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Biologically Structured Water (BSW) - A Review (Part 3): Structured Water (SW) Generation, BSW Water, Bioenergetics, Consciousness and Coherence

Craig L. Ramsey*

Retired – USDA, Fort Collins, CO, 80526, USA

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Abstract:

Natural water sources become partially structured when exposed to cold temperatures, aeration, and sunlight in high mountain streams or kosmotropic ions. Drinking water devices that make structured water utilize methods such as resonance, vortex designs, and static magnets to alter H-bond configurations in liquid water. Other methods, such as the Advanced Oxidation Process (AOP) or vortexing, utilize energy or mechanical methods that are strong enough to break the covalent bonds in liquid water. After water splits into hydronium ions (H_30^+) and hydroxyl radicals (•OH), these molecular species rapidly reform back into SW water with stable H-bonds. Several companies offer AOP water generators for the remediation of wastewater, industrial water treatment, hydroponic, and agricultural uses. Other companies offer vortex generators for SW drinking water for households and institutions. The final section summarizes the interconnectivity and synchronization between BSW water, bioenergetics, consciousness, and quantum coherence. The continuous layer of BSW water within all cells and covering all biological membranes allows it to capture, store, resonate, amplify, and transmit a wide spectrum of EMF energy that forms the basis of bioenergetics. Application of quantum biology principles to BSW water opens promising research fields potent with solutions to enhance human health and longevity. Other SW and BSW water research areas potentially include environmental and wastewater treatment, medical treatments for age-related diseases, energy generation, and possibly even manipulation of rainfall patterns.

*Corresponding Author
E-mail: clramsey37@gmail.com

1. STRUCTURED WATER GENERATION METHODS

This review emphasized that SW water and BSW water are very different in terms of structure and function. Natural healing springs, wells, and high mountain streams typically contain moderate levels of SW water. Also, high-quality SW water can be man-made or generated using the abovementioned techniques. As aging occurs or during stress events, BSW water can be replenished with SW water. Replenishment with natural water sources if SW drinking water is consumed frequently or daily. If natural SW water sources are not locally available, then drinking SW-generated water should also maintain BSW water at optimum health levels. Unlike SW water, BSW water is self-assembled, *in vivo*, under physiological constraints. BSW water has significant biological functions due to its interfacial, liquid crystalline properties and its universal coverage of all living biological surfaces. BSW water is created as needed in the same manner as all other cell components. However, BSW water levels decline with age. At present, research suggests that biological-based liquid water absorbs either internal or external energy sources, altering H-bond strength and configuration, and transforming liquid water into BSW water. The first section of Part 3 of this review will cover how to add structure to liquid water using moderate energy fields to alter the H-bond network or energy sources strong enough to ionize the covalent bonds in water. The last section of Part 3 will then focus on the interactions between very subtle "*in vivo*" energy fields, bioenergetics, and BSW water.

Energy fields are required to stabilize, alter, or bend hydrogen bonds between water molecules to increase structure in liquid water. As mentioned earlier in this review, energy fields such as infrared radiation, ultrasound, ion cyclotron resonance at 7 Hz, vortex dynamics, and magnetic fields can add structure to liquid water (Part 1). These are generally considered moderately strong energy fields that interact with the H-bonds without breaking covalent bonds. The mechanisms underlying the interactions between the energy fields and H-bonds appear to vary with the type of energy and strength of the energy field. Pollack [1] states that infrared radiation alters ionic concentrations and electrostatic charges, strengthening the H-bonds between water molecules. Other water devices use magnetic fields combined with vortex designs based on the Golden Rule. This design generates SW water as the water flows in ever smaller concentric circles. One website claims that mineral water spinning in the vortex flow generates a piezoelectric energy that adds structure to liquid water. Another website states that the Golden Rule design initiates "phase conjunction" as water swirls in the device. Phase conjunction is the synchronization and phase locking of the flowing water's combined energies, increasing water structure [2]. Chang and Weng [3] found that magnetic fields cause electron delocalization, resulting in stronger H-bonds in water. Hosoda *et al*. [4] also found that magnetic fields induce the delocalization of electrons that strengthen H-bonds in water. Mohri *et al*. [5] found that hydronium ions (H_3O^+) resonate at 7.85 Hz, which increases water structure. The resonance of H_3O^+ ions implies that energy fields with these ion frequencies that resonate with water molecules will also increase water structure. Another water device uses a wire mesh to increase structure [6]. The device website claims that vortex, magnetic, electric, vibrational, and hexagonal energies induce structure as water is passed through the wire mesh. The myriad of interactions between non-ionizing energy fields and water H-bonds is very complex. Chapin [7] maintains a continuously updated website with the latest information on how energy fields alter H-bonds in liquid water and how they may form into SW water. Despite all this information, many unanswered questions remain about the effects of energy fields on H-bonds in water, including the duration of any alteration in H-bond strengths and the resulting polymeric structures. Most commercial SW drinking water devices for homes use methods that alter the H-bond numbers or change the H-bond strength without ionizing the water.

Another method for increasing water structure is to expose liquid water to energy sources that are strong enough to ionize the covalent bonds within water molecules. Research has shown that splitting water molecules using specific methods causes the ions and free radicals to reform back into water with stronger H-bonds between water molecules. The hydrogen bonds in water can range from strong chemical strengths (covalent bonds) to weak physical bonds (weak H-bonds) depending on the degree of water structure [7-12]. The strength of the H-bond is the primary determinant of water structure stability [8, 11].

In Part 2, the generation of alkaline water was briefly reviewed. Water can be electrolyzed or split into ions using the ionizing energy of electricity. During electrolysis, hydroxide ions (OH^-) are formed at the anode, which converts the neutrally charged liquid

water into alkaline water. Water electrolysis results in only positive and negative ions that result in liquid water with either lower or higher pH properties. All electrolyzed drinking water products have a higher pH and are labeled alkaline. Other ionizing methods are used to generate structured water to create hydroxyl radicals (•OH) and hydronium ions (H_30^+) by breaking the covalent bonds in water molecules.

Creating strong and stable H-bonds in water requires that liquid water is split into hydroxyl radicals (•OH) and hydronium ions (H30+), which results in several polymeric water structures. The dimer, trimer, and tetramer water structures have weaker H-bond structures. The cyclic-shaped pentamer and hexamer water structures have stronger H-bonds. These cyclic polymer structures can be generated using methods that hydroxylate liquid water sources. Liquid water molecules break their covalent bonds after crossing the ionization threshold of 12.6 eV, and water temporarily disassociates into ions and •OH free radicals [13, 14]. Adding oxygen species such as ozone (O_3) or hydrogen peroxide (H_2O_2) is crucial in generating hydroxylated water. These non-radical but reactive oxygen species react with the ions and hydroxyl radicals created during the water-splitting process at femtosecond intervals. Unal and Bozkava [15] conducted a computational study using quantum-based models to study hydroxylated water's structure, stability, and binding energy as it converted back into cationic water clusters $(H_2O)_n^+$ n=2-6. They also found that water clusters formed at the following frequency: 2 dimers, eight trimers, 18 tetramers, 23 pentamers, and 25 hexamer structures. In a similar study, Unal and Bozkava [16] found that hydroxylated water also reformed back into anionic water structures $(H_2O)_n^-$ resulting in 16 pentamer and 18 hexamer clusters. A study by Lin *et al*. [17] found that hydronium ions (H_30^+) and hydroxyl radicals (•OH) are the most frequent species generated in laser-ionized water when imaged at femtosecond time frames. Also, Xing *et al*. [18] found that hydroxyl radicals will react with hydronium ions in water droplets. Numerous quantum-based computational studies have been performed to determine the effects on the structure and stability of reformed water molecules during the hydroxylated water process [19-21]. These computational studies show that hydroxylated water produces a high percentage of cyclic, pentamer, and hexamer water structures with strong H-bonds. The stability of these cyclic structures makes them degradation resistant for such agricultural uses as hydroponics, aquaculture, or crop irrigation. Drinking water devices that use less expensive methods to alter H-bond networks in liquid water may be more desirable when SW water stability is not critical for the end use. The accuracy of the different computational models and methods is an ongoing research topic for estimating cluster size, stability, and H-bond binding strength.

If liquid water is split using appropriate methods so that hydronium ions (H_30^+) and hydroxyl radicals (•OH) are the most frequent species, the free radicals can be magnetized. A free radical is an atom, molecule, or ion with an unpaired valence electron. Depending on the energy input, liquid water can disassociate into such species as H (atomic hydrogen), H_2 (molecular hydrogen), H^+ (hydrogen proton only), $H:^-$ (hydride), •OH (hydroxyl), and $H3O^+$ (hydronium ion). The atomic hydrogen (H) and hydroxyl (•OH) species are free radicals with a single electron in the valence orbit. Any atomic or molecular free radical species can be magnetized when exposed to an external magnetic field. A magnetic field can align electron and proton spins to the magnet's polarity, i.e., positive or negative spins align with the magnet's polarity [22]. However, free radicals with the same spin cannot recombine but will react with another species without single electrons in the valence orbit. In summary, if water disassociates into atomic and molecular radical species, then reform those species back into water molecules that maintain the electron spin status associated with the polarity of the external magnetic field.

Pang [23, 24] and Smirnov [25] postulated that the quasi-free H^+ vortices in the cyclic rings in SW water could be spin-aligned with an external magnetic field. Spin alignment of either quasi-free electrons or H^+ in cyclic rings is possible due to the delocalization of the subatomic species. Pang [23, 24] states that the delocalized proton rings that circle hexamer water rings are free and can be spin-aligned, up or down, depending on the polarity of the external magnetic field. Smirnov [25] also concluded that delocalized protons circling the hexagonal water rings could be spin-aligned to either the North or South pole of an external magnetic field. The proton ring spin alignment postulate is indirectly confirmed in several magnetized water studies that revealed that the magnetic polarity of irrigated water can affect plant growth. Several studies that used magnetized water exposed to the South Pole face of the magnets increased plant growth [26-29].

The use of external magnetic fields in combination with water hydroxylation methods would generate SW water with water properties associated with magnetized water exposed to North or South Pole magnetic fields.

These polymeric water structures favored cyclic rings with shortened H-bonds and delocalized electrons swarming in π orbits above and below the cyclic rings. Rai *et al*. [30] found that an external electric field caused the cyclic water structures to form into open chains of H-bond linked pentamer and hexamer water strings. These open chains of cyclic pentamer and hexamer water strings readily conduct electricity due to the delocalized electrons in the π orbits of each cyclic water ring. Ge *et al*. [31] published a review on using terahertz scanning methods to detect and quantify water content in tissue. They report that terahertz scanning of biological tissue resulted in a dielectric relaxation time for bound water in the tissue that was 30 times higher than that of free water. Ho [13, 14] states that the dielectric constants are 160 and 15 for coherent or SW water and liquid water, respectively. In other words, SW water has a tenfold higher capacity to store electrical charges. Custelcean *et al*. [32] found that hexamer water rings could self-assemble into 2D crystalline “tapes” that resemble the hexagonal ringed lattice layers in ice. These lattice layers contain “dangling H-bonds” that allow proton tunneling to alter the next H-bond sequence that continues the self-assembly process. Other research has shown that hexamer water rings can form stable supramolecular water structures [33-35]. These findings indicate that the hydroxylated water process allows hydronium ions and hydroxyl radicals to reform into SW water with stronger H-bonds that favor cyclic rings with increased electrical conductivity, a higher dielectric constant, and long-term stability.

Hydroxylated water is generated using a combination of ionizing energy with oxygen non-radical species based on Advanced Oxidation Process (AOP) principles. At present, there are seven AOP methods for generating hydroxylated water. The seven AOP methods include 1) Ozone + Ultraviolet Irradiation (O3 + UV), 2) Ozone + Hydrogen Peroxide/Ozone (O_3 + H_2O_2), 3) Hydrogen Peroxide + Ultraviolet Irradiation (H_2O_2 + UV), 4) Cavitation- hydrodynamic, or acoustic - ultrasonic plus O_3, 5) Fenton’s Reaction – hydrogen peroxide and Fe cation, 6) High Energy Electron Beam Irradiation (E-beam), and 7) TiO2-catalyzed UV Oxidation. The most common commercial AOP water generators use the first four methods for creating hydroxylated water [36-40].

The Ozone + Ultraviolet Irradiation (O3 + UV) method consists of a closed-loop water system with water tanks, pumps, venturi jets, ozone concentrators, and UV lamps. Ozone must be injected into the water before the UV radiation so that reactive oxygen is available as the water molecules are split with the UV radiation. Water molecules can be split with ultra-violet wavelengths at 185 nm or shorter, with a minimum energy input of 6.893 eV [41]. One method of generating ozone is to use ultraviolet light (185 nm) to convert air and water droplets into ozone. A venturi jet adds O_3 into a water tube, and the ozonated water is exposed to 254 nm UV light, which converts the ozone into hydroxyl radicals. Larger, more complex water generators use oxygen concentrators and ozone generators to create a high-volume flow of concentrated ozone. A venturi jet then injects the ozone into a water tube, where the ozonated water is exposed to UV radiation to produce hydroxyl radicals. These •OH radicals react with hydronium ions in liquid water to create SW water with cyclic, polymeric structures with stable H-bonds [16-18, 30, 31].

The Ozone + Ultraviolet Irradiation (O3 + UV) method was used to design a custom-built SW water generator for a study conducted by Ramsey [42]. The custom-built SW water generator also used neodymium magnets to strengthen the H-bond formation process during the hydroxylation of liquid water. The first results from this study reported that the optimal seed and SW water treatments had a total water savings of 50% for plants under high water stress. Along with total water savings estimates, another water usage parameter is whole-plant water use efficiency, which reached 87% for this study's optimal seed and SW water treatment. The second article focused on new water vapor data and whole plant water use that was not explored in the first article. The second article also expanded on the study factor effects on the deactivation of plant defenses, plant resilience, and macroscopic coherence.

Comparison of the hydroxyl radical yields for the different AOP methods is an ongoing research topic [43-45]. Medium to large-scale AOP systems treat industrial, agricultural, or municipal wastewater. A study by Ambrogi *et al*. [46] conducted a comprehensive comparison among eight AOP methods. They concluded that there was no clear

winner among the eight AOP methods tested based on first-order degradation kinetics of wastewater pollutants. However, they also state that the Hydrogen Peroxide + Ultraviolet Irradiation (H_2O_2 + UV) and the Fenton-based AOP systems had broad efficiency in the degradation of multiple water contaminants. In general, as the input energy increases in the AOP methods, higher water splitting rates occur, with higher yields of hydroxyl radicals that are used to degrade the wastewater contaminants. The commercial AOP systems mentioned above [36-40] are used for industrial or municipal water treatments. These water systems also treat wastewater, which is often returned to resupply municipal water systems as a future drinking water source.

One company [38] offers several AOP water treatment systems based on ozone and ultraviolet radiation. They offer these AOP systems in agriculture for controlled environments such as hydroponics, greenhouse, and aquaculture facilities. They also provide water treatment systems for livestock, swine, poultry, and dairy facilities. Their AOP systems include flow sensors to control physicochemical water properties such as pH and ORP accurately. Their systems are then fine-tuned to match the specific plant or animal requirements of the end user. The recommended safe range for ORP for hydroponics is +300 to +400 mV. Research in hydroponic systems reveals that prolonged exposure over +450 mV may harm plant roots [47]. Hydroponic systems often require the most fine-tuning of ORP parameters so that plant roots remain healthy while aquatic microbes and algae blooms are kept at non-harmful levels. The CDC drinking water standards for ORP levels are set at 600 mV and are not to exceed 900 mV. The German drinking water standard for ORP is 750 mV for disinfecting bio-contaminates in water sources. All the AOP systems have controls to fine-tune the physicochemical parameters to match the end user's specific needs.

The other primary method of generating SW water is based on water cavitation using various vortex methods. The non-ionizing generator designs include spiral tubes based on the Golden Rule or devices that create vortex hydrodynamics based on cavitation principles. The generator designs that cross over the ionization threshold of water are based on cavitation principles. Hydrodynamic cavitation occurs when the local pressure in water drops sharply below the saturated vapor pressure of the liquid, creating microbubbles of gas vapor. The microbubbles implode or cavitate as the local liquid pressure returns to normal [48-51]. A high-energy ultrasonic pulse is released as the gas bubbles expand and implode. The ultrasonic bursts can reach pressures up to 500 MPa with a temperature of 4,800 C [48, 49]. As mentioned in Part 1, the study by Sugihara and Maiwa [52] only used 147 MPa hydraulic pressure to restructure the H-bonds in seawater to generate SIGN water. As seawater converted into SIGN water, it transmuted Na to Mg and several other radioactive elements back into non-radioactive elements [52]. These findings show that cavitation pressures from vortex hydrodynamic generators are higher than the hydraulic pressure used to convert seawater into SIGN water. A company (Molecular Impact Energy LLC, [53]) developed a steam-driven electrical generator that runs on Brown's Gas produced from the vortex-based cavitation of seawater. The energy or pressure produced by a hydrodynamic vortex system should be more than enough to create hydroxyl radicals that would reform into SW water.

Birjuk and Serebryakov [54-55] say that vortex water devices designed on the Golden Rule ratio can induce "hydro-cavitation," or microbubbles that generate SW drinking water. However, most vortex literature focuses on water generators based on hydrodynamic designs such as rotors, orifice plates, vortex diodes, or venturi tubes [56-59]. Čehovin *et al*. [60] evaluated hydrodynamic cavitation combined with ozone, hydrogen peroxide, and UV radiation to degrade natural organic matter from drinking water. Wang *et al*. [61] published a review on the disinfectant efficiency of combining hydrodynamic cavitation and ozonation for treating drinking water sources. Generally, hydrodynamic designs are more efficient and use less energy than other cavitation methods [50]. If hydrodynamic vortex water treatment systems can be designed to create powerful sonic waves that can completely disassociate water molecules, then there may be no need to add ozone to ensure the reactions favor hydroxyl formation instead of anions and cations from water molecules.

Currently, at least three companies in the USA have developed commercial drinking water systems and devices based on hydrodynamic vortex principles [62-65]. The Vortex CHC company [62, 63] tested the physicochemical water properties of their vortex system. The electrical conductivity was 300 and 1,200 µS/cm before and after water treatment [62, 63]. The

four-fold increase in electrical conductivity is a strong indicator that their vortex system converted liquid water into SW water. The Fractal Water company [65] offers water treatment devices for growing plants in hydroponic systems and greenhouses. Their water treatment devices combine vortex and magnetic energies into one design to generate SW water for various end uses.

Mitchell and Nellis [66] evaluated the effects of extreme "shock" pressure on the electrical conductivity of water. They found that water exposed to a shock pressure of 5,900 MPa had an electrical conductivity of 3.1 x 10^7 µS/cm. Chau *et al*. [67] also investigated the effects of extreme pressure on the electrical conductivity of water. They found that water under a pressure of 180,000 MPa had an electrical conductivity of 2.0 x 10^8 µS/cm. These research findings show that liquid water exposed to ultrasonic bursts from cavitation, "shock" pressure, or only extreme pressure will disassociate water molecules, which then reform back into SW water. These extremely high electrical conductivity values indicate very pure SW water. SW water has delocalized electrons associated with the cyclic water ring structures, increasing the electrical conductivity of the cyclic ringed, H-bonded water (See Part 2 Physicochemical Properties of SW Water).

Other cavitation designs are based on photoinduced and ultrasonic methods [50]. Kwak *et al*. [68] evaluated the effects of ultrasonics on energy generation due to cavitation. They found that the temperatures ranged from 2,026 to 4,326 C during the implosion of the microbubbles, and the energy released reached 47 GW/m^2. Patek and Caldwell [69] studied the cavitation forces used by the claw hammer of Peacock Mantis shrimp (*Odontodactylus scyllarus*). They found that the sonic cavitation force for the Mantis shrimp hammer was 5.04 MPa, which is strong enough to open up shellfish. Research has shown that ultrasonic cavitation generates enough energy to split water into molecular hydrogen (H_2), hydroxyl radicals, as well as other radicals (H, HO2, and O) [70-74]. At least one company offers large water treatment systems based on an ultrasonic design [40]. Their water treatment systems generate hydroxyl radicals to treat water supplies, contaminated water, and industrial wastewater.

Part 2 of this review offered substantial evidence that drinking SW water improved overall health and longevity in humans. Also, the study by Ramsey [42] shows that irrigating plants with SW water enhanced resilience to severe abiotic stress. In other words, there is a substantial case study and research evidence that replenishment with SW water improves health and resilience to stress events by maintaining or increasing BSW water at near-ideal levels. The process of SW water converting into BSW water is still largely unknown. The biological transformation of liquid water with weak H-bonds that flicker on and off at 10^{-10} to 10^{-11} s to stable H-bonds in BSW water may only be explained using quantum biology principles. As mentioned in Part 1 the H-bond strength increases between water molecules as the proton-free energy profiles progress from asymmetric double-wells to symmetric double-wells with a concomitant decrease of the proton energy barrier [13]. Hassanali *et al*. [75] state that hydronium (H_30^+) and hydroxide ions (OH^-) are decorated with proton wires that allow long proton jumps over several hydrogen bonds. It may be possible for hydronium and hydroxide ions to have proton wires with lower energy barriers that allow SW water clusters to join with the edges of BSW interfacial water. Quantum tunneling of protons through energy barriers may be the underlying mechanism for strengthening H-bonds and self-assembly of BSW water from SW supramolecular water clusters. The putative role of these ions (H_30^+ and OH^-) in the self-assembly of BSW water from SW water clusters highlights the importance of alkaline and H_2 gas drinking water products. These drinking water products replenish or supply hydronium and hydroxide ion precursors necessary to create strong H-bonds and self-assembly of BSW water.

2. BSW WATER, QUANTUM BIOLOGY, CONSCIOUSNESS, METABOLIC EFFICIENCY, AND COHERENCE

BSW water and bioenergetics are inseparably linked, as mentioned in Part 1 of this review. BSW water absorbs internal and external energy sources, increasing the BSW water zone. Also, BSW water interacts with energy fields through redox potentials, energy states in electron valence states, and the capture, store, transform, transmit, and emit coherent energy waves. BSW water can absorb internal and external EMF energy frequencies, primarily as red to infrared wavelengths, to increase the EZ zone with a concomitant increase in membrane redox potential. BSW water captures, converts, and reuses infrared energy released during aerobic respiration in the mitochondria to act as a supplemental cell energy source. BSW water also absorbs different EMF frequencies from sunlight to increase EZ water zones

and increase the ratio of excited state to ground state in Water Respiration and photosynthesis redox cycles. BSW water resonates with Schuman Resonance waves, as described in more detail below. BSW water "captures" the vibrational energies of biological atoms, ions, and biomolecules by quantum mechanical condensation of these oscillations into coherent waves. Several biological-based mechanical activities can act as a source of piezo-electric energy. Also, any electrical currents within the BSW interfacial water zone or ion movement across membranes will generate subtle to moderately strong magnetic fields. The magnetic field emanating from the heart is strong enough to affect every cell in the human body and can be detected up to 1 to 1.5 m from the body. This abbreviated list covers many of the bioenergetic interactions between BSW water and internal or external energy sources.

Another important interaction between BSW water and energy is the release of energy as biophotons. One theory on biophoton emission is that during the water respiration cycle, the excited state of BSW water reverts to the ground state of liquid water and O_2, releasing biophotons as well as approximately 180 KJ of energy per mole of O_2 (see water respiration section in Part 1) [76-79]. Voeikov *et al*. [77] state that the decomposition of two H_2O_2 molecules during the water respiration cycle releases an energy quantum equivalent to 2 eV with a visible light wavelength of λ <610 nm. Voeikov *et al*. [76] also state that reducing one oxygen molecule to two water molecules by consecutive addition of four electrons releases 8 eV. In comparison, the energy of one UV photon with a wavelength of 250 nm is around 5 eV. A plant seed study by Benfatto *et al*. [80] states that biophoton emissions in living systems range from several to hundreds/sec/cm^2. Also, they state that biophoton emissions increase tenfold during exposure to any biotic or abiotic stressor. They suggest that biophoton patterns in seeds provide evidence of the emergence of quantum coherence. If water respiration becomes a widely accepted metabolic energy pathway, then the emission of biophotons from water respiration will also be inherently accepted. Research is ongoing on the biological significance of biophotons on health and their use as a biomarker.

This summary of the interplay between BSW water and bioenergetics is still incomplete, even 50 to 75 years after the start of structured water research. This research subject is so expansive and interconnected that a holistic summary has yet to be published on the interactions between BSW water and subtle internal energy fields and external fields. The BSW and bioenergetics list mentioned above didn't include the most intriguing and baffling research subjects involving consciousness and coherence. This research area relies heavily on quantum biology principles and very subtle, disparate biological energy sources such as atomic, ionic, and biomolecule oscillations. Recent literature has made many exploratory forays offering biological and bioenergetic explanations for consciousness and coherence.

This review focuses on the bioenergetics theory that BSW water acts as a "living matrix" which is the biological phenomena underlying consciousness and coherence. The premise of this "living matrix' theory is that BSW water covers all cell and organelle membranes, constituting a continuous crystalline matrix whose network extends to every cell in an organism [81-89]. This ubiquitous matrix has liquid crystalline properties with the role of media and medium for many significant biological activities [90-94]. When the myriad of bioenergetic roles of BSW water is properly understood, the overall biological significance of BSW water cannot be overemphasized. The ability of BSW water to act as a medium or carrier of quantum-based EMF waves that affect consciousness and coherence has been well published.

A psychological definition of human consciousness has three human aspects, including 1) awareness of internal and external existence and associated reflective responses, 2) subjective experience that is only available from the inside, and 3) explicit self-awareness that is only present in humans [6]. Henry [69] published an article on the history of water memory involving Benveniste's research in the late 1980s. The basic premise of Benveniste's study was that water could retain information or that water has a memory. His work was highly ridiculed, but his theory evolved into more advanced theories stating that "structured" water had the ability to collect, phase lock in resonance, and communicate information using electromagnetic (EM) waves [80]. A detailed history tracing the steps away from a neurological explanation of consciousness to an EM frequency and resonance theory based on the ubiquitous BSW water network is beyond this review's scope.

The ability of BSW water to have such profound and human-like properties as communication, information

management, memory, and synchronization depends on its inherent structural properties. The structure of BSW water involves a lattice of stacked layers of strong H-bonded hexagonal ringed water with liquid crystalline properties. This dense layer of bound, interfacial water has the same quantum properties of coherent domains in SW water to capture, store, and resonate with subtle EM frequencies. In addition, BSW water connects cell components and all cells together with the expanded liquid crystalline quantum properties necessary for coherence and interconnectivity across all biological scales. Pioneer scientists such as Preparata, Del Giudice, Mae-Wan Ho, and others propose that QED principles explain how coherent domains originate in liquid water and oscillate in phase with biological-based EM frequencies [95-100]. The same QED principles explain how BSW water properties can capture, store, amplify, and phase lock into coherence or resonance with biological EM frequencies [101, 102]. As the vibrations induce resonance and superposition of atom, ion, and biomolecule frequencies in cells, the particle/waves become amplified in the liquid crystalline structure of BSW water. The energy levels of these vibrations are so low they are essentially trivial or overshadowed by stronger energy sources within the cell. However, the atom, ion, and molecular vibrational EMF waves can become non-trivial due to superposition and resonance, which leads to biological coherence and supercoherence. This living matrix is often ascribed with anthropomorphic properties such as communication, information management, memory, and coherence [103, 104].

In the late 60s, Frolich formulated his famous hypothesis that quantum coherence is an EMF-based property of life [105-108]. Over 50 years ago, Frohlich predicted that vibrational modes within protein molecules could organize and condense into a lowest-frequency vibrational mode based on Bose-Einstein condensation principles. As the various biomolecular oscillations condense into more unified EMF waves, the result is multi-scale coherence in biological systems [109]. Lundholm *et al*. [110] conducted a study to evaluate whether terahertz radiation could induce non-thermal structural changes in a protein crystal based on Frohlich's condensation theory. They conclude that the unexpected duration of protein crystal vibrations, which had micro- to milli-second lifetimes, can only be explained by Fröhlich's condensation theory.

Articles published by Del Giudice [95-98], Messori [99, 100], Ho [14, 84], Renati [111], and Madl and Renati [112] reveal how Quantum Field Theory (QFT) explains the interactions between BSW water and biological coherence. The QFT theory predicts that all matter vibrates, and subatomic particles and atoms oscillate, causing biomolecules to vibrate. Other scientists offered similar quantum biology principles to connect the interactions between BSW water and the resonance of universal frequencies with coherence and high-level consciousness or self-awareness [113-121]. Consciousness or self-awareness is the ability to assess and comprehend our inner being or being able to reason, conceptualize, and have thoughts, feelings, beliefs, values, and actions. Geeksink *et al*. [113] proposed that BSW water is the cradle of life due to its liquid crystalline properties that act as a zero-point energy biological medium for quantum coherent frequencies. They state that BSW water has a comparable set of EMF bands with the frequency bands in the cell cytoplasm; therefore, the EMF frequencies will phase lock into coherent resonance between BSW water and the integrated oscillations of the cells [113]. Oschman [80, 114] proposed a variation of the QFT theory that atom, ion, and biomolecule vibrations are captured and become coherent in BSW water. He proposes that the collective ion and molecular oscillations are amplified by the resonance that induces coherence in the liquid crystalline water media.

Messori *et al*. [99, 100] wrote two insightful reviews on BSW water and biological coherence. They explain that the QFT theory describes the interactions between matter, tissue, and vacuum electromagnetic fields (VEMF). When biological tissue or cells absorb energy from the VEMF photons, the cells or tissue oscillate in phase with the VEMF frequency, leading to a phase transition. Bose condensation is a second-order phase transition with no latent heat associated with the transition. When cellular oscillations are in phase, and two or more energy waves/particles overlap, the resultant wave is the algebraic sum of the individual waves, according to superposition principles [101, 102]. Messori *et al*. [99, 100] explain how liquid water absorbs EMF energy inside any coherent domains in unstructured water. They also explain how the expanded quantum properties of liquid crystalline BSW water allow the superposition of EMF particles/waves emitted from the cell cytoplasm. Quantum coherency emerges when the subtle, disparate vibrations of atoms, ions, and biomolecules slip into phase or superimpose together in BSW water. Quantum

coherence involves the superposition or entanglement of basic states (waves/particles), such as the spin, ground, or excited states [101, 102]. The superposition theory has been combined with the Bose-Einstein Condensation theory. This integrated theory states that macroscopic superposition states can be generated from Bose-Einstein Condensation energy states [109, 115, 116]. However, this integrated theory has yet to be verified, or acknowledged that it has merit. Despite a lack of consensus on the theory of macroscopic superposition, there is widespread acceptance of quantum coherence. Coherence suggests that macroscopic superposition principles are valid but, as of yet, remain at the edge of scientific knowledge.

A study by Geesink and Meijer [117] developed an algorithm for coherent quantum frequencies that is linked to biological organization and order. They analyzed 175 studies and created an algorithm that generated a set of discrete EMF frequencies associated with biological health and stability. The biological-based algorithm identifies wave equations where all the frequencies have ratios of 1:2 and also closely approach ratios of 2:3. Other studies by Geesink [118] proposed that EMF frequency patterns in healthy individuals have quantum coherent patterns. In contrast, unhealthy individuals show a combination of coherent and chaotic frequency patterns. Meijer and Geesink [119] postulated that life and consciousness are guided by a semi-harmonic EMF background field emanating from fractal structured water (BSW water). Meijer *et al*. [120-122] published a three-part series of articles describing that a musical master code tunes consciousness in the universe. Another article by Meijer *et al*. [123] explains that semi-harmonic EMF frequencies exist as universal quantum entities in which humans are fully embedded in a dynamic energy field. They also state that BSW water in human brains contains hydronium ions acting as superconductive antennae that receive the semi-harmonic frequencies (musical master code) according to the Schrodinger equation. In essence, BSW water in human brains converts the universal, musical master code into consciousness. Hameroff [124] postulated that brain activity is based on quantum vibrational states, i.e., in allegorical terms, brains are more like an orchestra, and consciousness is more like music.

There is abundant evidence that quantum coherence exists at quantum scales. However, many scientists have questioned whether coherence is possible at macroscopic scales due to the decoherence effects of gravity or mass effects that theoretically disrupt quantum behavior. Other scientists argue that coherence exists at meso- and macroscopic scales or is 'scale-invariant" and can be extended into supercoherence [84, 109, 111-116, 125]. Fertig *et al*. [125] estimated that biological time scales ranged over 21 orders of magnitude, from H-bond oscillation in water (10^{-11} s) to human life span (10^{9} s). Also, Fertig *et al*. [125] estimated that biological spatial scales ranged from atoms (10^{-10} m) to whole organisms (1 m) or ten orders of magnitude. Biological coherence across these spatial-temporal scales must be scale-invariant [112]. Ho [14, 84], Tuszynski [109], and Henry [77] offer explanations for supercoherence at the macroscopic scale based on superposition and phase convergence of disparate particle/wave oscillations in the cytoplasm. They offer numerous examples of quantum biology at macroscopic scales, including vision, smell, navigation of birds, and photosynthesis.

Renati [107] and Madl and Renati [108] wrote insightful review articles on the interactions between quantum biology and BSW water across the quantum and macroscopic scales. They utilized QFT principles to explain biological coherence and supercoherence. As coherence expands across biological scales, it takes on new roles and functions at each level [107]. Biological coherence becomes more comprehensive and less defined as its roles expand to include holistic interconnectivity, information flow, and homeostasis, etc. Renati [107] attempted to broadly define the immense complexity of biological metabolism and physiology across multiple scales. He stated that biological complexity and health are a function of 1) the myriad of chemical reactions, metabolic activities, their interactive feedback systems, and responses to stimuli across all the biological scales, and 2) keeping all biological reactions and metabolic activities precisely tuned and maintaining relative homeostasis at several space-time scales [107]. BSW water, quantum biology, and bioenergetics are the fundamental components that constitute consciousness, coherence, and macroscopic coherence [14, 77, 84, 91-98, 107-120]. The liquid crystalline properties and universal coverage of BSW water enable supercoherence at the macroscopic level. Madl and Renati [108] state that BSW water is the matrix of life, i.e., that BSW water is the media and message for maintaining macroscopic coherence.

Alternative avenues of research investigated how other life forms, such as microbes and plants, have

perceived qualities such as memory, coherence, and multi-scale adaptation that mimic higher life forms. Recent publications have suggested that plants can learn and retain information at least as short-term memory [125-131]. Several scientists have postulated that plants possess at least a subliminal consciousness, also called primary consciousness [125, 126]. Other researchers have ventured further to suggest that plants can learn and adapt to biotic and abiotic stressors and retain this information as short-term memory. Segundo-Ortin *et al*. [125] published a review article on plant consciousness and cognition. They propose that primary consciousness is " marked by the occurrence of feelings, subjective or experienced states, a primitive awareness of internal and external events, states or conditions" [125]. As evidence, they offer several examples of plant behavior involving communication, decision-making, anticipatory behavior, and learning and memory. They reviewed five possible theories that could be used to explain plant cognition, including quantum-based theories. Lamarck and Desfontaines [126] tested *Mimosa pudica* plants for leaf-closing reactions to repeated plant dropping and shaking. They found that the dropped plants stopped closing their leaves after about seven or eight repeated drops. The plants had learned that the 10 cm drop was no longer a threat or injurious, so the leaves remained open after the eighth drop. If the same plants were shaken instead of dropped in the next sequence of treatments, they closed their leaves, which indicated that they were not fatigued or energy-depleted. They repeated this set of tests on the same *Mimosa* plants and found that they retained their plant drop memory for 42 days before re-starting to close their leaves after starting a new set of 10 cm drop tests. Their study shows that plants can react to environmental stimuli and retain physiological reactions in a memory system for over a month. Another avenue for exploring adaptive plant behavior and short-term memory is the emerging field of plant priming to enhance crop tolerance [127, 128].

A study by Ramsey [42] investigated the effects of SW irrigation water on a tropical legume exposed to three deficit irrigation treatments. The study results show that watering plants with SW water substantially improved their resilience to high-water stress conditions over a 45-day period. Also, SW-watered plants maintained their BSW water levels, allowing rapid synchronization between metabolic efficiency and ensuring minimal plant injury when exposed to a daily pattern of watering followed by moderate to severe water stress. The multitude of chemical signals and chemical reactions in plant defenses occur too slowly or don't occur if there are any locality (distance issues) or temporal (too few or too many reactants per time interval) issues. Maintaining optimum efficiency and minimal injury under real-time constraints in a four-meter-high legume seems highly improbable without some form of coherence. The study results show that SW-watered plants had enhanced resilience and exhibited macroscopic coherence that deactivated a suite of plant defenses while achieving both metabolic efficiency and minimal injury levels to plants under high water stress.

Excellent reviews on biological complexity have been published by Bizzarri *et al*. [129], Mazzocchi [130], and Robert [131]. Other conceptual papers focused on the interplay between BSW water, coherence, and complexity [88, 111-114, 132-134]. Vascular plants are biologically complex and are necessarily highly adaptive as they are non-mobile and cannot flee from adverse environmental conditions. Biological complexity necessitates macroscopic coherence to sustain life, i.e., when biological systems become non-organized and non-synchronized they have a high risk of injury and/or becoming terminally dysfunctional. Coherence in plants exhibits macroscopic roles such as learning, active adaptation, and memory, allowing plants to efficiently adapt and respond appropriately to ever-changing environmental conditions. In this sense, plants should not be considered lower life forms, but they operate with different quantum principles that fit their biological needs.

Medical anesthesia studies also reveal an association between BSW water, coherence, and consciousness. Three studies by Ueda *et al*. [135-137] found that general anesthesia released non-freezable, or bound water, from membrane surfaces, i.e., the BSW interfacial water was separated from the membrane surfaces. Riveros-Perez and Riveros [138] and Bond [139] published medical reviews on the interactions of BSW interfacial water and anesthesia involving pain signaling or consciousness of pain. Also, Kundacina *et al*. [140] (co-authored by Dr. Pollack) conducted a study with three local and general types of anesthesia. They found that all three types reduced the size of BSW interfacial (EZ) water zones. A related study by Yokawa *et al*. [141] investigated the effects of

noble gas-based general anesthesia on plants. They found that *Mimosa pudica* leaves, Venus flytrap (Dionaea muscipula Ellis), Cape sundew (Drosera capensis L.) exhibited snap-shutting behavior, but lost both their autonomous and touch-induced movements after exposure to the anesthetics. Also, garden cress (Lepidium sativum L.) seeds failed to break dormancy when exposed to anesthetic drugs [141]. Seto [142] found an inhalation anesthetic (enflurane) released interfacial-bound water. Yoshida *et al*. [143] published a comprehensive study on the mode of action for a range of general anesthetics. They found that regardless of the diverse structures of the general anesthetics, they can all act as molecular substitutes for interfacial water molecules, which disrupts the integrity of BSW interfacial water. As the general anesthetics bind to a protein receptor in the brain cortex region, they substitute for interfacial water molecules attached to the protein receptor sites. These results suggest that general anesthetics disrupt BSW interfacial water interactions with membrane surfaces in the brain cortex. Disruption of the BSW water structure also appears to deactivate coherence, resulting in loss of consciousness, which is the function of general anesthetics. The similar effects of gas-based anesthetics on animals and plants should be investigated further to determine whether general anesthetics disrupt the liquid crystalline properties of BSW interfacial water. If it can be determined that disrupting BSW interfacial water also disrupts quantum coherence, thereby causing unconsciousness, then alternative medical methods could be developed to achieve pain-free surgery.

Mae-Wan-Ho [14, 84] is renowned for describing complex biological coherence principles with simplicity and clarity in non-scientific terms. She states that coherence is a state of maximum local freedom and global synchronicity, something that's impossible in a classical mechanical system [84]. In other words, quantum coherence allows maximum freedom at the smaller biological scales while simultaneously having full synchronization or cohesion at all other higher biological scales. This allows lower-scale systems to respond separately and independently to rigorous activities while simultaneously synchronizing across all the higher biological scales to perform the activity efficiently.

The incongruent ramifications of studying biological complexity using reductionist methods were not lost on Mae-Wan Ho. She published a masterpiece book in 1993 titled *The Rainbow and the Worm- The Physics of Organisms* [144] that delved into the quantum weirdness between physics and biology. Her applied science book was built on the quantum theories proposed by physicist Herbert Frohlich. Her work evolved through several iterations into a tour de force summary of the interplay between quantum biology, BSW water, coherence, and the most fundamental aspects of biology that is still yet to be fully comprehended 30 years after publication. One of her primary arguments was that biological complexity should be studied holistically. She stated that reductionist methods invariably dismiss or ignore the interconnectivity among system components that seem trivial at first glance but are not. Other scientists have also concluded that biological complexity is best studied at the holistic level [132, 133, 145-148]. Her manuscript was titled after her research discoveries with hatching fruit fly larvae that shimmered with rainbow colors under a polarizing microscope. The rainbow colors were refracted from the liquid crystalline water that covered the larvae membranes. Thus, she started her journey toward an enlightened understanding of quantum coherence and supercoherence along the full range of biological spatial-temporal scales.

The principle of coherence has been extended to include entrainment or group coherence. Entrainment occurs when individual life forms become interconnected through EMF-based auras or "biofields" that extend into the space surrounding each individual. Observations of social-animal interactions suggest that entrainment is a biological phenomenon due to the unexplained synchronicity in migratory birds, herding animals, and insect or bird swarms. Biological entrainment is evident in the fully synchronized movements of bird and insect swarms and schools of fish in YouTube videos. Starling swarms may contain thousands of individual birds that exhibit free-form flight patterns that are fully synchronized and so tightly spaced that the visual image looks like one flowing stream of birds [149]. Another video shows a large school of large Jack fish in a tightly packed, vertical spiral [150]. The fish school shows highly synchronized swimming patterns in hundreds of fish that can only be explained by a biofield-based interconnectivity among the individual fish. Another video shows nine synchronized kittens batting at a feather on a string [151]. The nine kittens exhibit near instantaneous and

identical body movements that can only be explained by the interconnectivity of biofields. Scientists interested in alternative medical treatments have investigated the evidence for human biofields and auras by measuring subtle energy fields emanating from individuals [152, 156].

Biomonitoring devices are being developed to detect, monitor, and analyze health status based on life-form EMF emissions. If biophotons originate from the release of energy during the decomposition of BSW water, then there should be a direct relationship between BSW levels and biophoton emission rates. A recent review evaluated three techniques for monitoring biophoton emissions in humans and plants [157]. Monitoring the absorption of specific energy bands in tissue is the opposite of monitoring biofields based on energy emissions. However, biomonitoring the absorption and emission spectra of energy fields in living tissue has the potential to rapidly and frequently detect any changes in health status and resilience to stressors. A promising research area based on the absorption of near-infrared (NIR) spectral bands in tissue is known as aquaphotomics. This system uses non-destructive near-infrared spectroscopy methods to measure water structure dynamics in living tissue [158-162]. The aquaphotomics system is based on software programs that associate 12 near-infrared spectral bands from 1,350 to 1,500 nm with a range of water structures. An aquaphotomic review by van de Kraats *et al*. [162] states that the NIR band between 1,492 and 1,494 is absorbed by water molecules with four hydrogen bonds with pentamer structures. Also, interfacial water molecules that are strongly bound to cell membranes (BSW water) absorb NIR bands between 1,506 and 1,516 nm [162]. Biomonitoring the NIR absorption spectra in tissue could potentially be associated with biofield emissions if they are both linked to BSW water as an EMF-based energy sink and source.

In addition to biological entrainment due to EMF-based biofields emanating from life forms, another form of group interconnectivity is based on extremely low frequency (ELF) EMF fields. As mentioned in Part 1, Schuman Resonance waves are global standing waves that circle the Earth in the atmosphere between the Earth and the ionosphere. These standing ELF-EMF waves are continuous, and due to their long wavelength, they penetrate virtually all materials, i.e., they are standing waves that affect all life on a global basis. The Schuman Resonance waves are standing waves due to continuous energy inputs from the sun and lightning strikes. Schuman Resonance has five fundamental ELF-EMF bands directly match the five main frequencies of human brains, 1) Delta (0.5 – 4 Hz) - sleep, 2) Theta (4 – 8 Hz) – deep mediation, 3) Alpha (8 – 12 Hz) – calmness, creativity, learning and mental activity, 4) Beta (12 – 30 Hz) – alertness, focused, aware of self and surroundings, and 5) Gamma (30 – 70 Hz) – high-level learning, insight, peak experiential [163, 164]. All life forms are affected by the standing Schuman Resonance (ELF-EMF) waves due to resonance between BSW water and the ELF-EMF frequencies. Schuman Resonance bands affect human thought, emotions, and behavior. The ELF-EMF wavelength properties quasi-interconnect all life forms that maintain BSW water levels that can absorb biologically active rates of these wavelengths. The overall human impact depends on individual sensitivity and variation in the ELF-EMF frequencies due to geomagnetic storms and sun flares [165-169].

Research has shown that sun flares often intensify or increase the peak frequency within the five Schuman Resonance bands, which typically negatively affects human emotions, behavior, and brain activity [165-169]. Persinger and Saroke monitored Quantitative Electroencephalographic (QEEGs) brain activity profiles that were matched with simultaneously occurring Schuman Resonance patterns [170]. They found a real-time coherence, or synchronization between brain and Schuman frequencies, with altered cognition and dream patterns. Another study by Saroke and Persinger found a strong coherence pattern between the brain and Schuman Resonance bands [171]. McCraty and Alabdulgader [172] published a review on the effects of solar and geomagnetic storms on human behavior and physiology. They found that human behavior was often synchronized with solar and geomagnetic storms. Alabdulgader [173] also attempted to link global human consciousness with Schuman Resonance temporal patterns, which he referred to as the universal “Great Whisper.” Several articles have suggested global interconnectivity between geomagnetic and solar storms, Schuman Resonance patterns, and human behavior [173-177]. Solar storms increase the frequencies in the five Schuman Resonance bands, negatively affecting human behavior, physiology, and brain activity in the lower brain wave bands (Delta, Theta, and Alpha bands).

In contrast to the negative effects of geomagnetic storms, several brain mediation studies have found positive effects by activating higher bands (Gamma) on brain activity. Rubik [178] found that adults could increase their gamma brain activity using self-training in neurofeedback methods. The twelve adults in this study conducted self-assessments and reported enhanced emotions of happiness and love, along with reduced stress. Acosta-Urquidi [179] states that his personal studies with subjects who used biofeedback training increased their brain activity in the gamma bands. Also, the subjects experienced a feeling of bliss and an "orgasmic state" that lasted several minutes. Pennington *et al*. [180] utilized EcoMeditation, a biofeedback training method, to investigate the effects of gamma brain activity on human emotions and blissfulness. They found that after participating in an EcoMediation workshop, all the subjects could generate high-amplitude 45-65 Hz gamma frequencies and Gamma Synchrony values. The subjects could also carry their elevated mental states into waking consciousness. Church *et al*. [181] also investigated the effects of EcoMeditation training on gamma brain activity and transcendent experiences. They found a significant reduction in anxiety, depression, posttraumatic stress, and pain. They also found increased happiness, flow states, and transcendent experiences. Stapleton *et al*. [182] also investigated the effects of a mediation workshop on the five brain activity bands. They found an 11% increase in gamma brain activity for the subjects tested before and after the brief mediation training. A follow-up study by Stapleton *et al*. [183] investigated the effects of EcoMeditation training on brain activity and transcendental experiences. They found connectivity patterns between brain regions in those practicing EcoMeditation that were absent in the control group. They also found that the meditation-trained subjects scored higher in mystical experiences than the control group. Finally, they found that the overall emotional states were mixed, with some subjects feeling positive emotions while others experienced negative emotions.

The meditation training only resulted in temporary sensations of transcendence, blissfulness, positive mood, mystical experience, or ineffability. These studies engender further questions about gamma brain activity and sensing euphoria, blissfulness, or mystical feelings. Are there any differences between the internal generation of gamma waves through mediation or exposure to external sources of gamma waves (30 - 70 Hz ELF-EMF)? Is it possible to maintain higher levels of BSW water to capture and transform any external gamma frequencies (30 – 70 Hz) into positive emotional experiences? Is it possible to extend the time span of the temporary emotional experiences by using a continuous external source of 30 – 70 Hz ELF-EMF energy? Is it possible to increase BSW water levels by drinking SW water or exposure to NIR lamp treatments and avoid possible negative impacts on the Delta, Theta, and Alpha brain activity while enhancing any potential positive effects of increased BSW levels? Brain wave interactions with BSW water are a promising field of study concerning emotional, mental, and physical health and the interactions between external energy frequencies, quantum biology, and BSW water.

This review explored the current literature involving BSW water research and the significance of BSW water for maintaining biological health and vitality, increasing longevity, and enhancing biological resilience. The hope was to shift through the avalanche of research to piece together an understandable, up-to-date review that summarizes the many different aspects of BSW water and bioenergetics. Most biological research attempts to search for "cause and effect" or reduce complexity into simpler, more manageable hypotheses. However, the simpler the models, the higher the biological dysfunction and loss of ability to sustain life across all biological scales. This review focused on the holistic aspects of BSW water and bioenergetics research so that concepts such as complexity and interconnectivity could help explain the unbounded nature of biological systems. In Behe's book [184] "Darwin's black box: The biochemical challenge to evolution" the concept of irreducible complexity is defined for biological systems. This definition was originally constructed for complex biochemical systems but has larger implications for holistic research. Irreducible complexity implies that any attempt to simplify or reduce biological systems simultaneously introduces a degree of dysfunction into such massively interconnected and coherent systems. As the biological scale moves up to the individual, the concepts of biological complexity, coherence, and holistic bioenergetics merge into the higher and broader questions of how to sustain life under quite strict real-life spatial-temporal constraints in dynamic, widely varying environments.

This review started with the basic premise that BSW water and biological energy were intimately and

inseparably interconnected. Another introductory premise was that the structure of BSW water was as important or more important than water content for maintaining metabolic, redox, signaling, energy, and coherence functions in most life forms. The continuous layer of BSW water within all cells and covering all biological membranes allows it to capture, store, resonate, amplify, and transmit different forms of energy that form the basis of bioenergetics. The field of bioenergetics includes such energy sources as energy derived from energized electrons returning to their base state, membrane potential, biomolecular vibrations/ oscillations, resonance, and piezoelectric/mechanical or even bioluminescence. The interactions between BSW water and bioenergetics are so subtle and difficult to measure that a new field of quantum biology emerged to clarify and offer basic physical theories for the myriad of subtle and disparate redox and EMF-based activities.

The application of quantum biology principles to BSW water opens up fascinating and bewildering research fields that offer promise for preventing age-related diseases and enhancing human health and longevity. Also, BSW water can enhance biological resilience to alleviate biotic and abiotic stressors or reduce physical or emotional stress levels in humans. Other SW water research areas may include ensuring safe and clean municipal water supplies and wastewater treatment. Energized SW water can be readily split into H_2 and O_2 gases for energy generation. Even such far reaching concepts such as manipulation of rainfall patterns may be possible using a combination of SW water properties and Schuman Resonance principles. These research areas offer much promise and potential for scientists willing to keep an open mind and risk exploration of such uncharted scientific realms.

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