Enzymes – Biochemistry at the Speed of Light

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A human being is a complex set of interconnected organ systems functioning as an integrated whole. Each of these organ systems is made of identical cells, which are the powerplants and the workhorses of the human body. By most calculations, the number of cells is somewhere between 50 and 70 trillion. To put size in perspective, if a human being was the size of the earth, which is 8000 miles in diameter, a cell would be 2 feet wide. The work of the cell is unseen to the naked eye, but miraculous in its capability.

Inside the cell is a collection of individual organs, called organelles. These organelles function as miniature, fully automated manufacturing plants. Inside each manufacturing plant is a nucleus containing the blueprint for making the machinery necessary for each cell to carry out its work, instructions for the cell to repair and make a copy of itself, and plans for the cell to clean up after itself and take out the trash. The system functions like an assembly line: raw materials in, product assembled piece by piece, product finished, trash disposed, product recycled piece by piece. At each station on the assembly line are the machines, called enzymes.

Enzymes are complex proteins built from a coded message contained within the DNA. This message, called a codon, is translated into a growing string of single amino anywhere from 100 to 1000 amino acids long. (Figure 1). These strings of amino acids have a chemical structure holding them together and folding them around each other to form complex three-dimensional structures. (Figure 2). Bound with either minerals, or other substances, including vitamins, the enzyme acquires a specific shape making it specific to a given task.

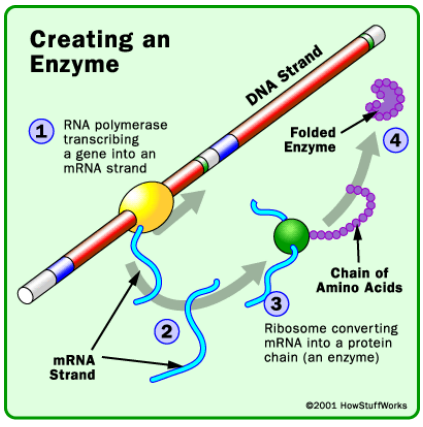

Figure 1

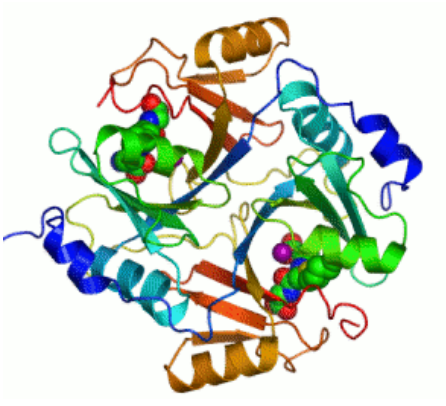

Figure 2

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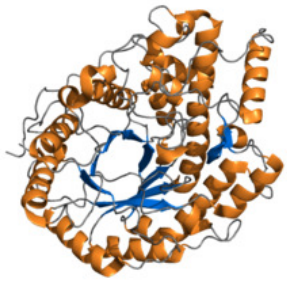
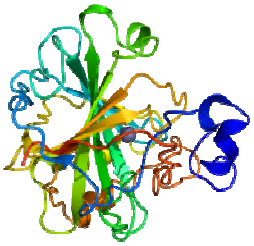
Enzymes not only have unique shapes, but are also specific to the organism. This is because molecules and structures in any given organism are unique to that system, whether animal, plant, microbe or virus. Shown below are two enzymes, amylase and carbonic anhydrase (CA), both of which function in human and plant cells. Amylase supports the digestion of starch and carbonic anhydrase converts carbon dioxide and water to bicarbonate and protons, a major part of the pH buffer system. As can be clearly seen, the human enzymes and the plant enzymes are not the same shape or structure. There are countless other examples of these differences. Plant enzymes support plant metabolism. Microbial enzymes support microbial metabolism. Viral enzymes are for viruses. **Plant enzymes do not perform enzyme functions in the human body. Enzymes that function in the human body are made by the human cell, under specific conditions, with specific nutrients extracted from the food that is consumed.**

Human Amylase



Plant Amylase



Human CA

Plant CA

The human genome project has identified 2709 different human enzymes participating in 896 biochemical reactions. Enzymes put things together, break things apart, rearrange things, add water, remove water and modify the structure of molecules to ultimately create a finished product or recycle the finished product to be used as piece parts for the next round of production. Any given cell may contain hundreds to millions of enzymes of each type, depending on the importance of the function and how often the reaction is needed. To understand how enzymes work, a great visual would be to see 3000 pieces of machinery on a factory floor, flowing through the piece by piece assembly and disassembly process, all of them moving at the same time, in a continuous circle, without hesitation and without interruption, all the while producing the energy to power the system. A truly mind- boggling feat of engineering!

Without enzymes, chemical reactions are often very slow, sometimes taking years to occur. Chemical reactions also require heat for activation, typically higher than 212° Fahrenheit. Neither of these limitations is compatible with human life. With enzymes acting as catalysts, kind of like spark plugs, chemical reactions occur trillions of times faster than they otherwise would and at much lower temperatures. Enzymes allow production and recycling and waste disposal, instantly and simultaneously in thousands of places, all at once, at the speed of light. **It is enzymes that support life in a human body.**

Enzymes extract oxygen from the air that is breathed and attach the oxygen to the hemoglobin molecule to be carried to all the cells. Enzymes cause the lungs to breathe and the heart to beat. Enzymes make brain processing happen. Enzymes are required for regulation of temperature and the pH in all organ systems. Enzymes control the clotting and unclotting of blood and the activation of the white blood cells and platelets for an immune response. Enzymes make HCl (hydrochloric acid) in the stomach to destroy bacteria in food that is consumed and begin the process of protein digestion. Enzymes make lipases and carbohydrases and proteases that process fats and carbohydrates and proteins in foods. Enzymes make nucleases that destroy the genetic information in plant cells and viral cells and microbial cells in food that is consumed. Enzymes make proteins that become hormones like thyroxine, insulin, glucagon, growth hormone, anti-diuretic hormone and leptin. Enzymes make neurotransmitters like serotonin, melatonin, glutamate, GABA, dopamine, norepinephrine, epinephrine and endorphins. Enzymes make cholesterol and estrogen, progesterone, testosterone, DHEA, cortisol and aldosterone. Enzymes are necessary to process and safely remove metabolic waste from the body. Without enzymes producing elastin (an elastic fiber) in the esophagus, the stomach, the pancreas, the bile ducts, the intestines, the colon and the bladder, there is esophageal reflux, bloating, constipation, digestive difficulties, gallstones and urinary incontinence. Without enzymes producing elastin, the skin sags, the joints are stiff and sore, the blood pressure is too high or too low and the lungs have asthma.

None of the products of enzyme reactions, including hormones, works without the others. Taking thyroid hormone, for instance, provides no benefit for optimal health if the 895 other reactions with which it is connected are out of sync or lack the enzymes to make them happen. **Without an adequate supply of enzymes working at the speed**

of light every nanosecond of every day, living well, mentally, physically, spiritually, emotionally and sexually, in a symptom-free, disease-free body cannot and does not happen.

Enzymes function under very specific conditions and are destroyed when these conditions are not met. Enzymes are primarily destroyed by excess heat, organic acids and variations in the acid/base environment (pH) where the enzyme does its work. Anything that destroys enzymes will create an enzyme deficit. (Table 1). If a person has an enzyme deficit, the proper type and amount of machinery will not be on the factory floor to perform the metabolic work necessary for optimal function. No person with an enzyme deficit will be optimally healthy.

ENZYME DEFICIT
Excess Heat
Organic Acids
Strong Alkalis
Alcohol
Coffee, Black Tea, Herbal Tea, Carbonated Beverages
Beverages with Phosphoric Acid or Citric Acid
Smoking
Pharmaceutical Drugs, Vaccines
Preservatives, Dyes in Food
Preservatives, Dyes, Binders, and Fillers in Supplements
Antibiotics, AntiVirals, AntiFungals
Herbal Supplements
Stress

Table 1

How is excess heat produced? Heat is produced in the metabolism of food for energy and also in the process of physical, mental and emotional work. Since the definition of a calorie, for the purpose of this discussion, is the amount of heat required to raise the temperature of 1 kilogram of water 1 degree centigrade, a person consuming or burning more calories than the balancing mechanisms in the body are able to handle, will produce excess heat. For the average adult woman, the number of calories that can be reasonably handled every day is about 3000. For the average adult man, it is about 4000 calories per day. Excess calorie consumption, prolonged, intense physical

exercise, whether aerobic or anaerobic, and constant worry or emotional stress produces excess heat. **Excess heat destroys enzymes.** Who has optimal health? Lance Armstrong, who grosses 20,000 calories of food consumed and calories burned every day? Lolo Jones who grosses 10000 calories per day? The marathon runner, the long distance athlete, or the bodybuilder who grosses 6000 calories per day? The person who does spinning, long-distance cycling, bodybuilding, CrossFit, or boot camp, grossing upwards of 5000 calories consumed and burned every day? Or the person who eats 1500 calories per day and in the course of a moderate increase in activity burns 1800 calories per day? Looking at the physics of energy expended and energy consumed, it is no wonder that athletes and road warriors burn out at an early age, often die suddenly, are likely to have chronic pain and degenerative joint issues, have chronic fatigue and/or insomnia and do not outlive the lifespan of average Americans. No one who consumes excess calories or over-exercises will be optimally healthy. No one whose mind is constantly on overload will be optimally healthy. No one who is in a constant state of emotional turmoil will be optimally healthy.

Enzymes also require tight regulation of the acid and base nature of chemical reactions in which they are involved. This is called pH balance. High acid foods and substances and high alkali foods and substances create pH imbalances that lead to an enzyme deficit. With a neutral pH being 7.0, blood, lymph, and cerebrospinal fluid are slightly alkaline at 7.36 – 7.42. Saliva has a pH of 6.2 when food is not present. Prostatic fluid is slightly alkaline at 7.31. On eating, the stomach pH is 2.0, the small intestines have a pH of 8.0 and the colons and rectum are slightly acidic at 5.6 – 6.9. The skin has a pH of 4.7. Urine pH is 4.0 – 6.0 and vaginal pH is 6.3. pH variance in tissues provides the mechanism whereby humans, dependent on an external fuel supply for nourishment, are able to peacefully coexist in a world of plants, animals, microbes and viruses. **pH in body tissues cannot be manipulated. The pH in all organ systems is controlled by enzymes performing under optimal conditions.** If the pH in a given system is off, the enzymes in that organ will not work. Then the cells will not renew. Enzyme malfunction charts a slow course from symptom to debilitating disease. Over many years, 2 feet of bad road turns mile by mile into thousands of miles of disrepair. Disease at the cellular level is very hard to detect until the process is often far advanced and very difficult to repair. It is best to maintain the roads on a daily basis.

What are organic acids? For the most part they are the waste products of metabolism in all organic life, including plants, yeast, fungus, and animals. These chemicals have names like citric acid, carbonic acid, succinic acid, acetic acid, glutamic acid, lactic acid, malic acid, salicylic acid, formic acid, fumaric acid, valeric acid, sulfuric acid, phosphoric acid and prussic acid. Where are these acids found in high amounts? In waste collecting systems, such as the urinary bladder and the fruit of the plant.

Yes, a fruit is the waste collecting system of the plant. In a plant, metabolic waste is accumulated with the seed to be disposed on ripening when the fruit falls off the tree or off the vine. All citrus fruit, including oranges, grapefruit, lemons, limes, tangerines, and nectarines are high in organic acids, especially citric acid. Citric acid is a chelating agent which binds minerals like calcium and magnesium and zinc and prevents them from being available for enzyme function. No person who consumes citric acid in whole foods or in preserved foods or supplements will be optimally healthy.

Coffee, black tea, herbal tea, carbonated beverages, raw apples, peaches, plums, pears, apricots, all berries, all cherries, all grapes, pomegranates, mushrooms, olives, raw tomatoes, apple cider vinegar, balsamic vinegar and fermented foods also have very high concentrations of organic acids. Organic acids are a product of microbial metabolism and plant metabolism, whether the plant is organic or not. The human cell has enough work on its hands in dealing with its own waste, without adding more acid waste from plants or microbes. No person who consumes coffee, black tea, herbal tea, carbonated beverages, fermented foods, foods containing citric acid, or the foods, fruits or their juices listed above will be optimally healthy.

What are the foods and substances that have too much alkali for optimal enzyme function? (Table 2). Sea salt, alkaline water, chocolate bars, baking soda boiled eggs and mouthwash, for example, disturb the pH in the skin, the mouth, the stomach and the colon. Higher alkaline in these places makes the enzymes non-functional. Dental caries, mouth sores, mouth cancer, bad breath, ulcers, inflammatory bowel disease, dry skin, eczema, psoriasis, impetigo, flesh eating bacterial infections and constipation are no longer a mystery. Alterations in local pH destroy enzymes, allow growth of unhealthy microbes and prevent tissue repair in that location. Failure of cells and organs to properly grow and repair is the primary problem in all of dis-ease.

HIGH ALKALI (pH)
Salt Water (7.5 – 8.4)
Alkaline Soap (8 – 10)
Alkaline Water (8 – 11)
Chocolate Bar (8.0) (Organic or Non-Organic)
Baking Soda (8.3)
Boiled Egg (8.7)
Mouthwash (9.9)
Sea Salt (10.0)
Milk of Magnesia (10.5)
Tums (10.5)

Table 2

It has long been debated: Does disease lead to an enzyme deficit, or does an enzyme deficit lead to disease? Understanding basic science makes the answer clear: **an enzyme deficit leads to sickness and disease**. To be optimally healthy, a person will eat and live in such a way as to support a surplus of enzymes, which starts with not destroying them in the first place. This includes eating a diet that is low in calories, low in acid and low in alkali. Living for optimal health will include moderate physical activity to support strong lungs and a strong heart, which supports better oxygen delivery to cells. It will include strong muscles, maintained by using one's own body weight and gravity. Strong muscles will support strong bones. A person who is optimally healthy does not smoke and drinks no alcohol in any form. Aldol in alcohol destroys enzymes, far outweighing any antioxidant benefit.

A person who is optimally healthy will limit exposure to television, internet, radio, Smartphones and IPhones, etc. which requires enzymes to process upwards of 200,000 chaotic thoughts every day. A person who is optimally healthy will find ways to relax or to mediate, which slows the movement of the mind and reduces the number of thoughts that are processed on a daily basis. Except in an emergency situation, a person who is optimally healthy does not take antibiotics, antivirals or antifungals, instead finding a way to eliminate bacterial, viral and fungal growth factors. A person who is optimally healthy avoids food that has preservatives, dyes, hormones and antibiotics and prefers home cooked meals. A person who is optimally healthy understands that cells are not made of herbs or pharmaceutical drugs and that vitamins and minerals and hormones participate

in cell function, but take a back seat to enzymes driving the machine. Where there is a hormone, neurotransmitter, vitamin or mineral deficiency, there is an enzyme deficit. The cart cannot go before the horse. Vitamins and minerals and hormones participate in the manufacturing process. Without enzymes, however, all these things become debris on the factory floor. Cells, clogged and congested with debris, do not work.

This information may seem contrary to popular wisdom and somewhat overwhelming. However, it is a presentation of basic science, painstakingly discovered over the past 600 years. Basic science knows the chemistry required to keep cells functioning at maximum efficiency and the primary role enzymes play in cell organization and function. Basic science knows what keeps enzymes doing their best at the speed of light. Apply basic science principles and create an enzyme surplus, paving the way to optimal health, even if it is just one change at a time. The cells will be grateful. And the reward, priceless!

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