GLUTATHIONE

KING OF THE MASTER MOLECULES OF HEALTH

W.D Greenman, Ph.D.

Click here now to order the full book:

In Praise Of Glutathione

Immune depressed individuals have lower Glutathione (GSH) concentrations. Healthy people also drop their Glutathione levels when fighting disease. Lymphocytes, cells vital for your immune response, depend on GSH for their proper function and replication.
Immunology 1987

Glutathione is your cells own major antioxidant. Maintaining elevated glutathione levels aids the body's natural antioxidant function.
Biochemical Pharmacology 1994

It is well known that aging is accompanied by a precipitous fall in Glutathione levels. Lower Glutathione levels are implicated in many diseases associated with aging....
Journal of Clinical Epidemiology 1994

Raised glutathione levels fight the oxidation of circulating fats in the bloodstream, including cholesterol, retarding the process of plaque formation in the arteries...
Nutrition Reviews 1996

Your life depends on Glutathione. Without it, your cells would disintegrate from unrestrained oxidation, your body would have little resistance to bacteria, viruses…and your liver would shrivel up from the eventual accumulation of toxins.
Glutathione: Essential Health AID - Antioxidant. Immune Booster. Detoxifier
Dr. Jimmy Gutman, M.D., FACEP

Glutathione (GSH) deficiency contributes to oxidative stress and therefore appears to play a key role in the pathology of many diseases…
Glutathione In Health And Disease
Dr. Patricia Kongshavn, MSC, Ph.D. 2005

Antioxidants are well documented and known to possess vital

roles in health maintenance and disease prevention. No other antioxidant is as important to overall health as Glutathione. Glutathione is important in DNA synthesis and repair, detoxification, enhancement of the immune system, and protection from oxidation...it is the regenerator of immune cells...
The Immune System Cure,
Lorna R. Vanderhaeghe & Patrick J.D. Bouic, Ph.D.

Without glutathione, other important antioxidants such as vitamins C and E cannot do their job adequately to protect your body against disease.
Breakthrough in Cell Defense
Allan Somersall, Ph.D., M.D., and Gustavo Bounous, M.D. FRCS(C)

Glutathione has potent anti-viral properties - if you raise the Glutathione level you can stop the replication of most any... intracellular pathogen...but Glutathione deficiency produces a pro-viral effect.
Paul Cheney, MD

Glutathione circulates constantly throughout your body neutralizing free radicals and removing dangerous waste products and toxins from your system while increasing your level of energy. When your Glutathione level is high, your overall health is high. You feel good and you look good. You fight off minor illnesses quickly, you have plenty of energy, and you feel mentally and physically alert... you're at an optimal level of good health.
Alan Pressman, DC, Phd, CCN

GSH (Glutathione) is the unsung antioxidant…the one that makes all the others work.
Robert C. Atkins, MD, Founder of The Atkins Center

GLUTATHIONE

King Of The Master Molecules
Of Health

A REFERENCE GUIDE

William D. Greenman, PhD

GLUTATHIONE

King of The Master Molecules Of Health

International Standard Book Number: 978-0-9721373-5-5
Published in the USA by Flying Elefantz, Inc.

The information in this book is rendered for educational purposes only and is not intended to provide medical or other health care advice or to take the place of advice given by your personal healthcare professionals. The reader is advised to consult his or her own physicians or healthcare professionals regarding the treatment of his or her health issues. Neither the author nor the publisher takes any responsibility for any consequences of the actions of the reader concerning any treatment in regard to the enclosed subject matter. If you are on medications, please consult your healthcare professional before using any nutritional product or supplement.

For additional copies of this book or other publications, in either printed or digital downloadable form, please contact us at:

flying elefantz, inc.
ALL THINGS ARE POSSIBLE

PO Box 680161 Franklin TN 37068
Admin@fegroup.tech

Dedication

To those in the healthcare profession
who live to strengthen the lives
of others.

GLUTATHIONE

King of The Master Molecules Of Health

Please note: The page numbers listed in this TOC are for the complete book and not this portion.

Table of Contents

Introduction

Since the mid 1970's my wife, Meg, and I have been searching for the nutrients that will bring the highest possible health to our bodies, and to everyone we can share that knowledge with. We became the "go to" health nuts for all of our friends and in the process we learned a ton about what's good for you, what's bad for you, and what you can get away with. We learned how the body works and what it produces within itself to be sure it keeps working. It's those endogenous (made by the body) items that most attracted me. We personally felt and confirmed that if we could get our bodies to make the very things they needed most, because they produced them, we'd have a great chance at good health and long life. Over four decades later – it's still working very well!

There is a handful of what I call *Master Molecules* made by the body to build and sustain these multi-faceted and fascinating physical machines in which we live and their synergism is truly astounding. Personally, I believe God created our bodies and has revealed the nutrients, lifestyles, and modalities that lead to optimal health – we just have to look for them. My quest continues to be to find as many of those as I possibly can and then share them with you. My search has brought me to arguably the most important molecule of all.

In this book I will focus on what I believe is the *Master* of the Master Molecules. It is the #1 *Guardian* of our physical selves. It is a true *King* that takes part in opening virtually every door of our health and wellness.

It touches every cell, organ, gland, and system with its spectacular power. This *King* is *Glutathione* and it will amaze you with its ability to do so many wonderful things for your health and well-being. You've always had it within you, keeping you alive and well. It's guarded you, energized you, fought for you, and dreamt with you. It has been a loyal friend since the moment you were conceived, keeping watch over you 24 hours a day. In fact it even protected both the sperm and egg that lead up to your conception.

I'm so glad to share this concise explanation of some of the things that Glutathione can do for you. The research articles, books, and blogs on this subject are myriad and you will have quite a time wading through it all. This is not an exhaustive study, but it will give you a great foundation to build upon. You won't look at your body or this powerful molecule the same way again.

And yes, I will be sharing how you can be sure to get all of the Glutathione you need. Enjoy the book and live your life in optimal health!

How To Use This Book

This is a reference book and is not sequential in its lay-out. You can read it cover to cover, but that is not its intended design. Please refer to the following before be-ginning your reading.

- Familiarize yourself with the **Table of Contents** so you know exactly what chapter holds the in-formation you might need for quick reference.

- You will find **redundancy** throughout, as I did not assume the reader would go cover to cover. I included the same information several times in different chapters for easier understanding with-out having to look through the entire book to discover the meaning of a word or phrase in each specific context.

- Another redundancy is the capitalization of the word Glutathione. While this is not necessary and is grammatically taboo, I wanted to make it easier for the reader to find direct references to this subject on any page as easily as possible.

- You will find very few direct references to spe-cific diseases in this book, though some of the books listed in the Reference section are replete with them. My philosophy is that if you will focus on the things that bring you life, such as the nutrients you are made of, and proper lifestyle

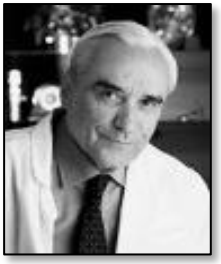
disciplines, your health will improve and stay strong. You will find this especially true with Glutathione. However, I do acknowledge the need for understanding Glutathione's role - its abundance or lack - where disease is concerned and I encourage the reader to study such.

- The research articles listed in the **Appendix** and **References** are included for the reader's ease of personal study, though are not intended as exhaustive listings. The majority of those listed con-tributed to my research for the writing of this book.

Acknowledgements

The Molecule Makers

Any book on Glutathione must include some space on the following three men. They are the preeminent pioneers in the formulating of Glutathione (GSH) supplements and each of them is responsible for helping untold thou-sands obtain better health through their discoveries. I will take time to discuss their formulas later in this book, but I will reference their names several other times so I wanted to be sure you knew who they were. I list them here in the order of their discoveries and will later discuss the various products they subsequently brought to market.



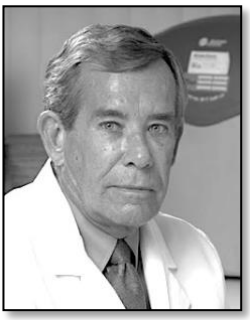
Dr. Gustavo Bounous

The late Dr. Bounous was educated at the University of Turin and the University of Genoa, Italy. He became a highly respected authority on the problems of nutrient absorption in disease and trauma. Dr. Bounous emigrated from Italy to the U.S. in the 1950's and his distinguished career in medical research began as a Research Fellow in surgery at the Indiana Medical Cen-ter, Indianapolis. This led to his appointment as Professor of Surgery, first at the University of Sherbrooke (1973-1985) and then at McGill University in Montreal,

Canada (1985-1993).

Dr. Bounous made a breakthrough in the treatment of hemorrhagic shock. This work earned him the 1965 Medal of the Royal College of Physicians and Surgeons of Canada. It also led him to develop the science of enteral nutrition and the invention of the "elemental diet," used in the prophylaxis and treatment of intestinal lesions associated with shock, intestinal ischemia, radiation, cancer chemotherapy, and Crohn's disease, now used in hospitals throughout the world.

In 1968, Dr. Bounous was named Career Investigator of the Medical Research Council, an award that was reconfirmed until 1993, the year of his retirement from McGill University. His discoveries in the area of Glutathione research were awarded with several patents.



Dr. Robert Keller

The late Dr. Keller was triple board certified in Internal Medi-cine, Immunology, and Hematology. He served on the scientific review panels for the National Institutes of Health and the United States Veterans Administration.

Dr. Keller also served on the faculties of the Mayo Graduate School of Medicine, the University of Wisconsin, and the Medical College of Wisconsin (Marquette Univ.) He published more than 100 original articles in various scientific and medical journals and

was awarded several patents. Additionally, Dr. Keller was elected to The Board of Governors of the American Academy of HIV Medicine. Fellow and Senior Research Fellow in Immunology, Mayo Clinic Foundation, Mayo Graduate School of Medicine Rochester, Minnesota.

Just a small portion of the awards he received included: the Consumers' Research Council named him one of America's Top Physicians in 2003, 2004, 2005, 2006, and 2007 in all three of his certified fields. He was also named as one of the top 2000 scientists of the 21st Century and one of the top 1000 Great Americans of the 21st Century, Humanitarian of the Year National Hemophilia Foundation, Who's Who in Medicine and Science, Who's Who in Science and Technology, and the VA Career Development Award, Clinical Investigator.

Dr. Herbert Nagasawa

Dr. Nagasawa received his B.S. degree in chemistry from Western Reserve University (Case-Western Reserve) in Cleveland, Ohio, and a Ph.D. degree in organic chemistry from the University of Minnesota. Subsequently, he spent two years as a Post-doctoral Fellow in biochemistry at the University of Minnesota before joining the research staff of the Veterans Administration Medical Center (VAMC) in Minneapolis as a Senior Chemist. He was appointed Assistant Professor of Medicinal Chemistry at the

University of Minnesota in 1959. He was named Principal Scientist of the VAMC in 1961 and was promoted in 1976 to Senior Research Career Scientist, a nationwide VA title reserved for the VA's top scientists. He was promoted to Associate Professor in 1963 and to Professor of Medicinal Chemistry in 1973.

Dr. Nagasawa also held joint professorships in the Department of Pharmacology and the university-wide Division of Toxicology, and served as Visiting Professor at Washington State University in 1990. He also served for 32 years as a Senior Editor for the prestigious international *Journal of Medicinal Chemistry* from 1972 to 2004, and one year as Acting Editor-in-Chief. In addition, he served on the Editorial Board of the journal, *Bioconjugate Chemistry* for eight years, and as an ad hoc grant reviewer for the NCI and NIAAA, National Institutes of Health. He has published over 165 papers in peer-reviewed journals. In June of 2010, Dr. Nagasawa and his team attended the National Institutes of Health-Homeland Security 4th Annual Countermeasures Against Chemical Threats Network Symposium to present their work on their 3 minute cyanide poison antidote. These same institutions honored him with a banquet in Washington DC for that antidote.

While I have only personally met Dr. Nagasawa, I had the privilege of learning about Dr. Bounous and Dr. Keller not long after each of their discoveries came to market in the form of nutritional supplements – though their products were decades apart. It is an honor for me to share some of their history with you here and their

groundbreaking discoveries in Chapter 11.

Addendum

In addition to the expertise of these three eminent scientists, there is now enjoined a growing pool of elite researchers in the area of Glutathione. These men and women, on a global scale, have discovered another powerful way to help us all ingest and utilize this King of the Master Molecules of Health. The number one way is not actually new, but new in its application to GSH. That process is an ancient one now vastly improved by the science of our day. It is called fermentation and we will discuss that process in later chapters and a specific formula that best utilizes that process and adds an abundance of cofactors to it for optimal benefit.

Chapter 1

The King

Butler/Trainer/Bodyguard

What would you be willing to pay me if you knew I could help you strengthen your body, clear your mind, and lengthen your life? How about if I also cleaned your furniture? What if I also kept bugs, flies, spiders, mosquitoes, and even violent criminals and thieves from harming you? And what if I also could keep your home spotless 24 hours a day? And what if I did all of this in stealth mode, so you never even knew I was there doing it all? What would you be willing to pay me? Would any price be too much?

Bad news: I can't do any of that for you. Good news: I know what can (for your body) and you already possess it. In fact you've had it with you since you were conceived and it's been working like that for you ever since. In stealth mode. Every day. All day. Its name is Glutathione (pronounced glue-ta-thigh-own) and every cell in your body produces it around the clock.

It's one of the very few substances our body produces that ties together every aspect of human health. It cleans our cells

and organs, destroys harmful substances, strengthens our immune system, assists every system within us, and can even lengthen our lives if we can gain enough of it. I believe it's the most significant discovery for our health and well being yet – greater than anything we can produce from any food or chemical. In fact, without it we cannot live.

In The Spotlight

Glutathione, or GSH, was discovered more than a century ago and has become one the most highly researched items in biochemistry, with ever-increasing numbers of studies being done around the world. Presently, as of this writing, there are more that 159,000 research articles related to Glutathione and its activities in the body on www.pubmed.gov, which is the National Institutes of Health's research library site. This is an increase of over 50,000 articles in the last 10 years and more are being added almost every day from around the world. Glutathione has garnered this interest due to its universal need by every aspect of the human body.

Those multiplied thousands of studies have proven that Glutathione functions in many diverse ways in the body, protecting us from the ravages of our increasingly toxic environment, our own poor food choices, and unexpected life events. Here are some of those functions, many of which we will discuss in more detail in later chapters:

- Glutathione's primary function is that of helping each individual cell produce maximum energy for optimal health and function of every organ, gland, and system of the body.
- Glutathione is the most powerful of all known antioxidants.
- Glutathione helps to regenerate other antioxidants

that also halt oxidative stress.

- Glutathione facilitates the transfer of proteins between cells and also between the myriads of sections within each cell.
- Glutathione acts as an anti-toxin and is also effect-tive in detoxifying such elements as heavy metals and other pollutants found in our foods, air, and water, which are detrimental to the health of our cells.
- Glutathione activates very specific immune system cells that act as the first wave of defense against all substances and living organisms that could harm our cells, then also protects those same defensive cells from being changed into enemy cells themselves.
- Glutathione is a promoter of efficient production of blood and facilitates better blood flow.
- Glutathione has a positive affect on our sleep, mental capacity, and overall quality of life.
- Glutathione strengthens our organs and greatly improves our life span.

More Evidence

A considerable number of research studies demonstrate that Glutathione is vitally important to both our quality of life and our longevity. Reviewing this list of conditions may give you a deeper appreciation for all Glutathione does to preserve and support our health.

- Increased Glutathione is always linked to an in-crease of ATP production. This is a mandatory activity for optimal physical and/or mental activity. (We will discuss ATP at length in Chapter 3.)
- Lowering of Glutathione is always linked to a de-crease of ATP. This lack of ATP production is usually

found in those with sedentary, (inactive) lifestyles.

- Glutathione levels continually decrease as we grow older.
- Glutathione is always found in greater quantity in healthy people compared to those who are sick, regardless of their age.
- Glutathione is also found in greater quantities in those people who live to 100 than in any other age group, with the exception of those who are healthy and in their 20's to 30's.
- Restricting the amount of calories (eating less) is correlated with increased levels of Glutathione.

Glutathione (GSH) is one of the most important and researched substances found in all cells of the human body. As mentioned, that research can be accessed by anyone through the Internet 24 hours a day and the findings of many of those research studies form the basis for much of what you will read in this book. However, my desire is not just to educate you on the glories of Glutathione or simply to change the way you think. Instead, **I want to give you a plan of action** for utilizing what you learn about this wonderful molecule and tell you how to help your body create as much of it as possible.

Many health care professionals are now coming to appreciate the undeniable link between vibrant *cell* health and therefore overall body health. The volumes of research mentioned above prove the effects of Glutathione on increasing the human lifespan and the quality of that life. For many years Glutathione has been a consistent and widely accepted indicator of health when tested from our blood.

High Glutathione levels indicate strong life and low levels point toward a body whose health is deeply im-paired. Such understanding has caused countless physiccians to embrace

Glutathione as a viable help for their patients. While it should *not* be seen as a silver bullet to cure all that ails us, research has shown it to be a very powerful part of the health and healing process. Unfortunately, as we shall see, Glutathione therapy has been mostly unreliable. But that has changed dramatically in the past decade, allowing health care professionals to find great help for their patients in many areas, beyond treating symptoms with toxic medications or invasive surgeries. Here are just a few of those areas you might like to study for yourself and some we will discuss in depth in other chapters:

- Blood Sugar
- Digestion
- Fatigue
- Vision
- Circulation
- Hearing
- Inflammation
- Kidney
- Liver
- Respiratory
- Neurological
- Pancreas
- Prostate
- Skin

Throughout this book we will look at the plethora of research concerning Glutathione covering the most prevalent issues we deal with on a daily basis as humans in today's world. But before we do I want to share with you the amazing ways Glutathione touches every aspect of our body's many and varied functions. There is nothing else like it in the body and that is why **I believe Glutathione is truly**

the King of the Master Molecules for vibrant health.

Non-Identical Twins

Glutathione is usually abbreviated in scientific terms as GSH and GSSG. Throughout the proceeding chapters I will use these abbreviations quite often. GSH is the antioxidant form of Glutathione. When we are young we find that about 90 percent of our Glutathione exists as GSH in our cells. When an antioxidant has all its electrons in place, such as GSH, it is said to be in a *reduced* state. When all its avail-able electrons have been given away, it is said to be in an *oxidized* state. It is the GSH or reduced-state molecule that is the main focus of our discussion in this book.

GSSG is the oxidized form of Glutathione. It is changed chemically by giving up electrons to neutralize free radicals and to revitalize other antioxidants. These two forms work synergistically throughout the body.

If too much Glutathione is in GSSG form - the oxidized state - enzymes are produced and activated to regenerate the antioxidant GSH form. This is a common occurrence in the liver, which is the organ with the highest per-cell concentration of Glutathione. When we are healthy the ratio between GSH and GSSG is 90%/10% respectively. Our cells become compromised, and disease can set in when these ratios change. **When our GSH levels fall below 70% there are big problems on the way for those cells or organs.**

However, if our GSH is simply working on our own normal metabolism its levels can continually stay in the correct range because GSH can continually "regenerate" or regain its missing electrons. But if the Glutathione is constantly used to eliminate toxins such as chemicals, heavy metals, or to shut down oxidative agents caused by such things as stress or injuries until its capacity to regenerate is gone, it becomes GSSG, which cannot regenerate itself. That's

a problem.

Cousins

There are several other kinds of Glutathione in the body. Two of the most helpful cousins are Glutathione S-transferase and Glutathione Peroxidase. They work synergistically with GSH in several meaningful ways.

Glutathione S-transferase

Glutathione S-transferase enzymes (GSTs) spark and speed up the joining of reduced Glutathione (GSH) to a wide variety of toxic molecules, such as heavy metals. This action also detoxifies compounds such as oxidized fats, as well as facilitates the breakdown of toxins. GSTs may also function to transport proteins (including GSH if the cell has too much) and unwanted substances *out* of the cells for elimination from the body.

Glutathione Peroxidase

Glutathione Peroxidase is the name given to a family of enzymes. The main role of these enzymes is to protect our cells from oxidative damage, in particular the reduction of hydroperoxides into specific alcohols. It is also used to dismantle hydrogen peroxide into harmless water molecules. So far, eight different forms of Glutathione Peroxidase have been identified in our bodies and their varying forms can be found in nearly every cell at differing levels. Some are found specifically in the intestines and others only in plasma.

In Summary:

A strong presence of Glutathione is essential for vibrant health. Glutathione is a mandatory part of the body's energy production within our cells. Glutathione is needed in order

to keep inflammation and waste build up from causing damage. It has several forms; the two most common are GSH, which is Glutathione with electrons to give, and GSSG, which has no electrons to give. Its cousin enzymes are Glutathione S-transferase, which transfers excess GSH out of the cells and into the blood stream, and Glutathione Peroxidase, which helps neutralize hydrogen peroxide in our bodies.

The ability of Glutathione to do so many different functions in the body qualifies it as the King of Molecules for Health. Making sure we have plenty of it is the first step to enlisting the King's services. To do that we will first discover what it's made of, where it's made, and exactly how it works in every aspect of our body.

Chapter 2

Glutathione: What – Where – How

What It Is

Glutathione is a tripeptide. In other words it is a protein-like compound of three very specific amino acids called glycine, glutamic acid (glutamate), and cysteine. Cysteine is by far the most important as it is the primary building block of the Glutathione molecule. And of the three acids cysteine is the most difficult to get into our bodies through our diets in the proper amounts for optimal Glutathione production.

Cysteine has the ability to actually put a limit on the amount of Glutathione a cell will produce. This limiting factor is not found in the other 2 acids. If our cellular levels of cysteine are too low and we cannot get it through our food intake we should be doing so with nutritional supplements. (More on that later in this book.)

These three amino acids must be presented to our cells in the exact proportions needed for the cells to make Glutathione. If any one of these three is missing or in the wrong

proportion the body must then manufacture that missing component (at its own expense of energy and materials) or go without. This creates one of two problems: either we will then have a diminished supply of Glutathione because we have too little of the right materials to make it; or we will deplete other parts of our body of these nutrients as our cells take them up to make Glutathione. As we will see in later chapters, neither decreased stores nor low production of Glutathione bode well for our health.

Where Glutathione Comes From

Glutathione is made within all 70+ trillion of our cells and is also found in all living creatures, including animals, plants, and microorganisms. Its universal presence among such diverse living organisms displays its vital importance to vibrant life. Glutathione is water-soluble, so therefore it's found mainly in the water containing parts of the body. This would specifically include the cytosolic compartment of every cell. Let me explain its function in that compartment.

Glutathione is found and produced inside the cytosol of every cell of our bodies. It is in the cytosol that the major-ity of metabolic processes take place. These would include bringing nutrients into the cell and expelling the waste from the cell. Glutathione is found in the cytosol as a *guardian* of those metabolic processes. This important work requires the amount of Glutathione to be highly regulated, both inside and outside every cell.

If the amount of Glutathione in the cytosol declines at any time a signal is automatically released to the cells to produce enzymes that create more Glutathione. But if too much GSH is accumulating within the cell, another specific enzyme will be made to transport excess GSH out of the cell and into the blood.

The liver and spleen have the highest concentration per

cell of Glutathione. The liver provides itself with sufficient Glutathione to function as our most powerful detoxifier. It will also export excess Glutathione to perform its many different tasks of cleaning up, protecting, and detoxifying cells.

Taking Glutathione

Glutathione is an extremely large molecule. Many studies have shown that while we can ingest Glutathione in a pill or liquid form, or even inject it into our blood stream intravenously, very little, if any of it, will make it into our cells and so it will have a nominal effect. Crudely put, due to the size of the molecule it cannot slide through the multitude of microscopic holes in the cell membrane. It would be like trying to put your fist through a buttonhole – it simply cannot happen.

More accurately, there are no mechanisms inside the cell to draw Glutathione in, as there are for nutrients and water. Also, the vast majority of Glutathione molecules when taken in pill or liquid forms will never make it through the digestive system, for as with all proteins they will be quickly broken down into their several component amino acids. However, this problem has been solved by the science of very specific fermentation discovered in the mid 2010's.

This process has been a major breakthrough in the area of Glutathione supplementation. While I won't go into the specifics of any company or product here, I do recommend specific Glutathione-building supplements. One particular product, due to its innovative formula, brings 2 types of Glutathione directly into the bloodstream and also delivers precursors (raw materials) for every cell to draw into itself and turn into the Glutathione compound for the cells to use. We will discuss the special formula that utilizes this process with excellent results in Chapter 11.

God meant the body to have enough of this precious

Glutathione protein for us to have a long and healthy life. Unfortunately, this just doesn't happen for most people today due to inadequate nutrition, and the effects can be devastating. But there is hope.

How Glutathione Works

The human body is an amazing machine that operates simultaneously on three distinct levels – chemical, mechanical, and electrical. All three are intricately woven together and function as one unit, though their functions are completely different. Glutathione is one of the few substances vital to the function of the body on all three of these distinct levels. Without Glutathione we cannot exist. The less we have the less vitality we have.

There is no substitute for Glutathione and there is nothing that can match its abilities. Let's take a look at these three elements of the human physiology and how they synergistically work together – all with the help of mighty Glutathione.

Chemical

The chemical aspects of our bodies have to do with the vitamins, minerals, enzymes, hormones, our very blood itself, and other substances within us. All work together in a symphony of reactions and activity that releases energy and allows and creates growth in the building of our every cell. Our organs, such as the liver and pancreas, rely on the constant flow of chemical substances to make the proper enzymes and other digestive and detoxifying substances that allow us to assimilate our food and cleanse our bodies from the inside out. Our blood is constantly delivering oxygen and removing carbon dioxide in the magnificent process of breathing, coupled with the beating of our hearts. Even our brains are bathed in specific hormonal chemicals that create specific moods and emotions – actually transcending the

physical as it moves us into the emotional.

We may not understand how the chemical factory is working, but we can certainly feel the affects. We definitely feel the stomach acid in our throats if we have acid reflux, the surge of strength and alertness from adrenalin in a fearful or dangerous situation, or joy from the release of endorphins when we exercise or hug someone we love. We may not know which ones are at work or how the chemicals come together to form tears or sweat - but we do experience them. We don't think about or even have to think about the chemical reactions in our mouths that begin the digestive process of our food, but it happens. We are undeniably awash in a sea of chemicals every moment of our lives.

Not all chemicals are created equal in the body, however. We all know people who are seriously imbalanced in their chemical makeup, yet who live full lives. There are also those who due to such imbalances are living lives of physical, mental, and emotional suffering. The human body can withstand a tremendous lack of the proper nutrients needed to bring the proper chemicals into the cells and survive. Junk food – what I call "fake food" – has wreaked havoc on the health of millions of people in all age groups, helping to drive obesity and diabetes to epidemic proportions. And yet the amazing chemical factory within us continues to adjust, cleanse, and neutralize the unwanted substances – such as additives, preservatives, and pesticides – in a heroic, though sometimes impossible effort to keep us alive.

Mechanical

The mechanical aspect of the human body refers to our skeletal structure, our muscles, and our organs. It is these parts of our body that perform many of the vital functions within us, help us to move about, and allow us to be

physically active. We are more in tune with this part of our physical being than the other two because we can see it, feel it, feel with it, and otherwise experience it throughout our daily lives. When we reach for a glass to fill with water for a drink, or sit, stand, walk, or run we feel and engage the many mechanical parts of us. We experience it when we drive our car, mow the lawn, write a letter, or throw a ball. It is not always a conscious effort on our part to experience the mechanical – it simply *is* a part of almost every one of our experiences.

The mechanical aspect of our bodies – in its simplest form of muscle and bone, ligaments, and tendons – is not completely necessary for life to continue. There are millions of people who become paralyzed to some extent or another, yet who live on. Even complete quadriplegics can survive with much help from loved ones, care givers, and often machines to assist with breathing, without any use of their mechanical systems. Amputees likewise have become award-winning athletes in the absence of body parts. Again, the body's ability to survive is astounding. Our Creator truly made us wonderfully.

Electrical

Most of us have never thought of ourselves as electrical beings, making this probably the least understood of the three parts of the human physiology. And yet it is this aspect of the body that is perhaps the most vital. Every cell in our bodies – be it a chemical cell or one of the trillions of the mechanical cells – is alive with electricity. We call such electrical charges protons (positively charged) and electrons (negatively charged). Our nervous system, along with the meridian system, makes up the intricately woven power grid through which our electrical currents run to every cell we have. It is the presence of our internal electricity and

electrical system that allows every cell, every organ, and every system to function. Take away the electrical and everything stops.

Computers are amazing machines that can do thousands of cyphers in the blink of an eye. But if you unplug a computer from the power source - be it a battery pack or a wall socket - it stops instantly. Flip the switch on the wall and the light stops lighting the room. Turn the key off in your car and the engine dies instantly. Why? No electricity – no power. Our bodies are exactly the same. We can live with bad chemicals and broken mechanicals – but we cannot live without electricity coursing though our cells.

It is electricity that causes your heart to beat for decades without you ever having to think about it. It is electricity that causes the brain to send an electric signal through the nervous system to tell the muscles in your arm to pick up the pencil you just dropped on the floor. These *electrical* impulses spark a series of *chemical* reactions within the *mechanical* tendons, muscles and bones to do what the brain has ordered. All this happens at the speed of light! The electrical ignites the chemical and the mechanical almost simultaneously. We are not aware of it. We don't feel it. We simply are electric.

Glutathione X 3

Glutathione runs effortlessly through all three aspects of the human body. It is simultaneously involved in the electrical, the chemical, and therefore the mechanical parts of us.

- In the midst of the chemical ocean within us Glutathione is produced from several chemically based ingredients.
- The amount of Glutathione we produce will

directly or indirectly affect almost every chemical action and reaction in our bodies.

- Glutathione assists in cleansing muscles and organs of unwanted waste.
- Glutathione can eliminate harmful substances from, and thereby strengthen, every organ, gland, and tissue.
- Electrically, Glutathione constantly exchanges electrons with both good and bad molecules, acting as both a skilled defender and a master builder.

Simply put, Glutathione facilitates energy production for the mechanical to use for movement, chemical reactions to be initiated and completed, and of course other electrical events needed in the body. It continually and safely changes the chemical makeup of the cells around it as it releases its electrons. Glutathione stands alone as the one molecule that can take a vital part in the defending, healing, protecting, and building aspects of our physical bodies - all at the same time. It does so at the electrical, chemical, and mechanical levels with precision as a true King of vibrant health in the body.

No Lone Ranger

But Glutathione never acts alone. It has the ability to join itself with other nutrients and compounds to form much more complex compounds that have a vast array of effects. It is Glutathione's compounding ability that makes it so vital in serving so many different functions with so many positive and needed results. Here are more ways in which Glutathione sets itself apart as a most unique and wonderful molecule:

- Helps with DNA synthesis and repair
- Helps with Protein synthesis
- Is a super nutrient for the feeding and health of our Immune System
- Assists in the function of important enzymes
- Oxygenates our blood

And even beyond these points Glutathione displays itself as vital to human function at every level.

In Summary:

Glutathione is made in every cell in our body from three amino acids - glycine, cysteine, and glutamic acid or glutamate. Its main function is to give its electrons away to other molecules in need and will continually regenerate its electrons. Glutathione's ability to fill a vital role in the chemical, mechanical, and electrical functions of our bodies makes it unique and further establishes it as vital to vibrant health. Now let's take a look at the role of Glutathione in energy production.

Click here now to order the full book:

Chapter 3

The Energy King

The Source of Our Energy

If I asked you what your source of energy is you might say food, water, your heart, exercise, or even God. All would be partially correct, but they are not the specific origin. The source I'm speaking of is found in every one of your cells, in microscopic energy factories called Mitochondria. There can be thousands of these factories in a single cell and all are very fragile – needing the protection of Glutathione.

Nutrients from our food are taken into the mitochondria factories for conversion to energy. Changing the nutrients into energy requires the presence of oxygen. It is this oxygen that is the main culprit in releasing damaging waste molecules after the energy is used or burned. Glutathione is present to neutralize or clean up the waste. Interestingly, it is the presence of Glutathione that both causes the burning to take place and also protects our cells from their fiercest attackers – free radical oxidizers – the waste molecules created by the burning of cellular fuel. Sound confusing? Let me explain.

Energizer!

Once Glutathione has been created in the human cell, many things begin to take place. First and foremost is the production of ATP within the cell. ATP is Adenosine Tri-phosphate – the energy source created by the mitochondria from the nutrients we ingest, with the aid of oxygen. Simply put, the more ATP a cell generates the more energy that cell has to work with. The more energy it has the stronger it is. As individual cells in-crease their energy levels, every organ, gland, and system likewise increase their energy and therefore function better. Better quality of life ensues.

But therein lies the problem mentioned above. As ATP is burned for energy there is heat given off and waste left over, as with anything consumed as fuel. These two aspects of that process can cause damage to the very cells that create and use the ATP. Glutathione – created in the cell with ATP – has the unique ability to both put out the fire and remove the waste before they can damage the cell. GSH is at once water and broom!

Inflammation is kept in check by Glutathione's "fire extinguisher" activity. Less inflammation means less pain and less disease. The Glutathione broom neutralizes and sweeps away damaging free radical molecules, which are the root of all inflammation.

The Tag Team

ATP is needed for the production of GSH and GSH takes part in the release of the energy within ATP. It is the delicate balance between these two that allows ATP to safely burn as fuel, in addition to the antioxidant and other activities of Glutathione. **If you raise your cellular levels of ATP, which can be done artificially, your Glutathione production will *not* rise with it. However, if you can raise your**

Glutathione levels within your cells, those cells instinctively know that they can then make and use more ATP for more energy, because the Glutathione will stop the free radical activity and stop any inflammation.

If ATP and Glutathione fall out of this balance due to trauma, toxins, aging, or other oxidative stress-causing issues, then disease states can be established. Unfortunately, as we age the ability of our cells to produce Glutathione decreases, which lowers ATP utilization. This is why older people tend to get sleepy and tired in the afternoons. It's also one of the reasons why aging usually brings on more disease states – there is less energy and less Glutathione to keep down oxidative stress.

This is why it's not a good idea to take an ATP supplement by itself. If you ingest ATP as a supplement, you will tip the scales *against* Glutathione and it will not be able to adequately handle the waste and free radical activity. Yes, your energy will increase, but it will come at a high price if you keep up such supplementation for very long.

However, if we can raise our Glutathione levels by supplying our cells with the correct formula of nutrients, or bioavailable Glutathione itself, then our cells will produce enough ATP to meet the new Glutathione levels. So, the best thing you can do for increased energy is not to supply more ATP, but to supply more Glutathione because you will release the energy in a safe manner.

Energy

If you raise the energy of every cell, the energy available to every organ and every aspect of every system will automatically be raised. If your organs and systems have more energy, then your overall health must increase. Now add to that the fact that Glutathione is the *Master Antioxidant* – ridding the body of free radicals and the oxidative

stress they create, plus the fact that it is also the *Master Detoxifier* removing poisons and heavy metals from our tissues – and you have a three stranded cord for vibrant health that cannot easily be broken. I'll go into more detail on each of these in later chapters.

There are multiple steps in the cellular production of Glutathione, which of course has a direct effect on ATP production. Each step requires a specific enzyme that is used to transfer energy from ATP to the newly forming Glutathione molecule. The new Glutathione molecule then takes that energy and distributes it as needed through its various functions, such as neutralizing free radicals and bonding to toxins.

Clarity

All athletes know that there are two mind games going on in a sports competition. It is for these mind games that raising your GSH levels comes into play once again. The first game is what goes on inside *your* head. Are you clear and confident? Are all your synapses firing at optimal levels so you can think with the speed of light and make the right decision and make the right moves to win?

The second game is about what you cause to go on inside your *opponent's* head. Interestingly the second game is greatly dependent on the success of your first game. You will project your confidence or lack of it into the thought processes of your opponent by your eyes, your focus, your demeanor, your words – all stemming from your clear or cloudy mind. You can see in an athlete's eyes if they are focused and clear. Watch any sport on TV and you will see this clarity and focus in the eyes of all champions.

When your energy levels are at their best your brain has what it needs to fire the synapses and bring you everything you mentally need to succeed. Free radicals, inflammation

and oxidative stress are taken out of the equation. Toxins are removed. Thoughts flow freely. This is a very common occurrence for those elevating their Glutathione levels. For the athlete and for us all, that is imperative.

When body and mind are coordinated, breaking world records doesn't seem so hard. For the rest of us who are not world-class athletes this mind/body equation is just as sweet a benefit when we boost our own GSH levels. Thinking clearly on the job is just as important as doing so in the gym. Moms, dads, grandparents and kids all need this congruency of body and mind for optimal performance.

Recovery

Athletic Performance

As we've seen, the mitochondria are the energy factories of the body and Glutathione is a major controlling factor over how much energy should and can be made. For an athlete this is extremely important. Why? Because energy is the foundation for all that an athlete will accomplish. The more stored and producible energy a body can muster the more it can do and the longer it can do it. Let's take a look at how this process works in the area of athletic performance.

As a natural function of the human cell Glutathione levels dictate the amount of ATP that can be burned because it is responsible for stopping the free radical (waste) activity. The harder an organ or muscle or system of the body works the more energy it will burn. The more energy burned means there are more free radicals (waste molecules) released by the burning process. The greater number of free radicals released into our cells the greater amount of Glutathione is needed to quench them to halt the onset of oxidative stress and inflammation.

Now, when an athlete pushes his or her body to the limits of endurance the mental stress as well as the physical will

always result in high free radical activity. It is extremely difficult for the body to overcome this overwhelming infusion of free radicals into the systems. This creates several common consequences for the athlete.

First, the burning of fuel releases free radicals into the cells that have been stressed by the exercise. This waste product sits in the cells and causes pressure and inflammation if not removed immediately. This pressure and inflammation is the pain felt by every athlete or anyone for that matter who has ever done anything strenuous. How often have we said – "I didn't even know I had muscles there!" – as we struggle to get out of a chair the day after such activity. It's not the muscles – it's the inflammation *in* the muscles.

Glutathione will act as an antioxidant and quench the inflammation caused by free radicals released by the burned fuel. But as a major detoxifying agent it will also work to remove any toxic elements, such as lactic acid, from the cells. If there is enough Glutathione to handle the job the pain will dissipate or never be felt at all. This is what I hear constantly from those athletes and weekend warriors who use the GSH supplement I recommend.

Let me give you a great example from a world champion weightlifter.

More Strength

This is a true story. Bill (not the author) has been lifting weights since he was teenager. When in his late 40's he was introduced to one of the most powerful Glutathione producing supplement of that day. He was skeptical as he was not a fan of supplements for the most part – so his mindset was not a positive one about the supplement actually working for him. However, as he began using the supplement his workouts became less strenuous and he

was recovering much more quickly. He was able to lift more and more weight for longer periods and do so again much sooner than what was normal for him. A month or so after starting on the product he entered a weightlifting event.

Amazingly, during this contest he set 5 consecutive world records for the bench press! His first lift broke the old record. His second, third, fourth and fifth lifts broke each of the records he had just set. And he broke them all in the *same* day – an unheard-of occurrence due to tremendous drain on the body's energy stores by each lift!

Bill stated that he actually was feeling stronger with each lift. There was obviously no placebo effect taking place that day because Bill was not a fan of supplements. Then a few months later Bill broke his previous record for an unprecedented sixth world record bench press!

What gave Bill this ability to go so far beyond his normal routines and shatter those records? How did the increased production of Glutathione help him? Here's a simple equation I believe will help you understand it, and it's one you can apply to any athlete or person who engages in strenuous activities:

More GSH = More E.A.D. = Less pain, faster recovery, more activity!

In other words, increasing your **Glutathione (GSH)** levels will increase your **Energy (E)**, and your **Antioxidant (A)** and **Detoxification (D)** ability to handle any amount of free radicals released in the process. This translates into less pain in the muscles and joints, which means faster recovery from workouts, which means you can work out and compete again sooner, which means you will build more strength and stamina at a faster yet safe rate. That's what happened to Bill and thousands of athletes at all levels

of competition and age groups who have supplemented their nutritional intake with Glutathione producing products. It can happen for you.

In Summary

Energy is the life force within our cells that makes everything work properly and efficiently. More energy means higher function and higher function means more vibrant health. Even in athletic performance we see this amazing molecule act as the true key to more strength and faster recovery.

Glutathione is unique in that it is involved in almost every aspect of the energy cycle. Its presence allows the cells to produce and then burn more ATP inside the mitochondria. GSH will then clean up any waste and reduce any damaging heat from the ATP burning process that gives the cells their energy.

Ironically, the entire energy cycle would create massive inflammation were it not for the powerful antioxidant activity of Glutathione. Our entire next chapter will go into great detail about that one function of this mighty molecule.

Chapter 4

The King & Antioxidant Superpower

"Categorically, and without any equivocation whatsoever, I can tell you that Glutathione is *the* most important endogenous antioxidant there is."

Dr. Herb Nagasawa

The quote above by Dr. Nagasawa – a leading expert in Glutathione research – echoes the voices of many scientists, that Glutathione is arguably the human body's most powerful and important of all antioxidants. In fact, it is the most potent antioxidant known on our planet. I find it profoundly interesting that our Creator placed the most powerfully protective substance needed by our bodies within *every* cell. Not in a fruit. Not in a vegetable. Not in the flesh of an animal. In *us*!

At www.PubMed.com you will find the research data-

base for the *National Institutes of Health US National Library of Medicine*. If you look up studies on uric acid you will find that it is used in the body as the last antioxidant of defense when all others have been exhausted. Dr. Keller righty surmised that if this represents the last line of defense, it begs the questions: “What is the *first* antioxidant used for cellular defense?" and “What is the primary or most important antioxidant in maintaining health and quality of life?” The answers to these vital questions culminated in Dr. Keller’s formula for increased Glutathione production we will discuss in a later chapter.

Antioxidants Part 1

Why Do We Need Antioxidants?

The science of antioxidants begins in the mitochondria found inside each of our cells. As we have already discus-sed, these microscopic power factories produce and burn Adenosine Triphosphate or ATP. ATP, like any other fuel, gives off heat when it is consumed for energy and leaves a waste product - the unburned portion - behind. It is both the heat and the leftover waste that can create serious pro-blems if not taken care of correctly and quickly, thus the need for the presence of Glutathione in every mitochondrial energy factory.

Dr. Keller used the analogy of a fire in a fireplace. It warms you up with its heat and brightens your mood as the flames dance among the logs. In a very real sense, that plea-sant fire is akin to cellular energy production and use. The logs represent the food we eat – it is our fuel. The dancing flames are similar to the movement of multiple electrons linked together like a chain creating our energy. The ashes left over in that fireplace are like the “free radicals” in our

cells, produced by the burning of ATP as fuel for energy.

We worry about sparks from any fire kindling into flame, as they have the ability to cause damage if not contained properly. We always close the screen on the fireplace in our homes so the ashes can't leap out onto the carpet or furniture and cause an entire house to burn to the ground. Now imagine how delightful it would be to have the warmth of the fire and the dance of the flames *without* the annoyance of worrying about sparks or having to clean out the ashes the next morning. To not only have the fire-blocking screen in place, but also an automatic vacuum system to clean up every ash as it is created.

Although this is not a perfect analogy, it is close. Free radicals are created during the energy burning process. If they are turned loose – if we don't put them out and shut the screen – they can wreak havoc on our cells and organs and systems. The damage such free radicals can produce is also known as *Oxidative Stress*.

Just as we snuff out the ashes and close the screen on our storybook fireplace so sparks don't jump out and damage our home, Glutathione's major function is to clean up the free radicals in our cells to prevent them from damaging any adjacent molecules or our entire body. We all need the energy-preserving, ash-consuming "fireplace" attendant known as Glutathione. This protective cleanup process takes place at the electrical level of our bodies but affects everything else at the same time.

We Rust!

We've all seen rust on an old iron pipe or a tin can or tragically on our car. What happened to the nice shiny steel, the perfect paint, or the smooth surface of that pipe, can, or car? How did it become rough, flaky and in need of repair or disposal? Maybe you've asked the question, "*Why did my old*

pickup truck leave a ring of orange particles in a perfect outline of its frame on the pavement when I slammed the door?" The answer is *oxidation*.

Oxidation happens when the elements of nature, especially oxygen, bind with the metal. This begins a breaking down of the molecules of which the metal is comprised. If we can protect the metal from those elements the rusting effect will be held to a minimum and perhaps even kept from starting at all. And while we can't reverse the affects of the decomposed pieces of the metal, such as those left on the ground by the old truck, we can stop the rust from continuing to destroy it by sanding off the oxidized parts, filling in the damaged areas with new metal or plastic material and repainting it.

This same exact scenario of oxidation happens in our cells every moment of every day. It is referred to as *Oxidative Stress*. And while we can't easily hide the scars of what has happened to us already, we can stop or at least dramatically slow the process and strengthen what remains. Glutathione is *the* molecule for opening the door to that process. But first let's see exactly how this oxidation takes place in our bodies – then we'll look at how to stop it.

Electrons R Us!

We cannot live without Glutathione production taking place daily in our cells. Our cells will die as a result of Glutathione levels falling too low. Some researchers assert that a cell actually cannot die unless the Glutathione levels fall low enough. So, the fight for survival is won or lost within the cells. If cells can stay healthy amid the challenges of daily life and the bombardment of outside free radical sources, they can then produce enough GSH for all cellular functions. But even without the attacks from outside enemies, the need for Glutathione production by our cells, organs, and vital

systems is still very high indeed.

This is because even the daily production and use of energy by our cells creates its own set of free radicals needing to be neutralized before they can cause damage. Add to that the pressures of life such as stress, toxins, poor eating habits, viruses and bacteria and our Glutathione levels can drop dramatically in a short period of time. But if GSH stores can be kept high our cellular defenses are assured. The main factor of Glutathione's multi-faceted capabilities is its ability to make and give away electrons within every cell.

Even when we ingest food we are simply eating electro-chemicals filled with specific electrons. These electrons then interface with the cells needing nutrition for ATP production or other help and electron exchanges begin to take place. If we said it's a chemical reaction we would be right because everything is based in chemicals in our bodies. But a more true explanation would be that it's an electron reaction within those chemicals, as the atomic realm is closer to the bottom line of our life force.

Of course in the case of medicinal remedies the very best electro-chemicals are those found in nature, which have no adverse side effects and are always found with complementary electro-chemicals around them. The fact is 100% of pharmaceutical products have adverse side effects, whether we feel them or not, and always create free radicals and possible oxidative stress. I'm not advocating we cease using all medications. I've often thanked those who made such things as painkillers when nursing an injury or antibiotics when fighting a bacterial issue.

However, I believe that natural forms of nutrients, particularly those that help in the creation of Glutathione, are much better for us in the long term. We *are* made of nutrients and it is their deficiency that brings disease. We are *not* deficient in the chemicals of medications, which are

all toxic to the body on some level.

To put it another way, virtually everything we take into our bodies will either give or take electrons in conjunction with the molecules with which it comes in contact. How easily a substance gives its electrons will determine the value of its nutrition for our cells. On the other hand, how easily it takes electrons from other cells will determine the level of its toxicity.

Basic chemistry teaches that every atom has electrons and protons orbiting their nuclei. This means that there is no chemical, no physical action that does not involve electron movement at some level. If energy is being used or created, there are electrons on the move to make it happen. Anything that is a help to the activity of these microscopic particles will bring better health.

Conversely, anything that slows or stops such activity will undoubtedly result in the hindering of our health as well. If we wish to stop such hindrance, we should constantly be ingesting the needed electrons from good food and supplements that form the highest quality antioxidants, Glutathione in particular. Now let's take a serious look at just how absolutely important this electron exchange is to Glutathione and our overall health as it acts as our Master Antioxidant.

Free Radicals

In order to comprehend the function of Glutathione as the body's Master Antioxidant, I believe it's important to understand the true nature of a free radical – where they are created and how they do the damage they cause. Knowing your enemy is the first step in successful warfare. Our enemy is easy to understand.

A free radical is a molecule that is chemically unstable because it is missing an electron. This lack of an electron

creates an imbalance in the molecule; therefore it will seek out and acquire an electron at any cost. Unfortunately, this creates a problem, as our bodies will not tolerate such imbalance, even at the molecular level. Also, as the free radical acquires the electron it's seeking and so comes into balance, it creates a "robbing Peter to pay Paul," scenario. When free radicals steal electrons from nearby molecules those burglarized molecules, now missing an electron, have themselves become free radicals (See Figure 1 below). This damage, left unchecked, will cascade into a very real problem as the new free radical thieves burglarize cell after cell around them.

Figure 1 - Free Radical Damage

In Figure 1 above, the Free Radical molecule steals an electron from the Complete molecule. This action makes the Free Radical molecule complete, but turns the complete molecule into a Free Radical. Glutathione (GSH) will freely give up its own electrons to the Free Radical to complete it and render it harmless, thus preventing damage to the first complete molecule.

Free radicals are capable of altering the structure of every biomolecule in your body through such activity. A few examples of these include:

- Damaging the lipids (fats) in blood vessel walls, resulting in arterial hardening or stiffening, and hypertension (high blood pressure) that can lead to heart and brain damage.

- Damaging DNA, leading to mutations that can promote aging and disease.
- Damaging the lubrication fluid producing cells in joints resulting in arthritis.
- Damaging proteins, which result in age spots, wrinkling, and sagging skin.

In fact, simply reading this page is creating millions if not billions of free radicals (if you are really concentrating), which must be quenched. Let me give you an example to which you might be able to relate a bit more easily.

Oxidative Stress - At The Movies?

Imagine you are standing in line to see a movie, your ticket in hand like most of the people in line with you. Everyone is happy because you all know it's a great uplifting film and you can't wait to get your seat and enjoy the show. Suddenly, several crazed-looking people come running toward the line of ticket holders. They begin to violently snatch tickets from the hands of those in line. Amazingly, the moment they do this they become completely docile and take a place in the line, as if nothing ever happened. Unfortunately, the victims of their theft suddenly go crazy and begin stealing tickets themselves! As they capture a ticket, they also become instantly calm and peacefully go to the back of the line. However, the immediate and swift chain reaction continues as each freshly robbed person goes just as crazy and takes a ticket from someone else.

You realize that no matter how hard you try to hold on to your ticket someone is going to take it from you and you'll go crazy too and do the same to the next person! Your heart is racing. Your muscles are tightening in anxious anticipation. Your breathing is short. You are stressed!

Then suddenly just as this insanity is about to reach you,

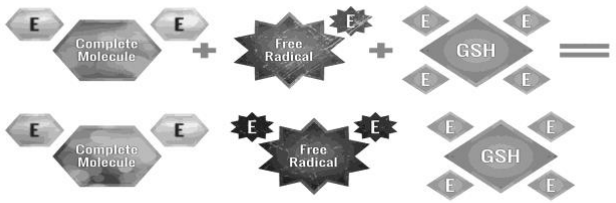
the manager of the movie house comes out with a handful of tickets and smilingly gives one to every crazed person who needs one – breaking the stealing process. Everyone's happy again, peacefully waiting in line for the show.

This is a great picture of how free radicals work to create oxidative stress. Oxidative stress refers to the stealing of electrons (the movie tickets) in our bodies by electron-starved *free radical scavengers* (the ticket thieves). These invaders seek to complete their own imperfect electrical makeup by taking what they need from the healthy cells around them. This damages those cells (the others in the movie line) and makes them free radicals as well.

These oxidizers would include such factors as pollutants, toxic medications, pesticides, chemical food additives, and more. Other free radicals can even be formed due to our own emotional stress from job, finances, or poor relationships, to name just a few. And of course, any physical exercise or even trauma to our bodies will had a negative effect on the amount of free radicals in our systems.

In the Figure 2 Glutathione has entered the scene and freely given up one of its electrons to the Free Radical molecule, making the Free Radical molecule complete. This renders it harmless to the Complete molecule. Also, upon giving up its electron the GSH molecule restores itself to full electron status, allowing it to stay a complete molecule for further Free Radical neutralization.

Figure 2 - Free Radical Damage



All such free radicals are constantly attacking our cells day and night. Glutathione (the movie house Manager) stands as the first line of defense against them by releasing the items needed by those scavengers – electrons (the movie tickets). This release of electrons by GSH neutralizes the harmful free radicals immediately, without damage to surrounding cells. If Glutathione is the *King molecule* for Vibrant Health, its super antioxidant power is arguably the most important of its royal attributes. Every cell of which we are made needs that antioxidant power.

How About Computers

I love this analogy by Dr. Keller. Another daily example of free radical activity to which we can all relate is the computer. A computer functions on electrical energy, but it loses up to one half of that energy as heat. All computers have exhaust fans built into them to release the heat to the air outside the housing surrounding the electronics. This keeps your PC or Mac from being damaged by the heat they are producing – a fact I discovered the hard way after my PC's fan froze up, unbeknownst to me, resulting in a fried motherboard and the purchase of new computer.

In comparison, the energy created and used by your cells also produces heat. The heat generated to produce and use that energy creates untold numbers of free radicals. If the free radicals are not neutralized in much the same way as the exhaust fan eliminates the computer's heat, the cell will be damaged much like my motherboard.

Fortunately for us all our cells are not as inefficient as our computers. The damage produced during the thou-sands of energy-producing reactions in each cell every second would be devastating to their function, were it not for Glutathione acting to neutralize the fire. It is an amazing balancing act. There are numerous studies that validate this concept. Again

– Glutathione is there to stop such damage, as the Master Antioxidant.

There are four primary sources of free radicals in humans, as in every other living organism:

1. Energy production in the Mitochondria.
2. Detoxification by the Liver.
3. Normal activity of the Immune System.
4. Metabolizing (chemically changing) the fats we eat.

In the next section we'll go over exactly how these sources of free radical production operate - with Glutathione as our protective hero.

Antioxidants Part 2

Energy Production = Free Radicals

Much of this section is again a salute to the teaching of Dr. Keller as I gleaned much of it from his writings.

Everyday our normal activities produce billions upon billions of free radicals as our mitochondria churn out and burn ATP to fuel these activities. Mitochondria are found in greatest numbers (in the tens of thousands!) in those organs needing the most energy – i.e. the heart, liver, and of course the brain. Obviously, the more energy you are producing and using the more chance of free radical damage – which is not a good situation for those particular organs for sure. Fortunately, as you have probably guessed, Glutathione is right there to handle any and all free radicals produced.

As would be expected well over 90% of our entire out-put of energy is produced by our mitochondria cellular factories. By combining the chemicals from the food and beverages we ingest with the oxygen we bring in through our breathing,

ATP production and the process of burning it for fuel both take place. The actual biochemical processes are quite complex, but let me share a familiar analogy - our trusty computer.

We know that a computer's worst enemy is the heat produced by the use of the electricity flowing through its electronics (remember my mother board). In our analogy it is the loss of heat - that which is vacuumed out by the fan - that determines just how well the computer will run. In our cells it is the release or loss of oxygen as we produce and use ATP that determines how well our cells work.

Free radicals are released during the ATP process and hinder the efficient activity of the cells. So, how well we control the proliferation of free radicals determines our body's energy loss, just as controlling the release of heat determines the computer's ability to keep working properly. Free Radicals are controlled by antioxidants – the computer by the fan.

Fortunately our free radical activating ATP process only accounts for a loss of about 3% of the oxygen when we are young and healthy. That's pretty stellar compared with a computer that may lose an average of over 50% of its energy from the heat it generates. And that is the key to this analogy – staying as vibrant as in our youth. The computer, to be kept in prime condition, must regularly have the fan cleaned, its memory upgraded, and the latest virus software uploaded to ward off cyber viruses and other attacks. Our cells – to keep them young and healthy – must have plenty of Glutathione to keep the cells clean, replenished with nutrients, and protected from free radicals attacking from outside as well as inside the cells. Healthy cells mean a healthy you!

The Liver vs. Free Radicals

The liver is an amazing organ. It is the major detoxifying

agent within the body. It neutralizes toxic materials introduced to the body through such vehicles as medications, bacterial infections, injury, trauma, pollution, poor diet, aging, and more. This activity creates a massive amount of free radical activity. This activity is produced in the two phases of the detoxification process.

Phase 1 Detoxification

Phase 1 Detoxification is supposed to convert any free radical materials to an inert and harmless state so it can-not cause any damage. This is accomplished by releasing a series of enzymes to break down the material. Unfortunately the very substance that is created is often a dangerous free radical itself.

Dr. Keller often gave the example of this regrettable process using the example of someone drinking an alcoholic beverage. Phase I Detoxification converts the alcohol in the drink into a second substance called acetaldehyde. While this second substance is very similar chemically to formaldehyde - which is embalming fluid - let the reader understand that drinking lots of alcohol will *not* "preserve" you! Of course, most people don't stop with just one drink and often will have more than they should. This can, and usually does, lead to the person's liver being unable to handle this free radical overload and leads to that person paying the price in the morning with a headache and other symptoms.

Studies have shown however, that if an over-intoxicated liver can get its owner to increase his or her Glutathione levels, either while imbibing or first thing in the morning after, the debilitating hangover-producing free radicals can be eliminated, taking their unpleasant symptoms with them.

Phase 2 Detoxification

Phase 2 Detoxification also takes place in the liver and

likewise requires the services of several specialized enzymes to breakdown the undesirable substances. The harmful free radical molecules are changed into water-soluble substances that are then easily and harmlessly eliminated from the body. And of course, it is the presence and power of Glutathione that causes this conversion of the free radicals to take place at all.

Without GSH Glutathione being present, Phase II Detoxification cannot take place. If the level of GSH is diminished, then the subsequent conversion of the substances will create an excess of toxins within the cells. When this occurs, the mitochondria are hindered in the ATP energy release process.

Phase II is much more dependent upon Glutathione than Phase I. If Glutathione levels in the body are low, Phase II will fail to complete its mission as easily or as completely as Phase I. **Therefore, keeping Glutathione levels as high as possible is vital to optimal liver function**.

Immune System vs. Free Radical Production

Keeping our immune system strong is paramount for health at every level. As the first responders to any emergency or military to a battlefield within us the components of our immune system are untiring soldiers. What I find fascinating is that this powerful army actually creates its own free radicals to do its bidding. These free radicals will then find and overwhelm germs, bacteria, viruses, parasites and other invaders that seek to harm us. And when our interior fighters have eliminated the emergency, the system will go back to a calm vigilance, shutting down its "good guys" free radical production.

But what if the health of that person is greatly compromised. What if there is continuous stress upon the immune system so it doesn't get to rest, but must fight day

and night against its enemies? Obviously no army, not even one as innovative as our immune system, can keep that up forever. Something will fail, as the free radical invaders will eventually overwhelm the system. In time the system will crumble completely.

Glutathione is the protector of the immune system. It has been cited as the very measurement for knowing if a patient will or will not survive a state of chronic illness. Simply said, lower Glutathione means lower health and higher Glutathione means more vibrant health. It is that important.

Metabolizing Fats vs. Free Radicals

Peroxisomes are minute cells whose job it is to break down the fatty acids found in the foods we eat. That process is known as peroxidation. This lipid (fat) peroxidation, if gone unchecked, has been demonstrated to be a major factor in the development of heart disease due to its free radical production. The synergistic effects of GSH and Glutathione Peroxidase are paramount to this metabolizing process. They act as guardians protecting both proteins and fats from the damaging activity of enemy free radicals.

As in all warfare, having sufficient soldiers and ammunition is the key to victory. The same is true in our fight against free radicals. If you want to be victorious you have to continually build your Glutathione fighting force. That theme is the foundation of this book.

Mega Free Radical Production!

Every smoker I have ever met has said they wanted to quit, and most tried multiple times. My heart breaks for those people. Both of my parents were heavy smokers during my childhood years. My father quit only when his doctor told him that he would soon develop emphysema. He died before he was 50. My mother quit much earlier yet only

lived to her mid 60's. Speaking of heartbreak, I've had 2 children become smokers, one has quit and the other continues to work on it. I know the pain and do not judge anyone. At the same time, I'm thrilled to share the following with any of you who might be bound by this tough-to-break and dangerous habit.

Of all the maladies that can shorten a human being's life smoking is by far the most preventable. Studies have shown that a smoker will on average have lost 8 years of life. Also, as we all know from the commercials and warning labels on cigarette packs that there are multiple deadly diseases associated with smoking. The horrible fact is that free radicals by the untold billions are released into the body from just one single cigarette. And that doesn't even begin to touch the illness-inducing chemicals injected into those tobacco products.

Combine the tars, chemicals, and free radical stress placed on the oxygen-absorbing surface of the lungs and the very least of the bad effects will be bronchial or asthmatic conditions. This is just as true for the non-smoker who constantly is exposed to secondhand smoke issuing from cigarettes and the lungs of smokers (such as happened to my siblings and me growing up with 2 smoking parents).

As I said, I am thrilled to tell you about another truth. If you are a smoker, or know someone who is, you can gain *some* protection by increasing the Glutathione in your body as much as possible. Your lungs will thank you for it with increased oxygen absorption. The beauty of that is there will also be a reduction of toxins, free radicals, oxidative stress, and inflammation in the lung tissue. What I'm *not* saying is that you can smoke all you want if you just keep your Glutathione high. That's like shooting 5 holes in the bottom of your boat in shark-infested waters and patching only two of them. You will still sink and be "what's for dinner," it just

may not happen as quickly.

And if you think I'm just blowing smoke here (sorry, I couldn't resist) then here is an interesting fact. In the mid 1990's during litigation against the tobacco industry, several of the largest cigarette makers suddenly had an epiphany that it would be a great idea to inject N-acetyl cysteine into their mixtures of some 590+ other chemicals they had already added to the tobaccos. This was a veiled admission that the body needed Glutathione to offset the detrimental effects of their products. I'm no fan of big tobacco, but I do appreciate the gesture, though that's about all it was.

Appendix

Using Pub Med

The website www.PubMed.gov is the official site for all research archived in the US National Library of Medicine The National Institutes of Health, which is part of the Department of Health and Human Services. When you go to this site, simply type in the search window at the top of the page whatever you wish to know about concerning medical research on any subject.

For example, type in Glutathione and you will have over 120,000 studies available to you. If you type in anything next to Glutathione in the search window it will show you the specific entries concerning GSH and that subject.

Internet Search

A simple Amazon or Google search will give you an ocean of articles, books, and booklets on glutathione to choose from. I've listed the books below because they cover the information about glutathione with the most research references and illustrations for easy use and education.

Suggested Reading

- **Glutathione (GSH) Your Body's Most Powerful Healing Agent**
  Dr. Jimmy Gutman, 2000 G&S Health Books
- **The GSH Phenomenon**
  Alan H. Pressman, 1997 St Martin's Press
- **GSH Master Defender**
  Dr. Thomas Levy, 2008 LivOn Books
- **Toxic Relief**
  Dr. Don Colbert, 2001 Siloam, Strang Publications

Glossary

- **Alpha lipoic acid** – an antioxidant that assists Glutathione (GSH) by its ability to lend electrons to GSH and by it's own antioxidant activity. 157, 160
- **Antioxidant** - a molecule that stops the oxidation of other molecules by supplying electrons to any oxidizing agent that tries to steal electrons from healthy cell molecules. 13, 17, 33, 41, 51, 62, 70, 86
- **Adenosine Triphosphate (ATP)** – our cells produce and consume ATP as the main energy transfer molecule; it is produced in the Mitochondria. 14, 32, 42
- **Catalase** - is a common enzyme found in nearly all living organisms exposed to oxygen. It catalyzes the decomposition of hydrogen peroxide to water and oxygen; one catalase molecule can convert millions of molecules of hydrogen peroxide to water and oxygen each second. 63, 162
- **Chelation** – the process of chelating (bonding) agents (molecules) bonding to metals so that they may be carried into the bloodstream and eliminated from the body. 70, 76
- **Coenzyme Q10** - oil-soluble, vitamin-like substance is present primarily in the mitochondria; helps generate energy in the form of ATP; organs with the highest energy requirements—such as the heart, liver and kidney—have the highest CoQ10 concentrations. 162
- **Cysteine** - the main amino acid building block of Glutathione; it has the ability to limit the amount of Glutathione produced in a cell; made by the living cells of our bodies from simpler compounds or can be obtained in the diet. 21, 30, 134, 136, 143, 154,
- **Deoxyribonucleic acid** (**DNA**) - a molecule that encodes the genetic instructions used in the development and

functioning of all known living organisms. 174

- **Electron** - a subatomic particle with a negative electric charge. 17, 19, 27, 29, 30, 45-48, 50, 62, 64, 69, 73, 98, 158, 160
- **Enzymes** - are highly selective catalysts that accelerate both the rate and specificity of metabolic reactions. Almost all chemical reactions in a biological cell need enzymes in order to occur at rates sufficient for life. 17-19, 23, 25, 54, 55, 65, 69, 112, 125, 162
- **Free Radicals** - produced by oxidation reactions; are intermediate stages in many chemical reactions; their need to balance their own electron bonds causes them to steal electrons from other molecules thereby making those molecules into new free radicals themselves. 17, 34-38, 43, 45-48, 50-58, 62, 77, 83, 85, 86, 103
- **Glutathione (GSH)** - is made by every cell in the body from the amino acids cysteine, glutamic acid, and glycine. It serves as the most powerful of all antioxidants, the master cellular detoxifier, removes heavy metals, quenches the heat of ATP production and use, reduces aging, and more. 12-19, 21-25, 28-33, 41-48, 50-55
- **Glutathione Disulfide (GSSG)** – if formed when glutathione (GSH) has given away all of it's electrons and is therefore in need of an electron. 16-19, 93, 127
- **Glutathione Peroxidase (GPX)** - an enzyme family whose main role is to protect cells from oxidative damage; the biochemical function is to reduce lipid hydroperoxides to alcohols and to reduce free hydrogen peroxide to water. 18, 23, 57,
- **Glutathione Reductase (GR)** – and enzyme that reduces glutathione disulfide to the sulfhydryl form GSH by acting as a catalyst in adding the needed electrons. 157
- **Glutathione S-transferase (GST)** – GSTs are a family of enzymes; they may also bind toxins and can transport

proteins such as Glutathione out of our cells. 18

- **Glutathione Synthetase (GSS)** - is the second enzyme in the Glutathione production pathway. A deficiency can be linked to over acidic body, malfunction of the nervous system and other maladies. 157
- **Glutamate** - a salt or ester of glutamic acid that functions as an excitatory neurotransmitter. 30
- **Glutamic acid** – one of the 3 main natural amino acids used as building blocks of Glutathione; widely distributed in plant and animal proteins; acts as a neurotransmitter throughout the central nervous system. 21, 30, 134, 136,
- **Glycine** – The simplest amino acid, it is one of the 3 main natural amino acid building blocks of Glutathione; is a neurotransmitter. 21, 30, 134, 137, 143,
- **Heavy Metal** – includes iron, cobalt, copper, manganese, and zinc are required by humans, though excessive levels can be damaging. Other heavy metals such as mercury, plutonium, and lead are toxic and their accumulation over time in our bodies can cause serious illness. 13, 17, 18, 34, 65, 69, 71, 75, 132, 136
- **Homocysteine** - is a protein amino acid; it can be derived from cysteine or methionine; elevated levels have been associated with a number of disease states, including cardiovascular disease. 136
- **Hormone** - a chemical messenger released by a gland in one part of the body (often transported in the blood) with a signal that affects cells in other parts of the organism. 25, 93, 95, 110, 115, 122-124, 149
- **Hydrochloric acid** - one of the main secretions of the stomach; acidifies the stomach content to a pH of 1 to 2; is highly corrosive; acts as a barrier against microorganisms to prevent infections and is important for the digestion of food. 113, 135

- **Hydrogen Peroxide** - the oxidizing capacity of hydrogen peroxide is so strong that it is considered a oxidative agent. Consequently, nearly all living things possess enzymes which decompose low concentrations of hydrogen peroxide to water and oxygen. 118, 162
- **Immune System** - a system of biological structures and processes within bodies that protects against disease by detecting and eliminating a wide variety of pathogens and parasites, and distinguishing them from the our own healthy tissue. 12, 13, 30, 52, 55, 59, 76, 17-86, 136, 147, 158, 160
- **Inflammation** - the complex biological response of tissues to harmful stimuli, such as pathogens, damaged cells, or irritants; this pathway can also be oxidation, which leads to free radical activity, which leads to oxidative stress, which leads to inflammation. 32, 33, 35, 36, 39, 58, 59, 61, 62, 65, 103-105, 109, 118-122, 127, 128, 159, 162,
- **Lymphatic system** - part of the circulatory system, comprised of a network of conduits called lymphatic vessels that carry a clear fluid called lymph towards the heart for return to the blood after it has been cleansed in the lymph nodes by lymphocytes (white blood cells) of bacteria and other possible pathogens. 80, 148
- **Lymph** - a clear fluid comprised of plasma and the fluid between cells that carries both nutrients and waste through the lymph system. 80, 81, 138, 147, 148,
- **Lymphocytes** – a form of white blood cells found in the lymph nodes that destroy bacteria, viruses and other harmful microscopic life forms. 80
- **Mitochondria** – the power plants of our cells that generate most of the cell's supply of adenosine triphosphate (ATP), which is used as a source of energy by our bodies. The number of mitochondria in a cell varies

widely. 31, 32, 35, 42, 52, 52, 55, 65, 101, 103, 118, 125, 126, 134, 141, 162

- ***N*-acetyl cysteine (NAC)** - is a derivative of cysteine with antioxidant and liver protecting effects; has been the primary source of getting cysteine into the body to create it's own Glutathione; is often used in poison control - of acetaminophen overdose specifically. 73, 152, 154,
- **Oxidation** - the *loss* of electrons or an *increase* in oxidation state by a molecule, atom, or ion. 44, 56, 118
- **Oxidative Stress** - oxidative stress is associated with increased production of oxidizing agents or a significant decrease in the effectiveness of antioxidant defenses, such as glutathione. The effects of oxidative stress depend upon the size of these changes. More severe oxidetive stress can cause cell death. 13, 33-36, 44, 46, 50, 59, 70, 75, 81, 96-98, 104, 105, 107-109, 113-117, 119, 121, 125-128, 132, 138, 140, 158
- **Pepsin** – is and enzyme released by cells in the stomach to break down protein. 136
- **pH Balance** – pH is a measure of the hydrogen ion concentration, measured on a scale of 0-9 with 7 being optimal by conventional standards. This can be measured by your saliva or urine. Low pH (below 7) is said to be acidic and high pH (above 7) is said to alkaline. 147
- **PubMed** – the National Library of Medicine for the National Institutes of Health of the USA, housing global research pertaining to the human body. 171
- **Reduced state** - the *gain* of electrons or a *decrease* in oxidation state by molecule, atom, or ion. 17
- **Super Oxide Dismutase (SOD)** – enzymes that catalyze the dismantling of superoxide into oxygen and hydrogen peroxide. Thus, they are an important antioxidant defense in nearly all cells exposed to oxygen. 63, 111,

162, 188

- **Toxin** - anything that is poisonous and damaging to the cells of our body. 17, 18, 33-35, 45, 55, 58, 62, 67-76, 80, 82, 84, 102, 131, 132, 136, 138, 139, 142, 147,148, 158, 160, 162, 164
- **White Blood Cells** – part of the immune system involved in defending the body against infectious disease and foreign materials. Five types of leukocytes exist, but they are all produced and derived from stem cells in the bone marrow. They are found throughout the body, including the blood and lymphatic system. 80, 81, 83, 84, 159

References

Research Studies

Chapter 1: The King

Townsend DM,'lew KW, Tapeto, H. The Importance of Glutathione in Human Disease. Biomedicine and Pharmacotherapy: 2003;57:145-155.

Meister A. Glutathione Metabolism. *Methods Enzymol.* 1995;251:37

Carper J. Stop Aging Now, *Harper Collins Publishers,* New York, NY, 1995

Molecular Biology of Antioxidant Defenses, *Cold Spring Harbor Laboratory Press,* 1997

Mindell E. What You Should Know About the Super Antioxidant Miracle. *Keats Publishing, New* Canaan, CT, 1996

Chapter 2: What, Where, & How It Works

Bender, E. Nutritional and metabolic aspects of glutathione. *Annu Rev Nutr.*

Kidd PM. Glutathione: Systemic protectant against oxidative and free radical damage. *Alt Med Rev.* 1997;2:155-176

Cabello CM, Bair WB3'[d], Wondrak GT. Experimental therapeutics: targeting the redox Achilles heel of cancer. *Curr Opin Investig Drugs.* 2007;8(12):1022-37

Franco R, Schoneveld CJ, Pappa A, Panayiotidis MI. The central role of glutathione in the pathophysiology of human diseases. *Arch Physiol Biochem.* 2007;113: 234-58

Tokatli A, Kalkanoglu-Sivri HS, Yuce A, Coskun T.

Acetaminophen-induced hepatotoxicity in a glutathione synthetase-deficient patient. *TurkJPediatr.* 2007;49:75-76

Akai S, Hosomi H., Minami K, Tsuneyama. Knock down of gamma-glutamylcysteine synthetase in rats causes acetaminophen-induced hepatotoxicity. *J Biol Chem.* 2007; 282(33):3996-4003

Williams D. Revising a Major Biochemical Cause of Aging: Alternatives for the Health Conscious Individual. *Mountain Home Publishing, Vol* 6, No 11, 1996:1-6

About The Author

Since the mid-1970s, Dr. William "Bill" Greenman has been helping people find, fund and fulfill their dreams in many different ways. He's been a living example of what he teaches as a counselor, pastor, teacher, conference speaker, author, illusionist, **trapeze artist**, circus owner, corporate executive, and entrepreneur. His vision for helping others has taken him, personally, to 4 continents and 20 nations. His books and training materials have circled the globe.

Bill has been involved in sports and personal fitness since his first day at a YMCA with his father when he was 5 years old. For over 60 years he has never wavered from his commitment to the fun and disciplines of both. It was this love of sports and fitness that took him not only to the circus and a 17-year career as an aerialist and acrobat, but also into the world of martial arts, surfing, and just about anything else that would challenge him physically.

Dr. Greenman's athletic career and personal interest directed him into the study of nutrition, health and fitness as lifestyle disciplines. This quest for knowledge of the human body and its miraculous and intricate functions blossomed into another career of nutritional training and sales, which, in turn, spawned international business ventures.

But it's Bill's love of teaching others how to better themselves that has formed his life's work. Helping people discover who they are and then how to grow into all they can be—including their physical, mental and spiritual health—is his daily motivation.

Bill earned his Ph.D. in Practical Theology from Life Christian University in 2001 and was also awarded an Honorary Doctorate from that same institution for his life's body of work in 2000. He also has degrees in Speech Communications, Biblical Studies, and Pastoral Ministry. He has studied nutrition under the University of Miami Florida Medical School Division of Complimentary Medicine and Humanitas International Foundation.

Dr. Greenman has been married to his lovely wife, Meg (who he met in the circus!), since 1975. They have 3 grown children and 6 growing grandchildren.