participation in blood sugar and fat metabolism and in helping build bones and teeth. Vanadium benefits the body by preventing heart

attacks due to inhibition of the formation of cholesterol. Vanadium present in the brain inhibits the formation of cholesterol in blood to decrease the risk of heart attack. It assists many other chemical reactions and processes to help keep the body in good. It plays an important role in the growth and reproduction of the human body. It is needed in cellular metabolism and for the formation of healthy bones in teeth.

Ytterbium Yb

is a trace mineral that closely resembles calcium, strontium, and barium. It has yet no known benefit to the human body. Ytterbium may be used to make atomic clocks more accurate and stable than the cesium chronometer which is based the number of vibrations of the cesium atom, exactly 9,192,631,770. A ytterbium clock has the potential to be even more accurate.

Zinc Zn

is an essential part of more than 200 enzymes involved in digestion, metabolism, reproduction and wound healing. It is critical in your immune response and antioxidant activity. Zinc plays a role in antibody production, and other aspects of immune response. Zinc deficiency impairs the immune response. Hair loss, lost night vision, and cognitive abilities may be reduced by a zinc deficiency. With zinc deficiency wound healing is slowed and protein metabolism is impaired. Zinc can be shuttled from blood to tissue in times of stress or illness which makes plasma levels unable to reflect the true concentration of zinc in the body. Zinc is absorbed in the small intestine. High-fiber diets and the presence of parasites can limit its absorption. Less than twenty-five percent (25%) of non-organic zinc that is ingested is absorbed. With poor intestinal absorption, the amount can be considerably less. Zinc plays major roles in the maintenance of membranes. Diarrhea can be both a cause and a result of zinc deficiency, and can obviously compound the problem. A reduction or change in your sense of taste can be an indication of a zinc deficiency which can effect appetite and absorption. Some AIDS studies have shown reduced zinc levels in people with HIV. AIDS treatment is known to lower zinc levels. Testosterone levels drop with zinc deficiency. One medical specialist published that some of his male patients have low testosterone levels particularly in those with advanced illness. One can take too much zinc which can weaken immune system function and lower calcium levels. A 1984 AIDS study with two hundred eighty-eight (288) HIV-positive men were asked what supplements they took, at the time they

entered the study. They were then monitored for seven years for progression to AIDS. High daily intakes of vitamin C, biotin, and niacin were associated with slower progression to AIDS. High zinc intakes show them to have a faster progression-in a pattern consistent with the amount of intake. The study indicated that high levels of zinc supplementation may have harmed immune status in these men. In conclusion, we understand that we need zinc. We understand that we do not need a lot of zinc. The RDA for zinc is 15 milligrams. The USDA published a work entitled Nutrition and Brain Function - Metals Essential to the Brain's Hardwiring from studies at the Grand Forks Human Nutrition Research Center that have shown copper and zinc are important for brain function.

Zirconium Zr

has no known biological role, though zirconium salts are of low toxicity. The human body contains about 1 milligram of zirconium, and daily intake is approximately 50 µg per day. Zirconium content in human blood is as low as 10 parts per billion. Aquatic plants readily take up soluble zirconium, but it is rare in land plants. About 70% of plants have no zirconium content, and those that do have about 5 parts per billion.

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Trace Minerals and Your DNA

Some trace minerals, as you have read, play significant roles in the DNA. Some of these are known as monoatomic or single atom minerals in the platinum mineral family (Iridium, Ruthenium, Rhodium, Palladium, Osmium, and Platinum). These and a few other monoatomic trace elements outside the Platinum family including Silver and chromium. Some of these have a positive effect on plant cells, animals cells, and human cells. Other trace minerals that are not of the Platinum family nor are they monpatomic but still pay roles in the DNA including phosphorus which with a sugar makes the back bone structure of the DNA’s double helix. As research continues into the function of DNA, RNA, and mitochondria, we will learn more about the role of the trace minerals. Expect scientists to soon discover remarkable functions of mineral ions that will have major health benefits for the human body.

These trace minerals are the lightning!

antimony, barium, beryllium, bismuth, boron, bromine, calcium, carbon, cerium, cesium, chloride, chromium, cobalt, copper, dysprosium, erbium, europium, fluorine, gadolinium, gallium, germanium, gold, hafnium, holmium, indium, iodine, iridium, iron, lanthanum, lithium, lutetium, magnesium, manganese, molybdenum, neodymium, niacin, nickel, niobium, osmium, palladium, phosphorous, platinum, potassium, praseodymium, rhenium, rhodium, rubidium, ruthenium, samarium, scandium, selenium, silicon, silver, sodium, strontium, sulfur, tantalum, tellurium, terbium, thallium, thorium, thulium, tin, titanium, tungsten, vanadium, ytterbium, zinc, zirconium in a fulvic acid phytochemical compound.

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National Nuclear Data Center

Charles E. Ophardt, Elmhurst College, Virtual Chembook
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