

Molecular Hydrogen & Hydration

Effects on Health and Performance

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Body Water Homeostasis: Essential for all Life

This article is designed to acquaint the reader with the benefits of hydration and molecular hydrogen supplementation. It is based upon a review of literature dating from 400B.C. to today.

Water is an essential nutrient¹ whose absence is lethal within days². Water is therefore very important for the prevention and healing of a host of conditions. Lack of proper hydration (hypohydration) can play a role in all infectious and noncommunicable diseases.

It is generally accepted that pure water consumption is very important for health. Is this true? Why? Since primordial times, when life first ventured from ocean to dry land, a critical adaptation needed across all species of life was the ability to balance fluids between the body and the environment. There are multiple studies to support the benefits of drinking water even when amounts consumed are inadequate for complete re-hydration^{3,4}. This alludes to both the neurological and physiological aspects of fluid balance regulation for overall health. To prevent dehydration all land animals have adapted an exquisitely sensitive network of physiological controls to modulate fluid levels in the body. The body can excrete water and solutes through urination or sweat and trigger thirst as needed to regulate fluid levels.

¹ "Water as an essential nutrient: the physiological basis of ... - NCBI." 2 Sep. 2009, <https://www.ncbi.nlm.nih.gov/pubmed/19724292>.

² "PubMed Central, Table 3: Nutr Rev. 2010 Aug; 68(8): 439–458. doi" <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2908954/table/T3/>.

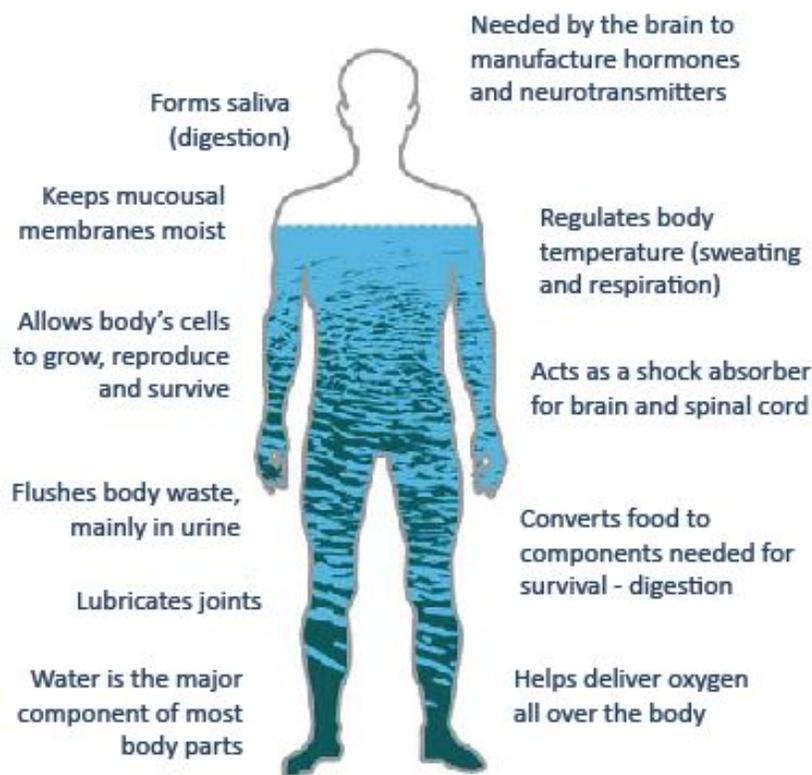
³ "The Effect of Fluid Intake Following Dehydration on ... - NCBI - NIH." 18 Mar. 2017, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5357466/>.

⁴ "Heat stress and dehydration in adapting for performance ... - NCBI - NIH." 27 Jul. 2016, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5356617/>.

It is widely accepted that water has a central role in both the function and composition of every fluid in the body. This is why water is of such critical importance for proper health. Health-related functions of the fluids in the body include 99% of the functions of every cell and system in the body. To help put that into perspective, here is a list of roles and functions of water in your body.

- lifting purity (vitamins, minerals, and nutrition) from food,
- separating turbidity,
- moistening the lungs, sinuses, colon, bones, bile, gastric juices, eyes, ears, and more
- thermoregulation, perspiration, respiration, urination, salivary glands

What Does Water do for You?



<https://water.usgs.gov/edu/images/property-you.png>

Molecular Hydrogen and Optimal Hydration

When I mention hydration to my clients, they usually respond by mentioning something about how much water they drink. Little do they know, it's not so much about how much water they drink, but how much molecular hydrogen is in their water.

Yes, water has the chemical nomenclature of H₂O, but the hydrogen in that formula are chemically bound to oxygen and therefore not readily available to provide hydrogen or oxygen. This is the same reason why we cannot breathe water, even though there is oxygen in water. Also, it's the same reason that steak can have 75% water content, but water doesn't come out if you squeeze a steak.

High hydrogen content water produces vastly different effects than drinking any other kind of water. Hydrogen Enriched Water™ (HRW) is produced by a water electrolysis machine such as the ECHO 9 Ultra H₂ or hydrogen-releasing salt tablets. Electrolysis is accomplished by passing an electric current through a platinum plate submerged in water which decomposes H₂O into 2H₂ and O₂. These constituents are then allowed to recombine with a higher ratio of 2H₂ by draining off a controlled amount of oxygen-rich water thus dissolving a therapeutic level of molecular hydrogen gas into the recombined water (approximately 1.6ppm).

The Importance of Hydrogen Enriched Water™ for Hydration

Oxygen is an essential element for life. Without oxygen, the body would die within minutes yet oxygen can also have damaging effects if left unchecked in the body. Much the same way oxidation can cause iron to rust and sliced apples to turn brown, oxygen can cause a type of degradation known as oxidative stress within the body.

Oxidative stress plays a major role in all aspects of human biochemistry. There are some beneficial aspects of oxidation in the body such as natural processes of protein phosphorylation, activation of DNA binding, gene transcription factors, apoptosis, immunity, and cell differentiation.

Each of these normal healthy processes are dependent on a particular reactive oxygen species (ROS) being produced and present inside cells. However, when the presence of ROS increases beyond a certain threshold, the reactive oxygen species start inflicting harmful effects upon vital cellular structures such as proteins, lipids, and nucleic acids.

ROS can form as a result of internal or external causes. Within the body ROS can form as a byproduct of cellular respiration, after the breakdown of fats, and by cells undergoing inflammatory conditions. ROS can also come from sources outside of the body such as from toxic chemical exposure, radioactivity, UV damage, smoking, stress, and more.

It is generally accepted that oxidative stress plays a role in the onset and/or progression of almost all diseases (i.e., arthritis, cancer, diabetes, metabolic disorders, atherosclerosis, and cardiovascular diseases to name a few). This is why the body has its own built-in antioxidant defense systems including SuperOxide Dismutase, Glutathione, and Catalase which counteract oxidation to keep it at a tolerably safe low level. Once ingested, hydrogen molecules are electro-magnetically attracted to free-radicals and oxidizing toxins regardless of where they are located in the body. Due to its incredibly small size, hydrogen can cross physiological barriers to improve hydration in subcellular compartments where toxins are generated before they can accumulate and cause harm.

Damaging oxidative radicals can be directly neutralized by Hydrogen Enriched Water™. When a hydrogen molecule gets close to a toxin it transforms the toxin directly into water. Supplementing with molecular hydrogen provides selective antioxidant support which has important benefits across over 200 biochemical processes within the body. Overall, evidence suggests a plethora of benefits related to drinking hydrogen rich water over any other type of water or beverage.

Benefits of Hydrating with Molecular Hydrogen Enriched Water™

1. Improves function and processing of over 200 different biomolecules which naturally occur in the human body
2. Improves the body's ability to handle oxidative stress (involved in EVERY function of life)
3. Smallest, most bioavailable substance in the known scientific universe (Hydrogen can access any tissue and all cell-types within the human body. Even crossing the blood-brain barrier and through the placenta)

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4. Selective—only scavenges bad radicals (H2 has no negative effect on beneficial oxidative processes which naturally occur in the body)
 5. Converts cytotoxic hydroxyl radicals to water—(no toxic byproducts of detox process)
 6. Improves the body's antioxidant system (recycles glutathione, catalase, SOD, Vitamin C, and a host of beneficial enzymes)
 7. Directly helps to lower excessive oxidative stress and reactive nitrogen species
 8. Anti-inflammatory properties
 9. Anti-allergy (H2 makes the body better at handling allergens and neutralizing toxins)
 10. Protects against radiation damage (protects DNA by helping to form tighter coils)
 11. Stimulates energy metabolism to help prevent weight gain (15% improved metabolic rate)
 12. Supports glucose homeostasis (instant effects can be seen on home glucose tests)
 13. Stabilizes cholesterol levels (accomplishes this through multiple ways)
 14. May help prevent erectile dysfunction (protects NO-, helps testosterone levels, protective of leydig cells, promotes circulation and electrolyte balance)
 15. Decreases lactate (lactic acid) build up during exercise
 16. Supports cognitive function (both for students and the elderly)
 17. Prevents age-related decline in cognitive capacity
 18. Neuroprotective and DNA protective (promotes healthy methylation and epigenetics)
 19. Extremely high safety (no toxic effects have ever been found)
 20. Hydrates better than regular water, alkaline water, or any sports drink.

The “Nourishing and Quenching” of Water in the human body

Going back thousands of years before the writings of Hippocrates, Ancient Greek and Egyptian healers understood the importance of fluid balance. They had an entire health system specifically focused on balancing the “four fluids” of the body. Hippocrates is credited as being the first to write the system out. He describes the theory of the Four Humours in his book *On the Nature of Man*⁵ as follows:

The Human body contains blood, phlegm, yellow bile and black bile. These are the things that make up its constitution and cause its pains and health. Health is primarily that state in which these constituent substances are in the correct proportion to each other, both in strength and quantity, and are well mixed. Pain occurs when one of the substances presents either a deficiency or an excess, or is separated in the body and not mixed with others.

⁵ "The Writings of Hippocrates and Galen - Online Library of Liberty."
<http://oll.libertyfund.org/titles/1988>.

In my understanding, the meaning of this statement refers to a nourishing quality of water in the body which is carried out by the function of the genitourinary system. The Water Element's life supporting functions manifest through the Kidneys' nourishment of the each of the body's life supporting systems. Water quenches system-wide requirements, maintaining delicate balance, primarily through the mechanisms of thirst and sweat.

Fluid balance of intracellular and extracellular compartments

Fluid balance inside and outside of the cell

Objectifying WATER HOMEOSTASIS

For ease and reliability, modern medicine attempts to objectively assess water homeostasis in the body by measuring qualities of the blood and urine to monitor the body's fluid balance. One method of scientifically measuring fluid balance is to assess the osmolality of the blood plasma. Osmolality in this case refers to the concentration or dilution of water in the blood. Osmolality of blood and urine are both valid methods of describing overall hydration status.

The kidneys are the chief regulator of body fluid concentration (osmolality). The Kidneys accomplish the balancing of blood plasma osmolality through the major processes of concentrating and diluting nutrients and toxins in the blood. There are intracellular osmoreceptors and extracellular baroreceptors, which tightly regulate blood plasma osmolality between 275 to 290 mOsm/kg (a range of only 15) through the conservation or dilution of water in the blood. It accomplishes this through changing urine output. When the kidneys are properly hydrated the regulation of blood plasma osmolality assists the transport of nutrients and flushing of toxins.⁶ The urinary tract flushes metabolic residues out of the body. Urinalysis shows how many solutes are getting through the kidney filtration system.

Water Homeostasis is Essential for Health

⁶ "Overview of Electrolytes - Hormonal and Metabolic Disorders - Merck"
<https://www.merckmanuals.com/home/hormonal-and-metabolic-disorders/electrolyte-balance/overview-of-electrolytes>.

The prime goals of the kidneys include essential functions for life such as reproduction, removal of toxins, and regulation of water balance in the entire body. Water homeostasis in the body is regulated through the hormone arginine vasopressin (AVP). Vasopressin is the body's chief method of balancing water in the blood, *maintaining a narrow range of constant water and electrolyte balance at all times*. This amazing feat is coordinated by a complex neural pathway controlled in the anterior hypothalamus.

Although we all have heard that hydration is very important for health, do you know why? There are 4 main reasons why the body places such importance on water balance in the body.

The 4 major functions of water for life support

1. THERMOREGULATION

Major fluctuations in blood plasma osmolality can occur when the body is under stress. Heat stress plays a major part in blood plasma osmolality changes because of the rapid effects of electrolyte loss through sweat.⁷ People in arid or high altitude environments should be vigilant of hydration status because of the body's sensitivity to temperature.⁸

2. PHYSICAL PERFORMANCE

Even mild dehydration (2-4% dehydration referred to as hypohydration) can cause reduced endurance and diminished motivation^{9,10}. Dehydration leads to increased perceived effort. Hydration levels affect high intensity aerobic sport performance more than anaerobic performance with an increasing loss of performance as dehydration intensifies.

3. COGNITIVE PERFORMANCE

⁷ "Thermoregulation and aging. - NCBI." <https://www.ncbi.nlm.nih.gov/pubmed/16041970>.

⁸ "Altered mechanisms of thermoregulatory vasoconstriction ... - NCBI - NIH." <https://www.ncbi.nlm.nih.gov/pubmed/18580292>.

⁹ "Effects of Voluntary Fluid Intake Deprivation on Mental ... - NCBI - NIH." <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2080479/>.

¹⁰ "The Effects of Dehydration on Cognitive Functioning ... - Knowledge Box." <http://kb.gcsu.edu/cgi/viewcontent.cgi?article=1031&context=thecorinthian>.

Reduced levels of hydration can affect cognitive functions including concentration, math ability, perception, alertness, short-term memory, visual tracking, and mood.¹¹ In studies, hypohydration is associated with increased fatigue, confusion, anger, and vigor. The thirst mechanism is monitored 24/7 by dedicated osmoreceptors in the brain, but further study is needed to fully explain the way the brain maintains water balance in the body.

4. ANTI-AGING EFFECTS

As a person ages, the thirst mechanism of hydration becomes less efficient due to a reduction in kidney filtration efficiency which may be measured by glomerular filtration rate blood tests.¹² Euhydration can lead to improved kidney function and having more water in the system is generally regarded as more favorable than hypohydration.

Improper hydration is a factor in ALMOST EVERY DISEASE

Diseases most closely associated with hydration status in the scientific literature:

Strength of Evidence basis for claims			
Strong Evidence	Urolithiasis	Broncho-Pulmonary Disorder	
Less Strong	Infant dehydration	Diabetic Hyperglycemia and Ketoacidosis	
Limited	Kidney function and morphological changes		Hypertension
Weaker	Coronary Artery Disease	Venous thromboembolism	
Clinical experience	Cerebral Infarct (stroke)	Dental Disease	UTI
Inconsistent	Bladder Cancer	Colon Cancer	
Speculative	Gallstones	Mitral Valve prolapse	Glaucoma

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2908954/table/T3/>

Other diseases associated with lack of full hydration include:

¹¹ "The relation of hydration status to cognitive performance in ... - NCBI." <https://www.ncbi.nlm.nih.gov/pubmed/15210289>.

¹² "GFR estimation: from physiology to public health. - NCBI - NIH." 28 Jan. 2014, <https://www.ncbi.nlm.nih.gov/pubmed/24485147>.

Urolithiasis, BronchoPulmonary Disorders, Infant dehydration, Diabetic Hyperglycemia, Diabetic Ketoacidosis, Kidney function, Kidney morphological changes, Hypertension, Coronary Artery Disease, Venous thromboembolism, Cerebral Infarct (stroke), Dental Disease, UTI, Bladder and Colon Cancer, Gallstones, Mitral Valve prolapse, Glaucoma dementia, reduced mobility, incontinence, poor diet, renal insufficiency, and constipation.

Discussion

Effects of hydration on the CardioVascular System

Fluid balance in the body is associated with many biological functions of the heart and blood vessels. Euhydration prevents high and low blood pressure¹³, coronary artery disease, and prevents thromboembolism.

Poor hydration status has been scientifically associated with insufficient cerebral circulation, headaches, impaired concentration, irritability, and may trigger or prolong migraines. Good news is that water is associated with reduced duration and intensity of headaches caused by intracranial dehydration. Relief may be expected within 30 to 180 minutes. This study also suggests that many people who do not get headaches may be preventing them simply by drinking water.¹⁴

Effects of hydration on Dementia and Brain health

Dehydration increases the risk for delirium and dementia in the elderly. The cycle of dehydration and dementia worsens over time because the of reduced thirst mechanism in older adults (hypodipsia).^{15,16}

Effects of hydration on the Skin

¹³ "Water drinking acutely improves orthostatic tolerance in healthy ... - NCBI." 26 Nov. 2002, <https://www.ncbi.nlm.nih.gov/pubmed/12451007>.

¹⁴ "Water-deprivation headache: a new headache with two variants. - NCBI." <https://www.ncbi.nlm.nih.gov/pubmed/14979888>.

¹⁵ "Delirium and dehydration: some fluid for thought? - NCBI." <https://www.ncbi.nlm.nih.gov/pubmed/12353122>.

¹⁶ "Predisposing factors associated with delirium among demented long" <https://www.ncbi.nlm.nih.gov/pubmed/19377042>.

The skin plays an important role in water balance by preventing water loss into the environment. Skin is composed of approximately 30% water which contributes to its elasticity, plumpness, and resiliency. Proper hydration and lipid content can improve skin thickness and density while dehydration can increase skin turgor.¹⁷ Dry skin conditions which may be aggravated by exposure to dry air, prolonged contact with hot water, disease conditions, medications, and scrubbing can all be helped with better hydration.

Effects of hydration on the Stomach and Digestive Tract

Fluids in the diet are generally absorbed by the proximal small intestine. Absorption rate is determined by the rate of gastric emptying.¹⁸ Gastric emptying rate is generally accelerated by the total volume of water consumed and slowed by coloring, flavoring, and solutes regardless of concentration. Constipation is characterized by slow gastrointestinal transit, small, hard stools, and difficulty passing stools. Dehydration can compound each of the major factors of constipation including illness, poor diet, low fiber intake, painkillers, and medication use¹⁹. Adequate hydration can reduce all causes of constipation by 50% in certain groups of people.

Effects of hydration on the Kidney system

Proper Hydration is associated with prevention of kidney stones²⁰ and UTI²¹. Increasing water intake is a well-accepted method for preventing renal calculi. As kidney function lessens, the body's ability to clear toxins from the blood also decreases. The kidneys ability

¹⁷ "Effect of fluid intake on skin physiology: distinct differences ... - NCBI."

<https://www.ncbi.nlm.nih.gov/pubmed/18489334>.

¹⁸ "Intestinal water absorption--implications for the formulation of ... - NCBI."

<https://www.ncbi.nlm.nih.gov/pubmed/9694418>.

¹⁹ "Mild dehydration: a risk factor of constipation? - NCBI."

<https://www.ncbi.nlm.nih.gov/pubmed/14681719>.

²⁰ "The medicinal use of water in renal disease. - Cátedra Internacional" 21 May. 2017,

<http://cieah.ulpgc.es/es/the-medicinal-use-of-water-in-renal-disease-2>.

²¹ "Hydration and Chronic Kidney Disease Progression: A Critical ... - NCBI." 3 May. 2016,

<https://www.ncbi.nlm.nih.gov/pubmed/27161565>.

to filter decreases with age^{22, 23}. This can result in increased solute load in the blood and increased allergies.

Effects of thought on hydration

Seeing water or even just thinking about swallowing water can trigger an anticipatory reflex within the brain²⁴. Specialized neurons called taste buds sense water and detect its nature (especially salt content) which causes neuronal responses as if the incoming water had already entered the bloodstream.

Traditional models of physiology credited the brain as the “ruler over the flow of water”. This refers to the balance of fluids in all of the systems and cells of the body and triggers mechanisms to allow some water into the bloodstream, and some to flush through the various body systems.

Effects of molecular hydrogen on health

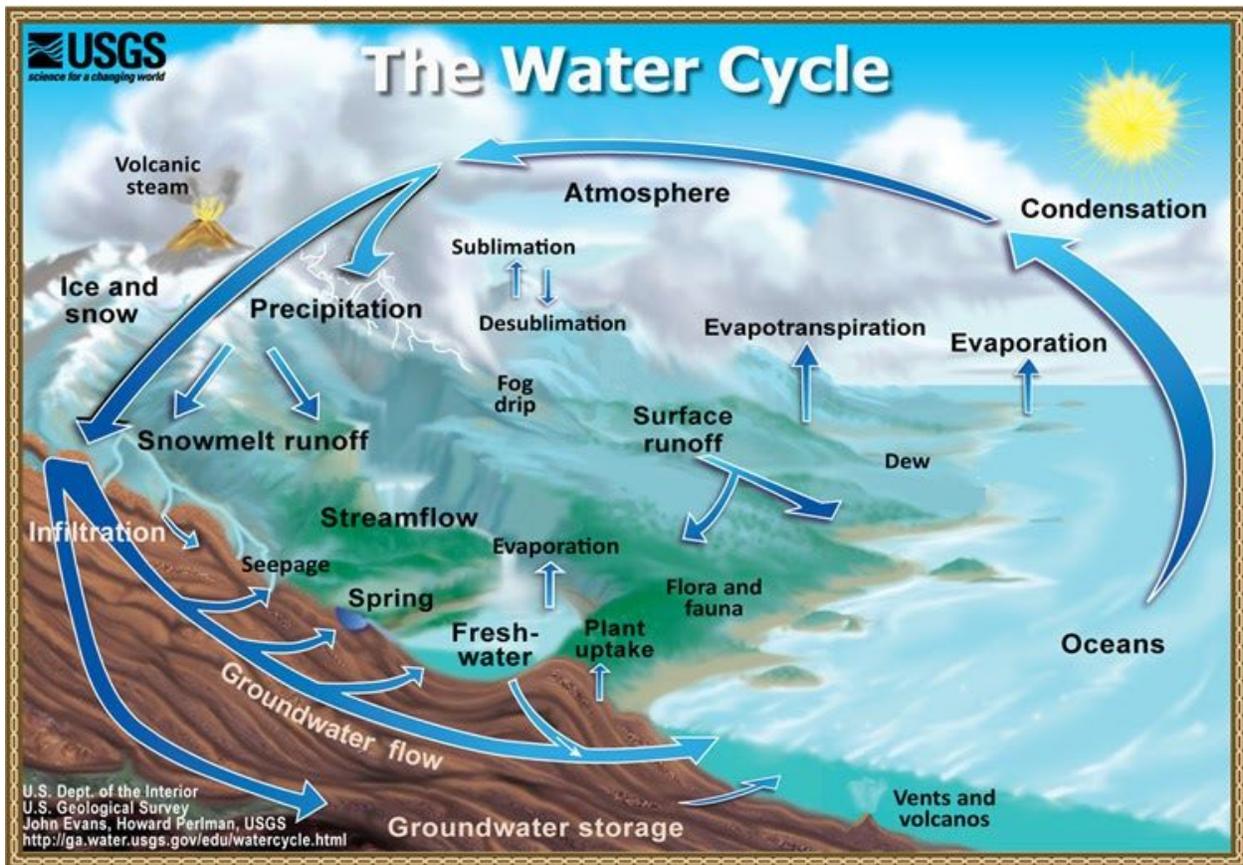
A growing body of over 700 studies indicate drinking H₂ enriched water can have desirable effects on over 170 disease models and in each of the paradigms of disease.

Water is said to move within the human body in a similar manner to how it moves in nature. See the graphic: <https://water.usgs.gov/edu/graphics/watercyclesummary.jpg>

²² "Ageing and the Glomerular Filtration Rate: Truths and Consequences."
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2744545/>.

²³ "THE AGING KIDNEY: PHYSIOLOGICAL CHANGES - NCBI - NIH."
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2901622/>.

²⁴ "John Libbey Eurotext - Hydration Throughout Life - Maurice Arnaud."
http://www.jle.com/en/ouvrages/e-docs/hydration_throughout_life_20450/ouvrage.phtml.



Summary of Traditionally understood Role of Water in body balance

Water quenches the principle of fire in the body which transforms water into vapor that may then deposit into the various regions of the body.

In the book, The Web That Has No Weaver, Ted Kaptchuk, O.M.D. summarizes the cycle of water in the body as follows:

“Fluids are received by the Stomach which begins the process of separation, by which the unusable portions of food are sent to the intestines as waste and pure water is extracted. This process is continued by the Spleen which then sends the pure Fluids in a vaporized state upward to the Lungs. The Lungs circulate the clear part of the Fluids throughout the body, but liquify whatever has become impure through use and send it downward to the Kidneys. In the kidneys, the impure part is further separated into relatively “clean” and “turbid” parts. The clear part is transformed into a mist and sent upward to the Lungs,

where it rejoins the cycle. The final impure portion goes into the Bladder, where it is stored and subsequently excreted."

Further study to reconcile modern and ancient physiological models of reality is needed to bridge the wisdom of the ages to the future of healthcare. I believe that through a combined understanding of ancient and modern models, we can continue to make breakthroughs in health and healing. A recent breakthrough is the increased understanding of the health effects of diatomic hydrogen.²⁵

The Best Water for Optimal Hydration

When hydrogen gets close to a toxin it transforms the toxin directly into water.²⁶ Supplementing with molecular hydrogen provides selective antioxidant support which has important benefits across over 200 biochemical processes within the body^{27, 28}. There is an evidence base suggesting a plethora of health benefits related to drinking hydrogen rich water. One major reason why hydrogen is so beneficial is because it reduces oxidative stress in the body.

Oxidative stress plays a major role in all aspects of human biochemistry.²⁹ Oxidative stress can be neutralized by molecular hydrogen gas when dissolved into water. Due to its electro-chemical magnetic attraction to toxins in the body³⁰, hydrogen can improve hydration in subcellular compartments where toxins are generated and can cause the most harm. List of disorders caused by oxidative stress:³¹

ADD/ADHD, Alzheimer's Disease, Angina, Anxiety, Arrhythmia, Asthma, Atherosclerosis, Benign Prostatic Hyperplasia (BPH), Carpal Tunnel Syndrome, Bipolar Disorder, Cancer,

²⁵ "Hydrogen acts as a therapeutic antioxidant by selectively reducing" 7 May. 2007, <http://www.nature.com/articles/nm1577>.

²⁶ "An introduction to free radical biochemistry. - NCBI." <https://www.ncbi.nlm.nih.gov/pubmed/8221017>.

²⁷ "Hydroxyl Radical and Its Scavengers in Health and Disease - NCBI - NIH." 17 Jul. 2011, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3166784/>.

²⁸ "Mechanisms of Oxidative Damage and Their Impact on ... - NCBI - NIH." <https://www.ncbi.nlm.nih.gov/books/NBK299057/>.

²⁹ "Biochemical responses and mitochondrial mediated ... - NCBI - NIH." 29 Apr. 2014, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4085354/>.

³⁰ "Biochemical responses and mitochondrial mediated ... - NCBI - NIH." 29 Apr. 2014, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4085354/>.

³¹ "Oxidative Stress Resource." <http://www.oxidativestressresource.org/>.

Breast, Bladder, Colon (post radiation and chemotherapy syndrome) Cardiovascular disease, Cataracts, Celiac Disease, Childhood Neurodevelopmental Disorders, Chronic Fatigue Syndrome, COPD, Congestive Heart Failure, Crohn's Disease, Depression, Dermatitis, Diabetes, Erectile Dysfunction, Fibromyalgia, GERD, Glaucoma, Hypercholesterolemia, Hypertension, Hyperthyroidism, Influenza, Kidney Stones, Lyme Disease, Macular Degeneration, Multiple Sclerosis, Parkinson's Disease, Psoriasis, Rheumatoid Arthritis, Sleep Apnea, Systemic Lupus Erythematosus (SLE), Thrombosis, Tinnitus

Summary of Real-World Benefits of H₂

1. Improved neuron and synapse development
2. Increased mitochondrial ATP (energy)
3. Healthier neuron structural development and creation
4. Improved Cell membrane integrity

Conclusion of molecular hydrogen on health

Extensive human study has been done on the effects of euhydration and hypohydration on health and athletic performance. Due to the action of hydrogen in the human body it is reasonable to believe that molecular hydrogen supplementation may improve cellular hydration thus maximizing physiological function. These desirable health effects may be achieved with absolutely NO negative side effects while preventing many diseases and promoting health from within.