BRAIN GUT 13: WHERE OPTIMAL MEETS ALL WORLD PERFORMANCE

READERS SUMMARY:

1. WHY IS DHA IN ITS EVOLUTIONARY PACKAGE THE KEY TO THE MASSIVE METABOLIC RATE OF THE HUMAN BRAIN AND HEART?

2. WHAT EVER MAKES CELLULAR SIGNALING "CLEAN" FOR AN ORGANISM LEADS TO OPTIMAL HEALTH.

3. WHAT THE BIOCHEMISTRY OF NEURAL LIPIDS MEANS FOR HOMO's SOLUTION?

4. WHAT ARE THE KEY METABOLIC NEUROLOGIC KEYS TO OUR REAL SOLUTION FOR HEALTH?

5. WHY METABOLIC NEUROPHYSIOLOGY = OPTIMAL HEALTH?

Many have asked me how I have the physical and mental ability to do all I do. It is pretty simple. On my own journey to Optimal I stumbled into some neural science that showed me where optimal nutrition meets optimal performance of all types. Since I found this evolutionary use, all my abilities have increased exponentially. I can do things now that I could not do even in my prime years when I was in college, medical school, or in neurosurgical residency. I mentioned this when I was in Austin in March.

This blog series is my goal of fulfilling a promise I made in March 2012 at Paleo Fx that there was a lot more to the paleolithic template than the current tribe believed. It was there, in Austin, that I first mentioned the possibility of an Epi-Paleo template for our species. Many in attendance were

non believers and visibly upset just by the suggestion that there might be something above the Paleo template for our species. My intentions were never to upstage the movement at all, I just wanted to share ideas with people.

Ironically, the people I most wanted to talk with were not interested in speaking with me. My goals are to make sure the movement knows it may not be on solid ground with some of their core beliefs. If a movement is going to make an impact on modern science and medicine it had better have a strong foundational base that is supported in all the literature we read. This same case was made at AHS 2011 by Dr. LaLonde. He did not face a lot of flack over his perspective back then and I do not think my perspective should be a big deal now for the community.

This series is painstakingly showing you the data supporting the Epi-Paleo Rx for our species that I mentioned in Austin. This data is well known in my field of neurosurgery/neurology and in several others, but is not well known in the Paleo arena. That is where the problem really lies for the movement. If they are going to get their foot in the door of medicine, they are going to have to examine this data carefully and re create their current solution to include the parts they did not know about.

This science paints a new picture for optimal health and performance. I think this data may make people like Ben Greenfield, look deeper into Usain Bolt or Mike Phelps diets and see the marine connection for ATP and VO2 max abilities. This is not a story of favored genetics. It is was based upon good genes being feed a steady diet of optimal fuels. You will find that Tiger Woods and Lance Armstrong also use the marine template to their advantage to compete. This data is now so overwhelming in my own field, that neural chemistry will soon be dictating the alterations of dietary templates for all modern humans to save money on health care costs.

The emerging science places nutrition, and docosahexaenoic acid (DHA) in particular, in an integral role in the evolution of human cognition, performance, and intelligence. Moreover, this data is causing the creation of a "new database" of the bony fossil record, which catalogues fossils at the level of individual collections, has been analyzed to demonstrate that a turning point in human evolution coincides with the inclusion of seafood in the diet.

SO WHAT ABOUT DHA MAKES IT CHANGE SCIENCE PERSPECTIVE ON EVOLUTION?

GEEK FEST: DHA is a long chain PUFA and is the most unsaturated fatty acid found in all mammals. It has 22 carbons and 6 double bonds. It is designated by 22:6n-3 or 22:6 omega 3. The double bonds configuration is found in a specific arrangement known as homoallylic, which implies that the double bonds and the methylene groups alternate along the carbon chain. The double bonds also all have a cis configuration in the molecule. This is consistent with other PUFA's found in mammals too.

The molecular structure of DHA impart its rather unique biophysical properties that DHA has in tissues. The alternating double bonds and the methylene groups make DHA very unstable and susceptible to to chemical attack by active agents like ROS. The methylene group between the double bonds is is considered to be doubly activated by being doubly allylic. The cis configuration further activates this position along the carbon chain. ***All of these features make DHA very susceptible to oxidation by molecular oxygen.***
When the DHA molecule is altered by hydroperoxides it becomes unstable and makes DHA further react with other biomolecules, like fats proteins, or even DNA. The damage inflicted to the DHA molecule must be removed by metabolic repair mechanisms, like autophagy, because they no long function correctly. This is precisely what happens to DHA molecules in Alzheimer's disease, Parkinson's, depression, and in eating disorders. If

you read the first cite below the data is there for you to examine.

The curious ability of DHA to remain chemically stable in an oxygenated form in tissues, so that it can also activate and modulate, the physiologic responses of cells is critical in understanding why this lipid was selected for in connecting neuronal tissues by Mother Nature. This is why DHA is found in abundance neural lipids with very high metabolic rates to support physiologic function.

Ironically, the chemical structure of DHA, outside the brain substance, makes it extremely vulnerable to attack by oxygen and by light. This is why we must be careful when our only form of DHA comes from supplements, and not in our diet. **This is a grave error I see repeated all over the blogosphere** . When DHA is extracted from fish tissues, DHA is rapidly degraded in air because it no longer has its evolutionary antioxidant protectors with it. They are stripped out in processing. It is best when it remains in its evolutionary package and ingested. This is how DHA retains its best chemical abilities.

After it is eaten and assimilated into tissues, it remains very stable because it is in its evolutionary package protected by iodine and the back up antioxidant systems in cells. In that package has developed an amazing biologic scavenging system to protect DHA from oxidation and to repair damaged DHA. Oxidized DHA can no longer connect neurons at the synapse. It loses its ability to support the amazing metabolic rates that neurons contain. With out this connective ability, cognitive function crashes quickly. One of those protection systems in tissues, is the presence of Vitamin E. Within neurons, mitochondria are again distributed to regions of high metabolic demand, like synapses, nodes of Ranvier, and myelination/demyelination interfaces (Kageyama and Wong-Riley, 1982; Berthold et al., 1993; Rowland et al., 2000; Bristow et al., 2002) Vitamin E is oxidized before DHA

is in cellular life, and the oxidized products are more stable and can be dealt with more easily by neurons. There is also the endogenous glutathione peroxidase system as well in the brain. The endogenous iodine systems is the **most impressive protection system for DHA**. It tends to be most critical in the areas where oxidative damage occurs the most frequently, the synapses, where neurons share electrical signals.

NON GEEKS: ***The efficiency of antioxidants in protecting DHA is quite astonishing, considering that DHA concentrations are always highest in human tissues that have the highest metabolic rates dictated by physiologic requirements, and by that necessity this means they have the highest levels of activated oxygen. This is a chemical paradox that shows you just how incredible DHA is for a high performance engine that humans possess in their heads and their chests.***

This implies that tissues like the brain and heart need DHA to improve their cellular signal transduction even though oxidation is this molecule's biggest risk! DHA has chemical abilities that no other lipid has, so evolution has devoted massive resources and energy toward aquisition and preservation of their own DHA stores and DHA innate protection from oxidative damage.

Let us take a look at this gem from Cite number 1 below: "Experimental and evolutionary evidence supports the notion of a unique role for DHA in cell membranes. Salem *et al.* report that the loss of a single double bond from the hydrocarbon chain significantly alters the properties of the membrane. Computerized three-dimensional energy-minimized structures of DHA (22:6 n-3) compared with DPA (22:5 n-6) demonstrated that the final double-bond in DHA (not present in DPA n-6) enables the molecule to take a slightly spiral (helical) structure. This property is thought to provide the membrane with a certain molecular order or "fluidity" that may be required for optimal functioning"

THE BRAIN AND DHA: ***Let us look deeper into the secrets of the neural lipid membrane for our health***

DHA is concentrated in the brain and in neural lipids, especially cell membranes. The reason is simple. DHA allows for complex signaling that no other lipid can match from a chemical standpoint. Brain DHA concentrations are remarkably constant accross many terrestrial species irrespective of the diversity of the natural diets. This has deep implications for all of us with respect to health. Moreover, this finding is also found in many fish species living in environments over a very broad temperature ranges too. The colder the temperature of their environment, the more DHA the fish species tends to have. This is also true in sea mammals. The reason for this, is the more DHA a fish has the better fluidity is found in their cell membranes to allow for optimal cellular signaling of complex systems.

All of this data implies that DHA has a very specific molecular role in life. Many detailed studies show that omega 6 PUFA's **can not** replicate what DHA can do in the brain or in nerves. Vegetarians do not seem to realize this. The closest omega 6 PUFA is docasapentaenoic acid (22:5n-6, DPA omega6) which has the same number of carbons but only has one less double bond compared to DHA. Otherwise, it is bioidentical to DHA. Dietary deprivation of DHA in many species experimentally shows a rise in tissue DPA omega 6, and a big fall in DHA. This result than impairs cellular physiology directly, by altering signaling. This implies DHA has special cellular signaling properties that can not be replicated by any other lipid. **The real interesting part of the story is that animal based omega 3 DHA is only found in the marine food chain.**

Plant based omega 3 is called alpha linolenic acid (ALA). ALA in human systems is not well converted to long chained DHA in humans because of the enzyme biochemistry in humans is not well developed. This implies to us that DHA had to be present

in abundance when we evolved to naturally select for our big brain. In humans, ALA is oxidized and used as a source of energy most frequently, and for carbon backbones to synthesize nonessential compounds like saturated fatty acids and cholesterol. We now know because of the work of Kaduce in 2008, that adult neurons can make DHA endogenously, but its ability is sharply limited. These facts are laid out in extreme detail in Cite 1. If you believe paleo is the solution for a mammal with a large brain, you better examine cite 1 very closely many times before you believe that meme. This new science shows you it is just not factual.

In adults humans, the DHA synthesis pathway is very inefficient and essentially stops at DPA omega 3, causing a sick brain to be dependent upon a constant source of new DHA. This is another reason why the Epi-paleo Rx is the best evolutionary answer for a mammal with a large brain. If that mammals brain is diseased for any reason at all it even becomes more critical for repair.

The interesting evolutionary correlate for humans is the DHA concentrations in breast milk is substantially greater than those of DPA omega 3. This is also true in all tissue of humans too. Breast milk has a similar profile of the long chained PUFA's found in neural tissues. Dr. Remko Kuipers is probably the world expert in this area, and recently spoke at AHS 2012 in Boston. It appears from reports out of Boston from Kuipers own tweets, his talk was not well attended by our paleo community. **This tells me very few in our community really understand the significance of his work or its implications for our species.** The leaders of this movement were all there, but apparently this talk was not important to their message? You can ask yourself why?

An uncomfortable thought that goes against a groups dogma is not 'our" personal enemy. It might liberate our mind to Optimal health.

The “paleo thought pyramid” is especially interested in promoting mediocre types that promote safe and boring life visions, retread recipe cookbooks, because then one ever needs to fear for his position, which, in case of serious controversy, they’d be forced to defend.

Therefore, for those paleo’s on the top of the pyramid, ‘controversy’ is structurally undesirable. For them, innovative thinking becomes inevitably controversial. They attack the person and not the ideas they stand upon.

Be less curious about people and more curious about ideas.

I believe it is the mark of an educated mind to sow doubt and disruption where dogma lives.

The reason breast milk matches neural tissues is because humans are born immature neurologically. They have to be to fit out of their mother’s pelvis, so brain development must be stunted to get a live birth. The human brain grows dramatically for the first 6 years of post natal life. Moreover, the brain is **not well myelinated** to save space for a successful live birth. This is how the brain saves space to fit out the mother’s birth canal. It also has another evolutionary side effect on immunity. It is the reason why the neuro immune system is deficient for 6 months and the mother has to protect the child from antigens. Myelin is also the insulation fat that covers many neural fiber tracts. This is why an infants can’t walk, talk, or perform complex neurologic tasks because its brain fiber tracts are not well insulated and functions much like a person who has MS. Myelin insulates nerve fibers. MS is like having massive amounts of short circuits in an electrical system and having no way to to

regenerate the immune system response of T helper cells. This is precisely what MS is like in the human brain and why people with MS have neurologic compromises.

METABOLIC FUNCTIONS OF DHA IN THE BRAIN:

The brain has massive concentrations of DHA in its foundational structure compared to other organ in the body. This suggests that it is indispensable for the special metabolic functions found in the brain. It also appears this was critical in overcoming the structural constraint of connect neurons to new places in the brain to develop new abilities.

GEEKS: Let us again revisit **cite number 1** for this massively important insight to human physiology that many seem to be oblivious too: "These recent advances in understanding the influence of the highly unsaturated DHA molecule in the membrane phospholipids has fueled speculation that it may work as a metabolic "pacemaker" for cells, and perhaps influence the metabolism of the **whole organism** via an impact on the basal metabolic rate. This theory was tested by Turner *et al.*, who demonstrated a positive linear relationship between the high molecular activity of the enzyme $Na^{+}K^{+}ATPase$ (the sodium-potassium pump) and membrane concentration of DHA in the surrounding phospholipids in brain, heart, and kidney tissue of samples from both mammals and birds. Further, the highest concentration of DHA was found in the mammalian brain as was the highest activity rate of the pump. **This is significant as the sodium-potassium pump accounts for some 20{a7b724a0454d92c70890dedf5ec22a026af4df067c7b55aa6009b4d34d5da3c6} of the basal metabolic rate but approximately 60{a7b724a0454d92c70890dedf5ec22a026af4df067c7b55aa6009b4d34d5da3c6} of the energy utilization in the brain.**"

NON GEEKS: Here is biochemical foundational proof that

performance is found in the Epi-paleo Rx and not in offal and bacon.

Another interesting factor is the requirement that each organ of the body has for omega 6 and 3 fatty acids. I decided to look into this issue more several years ago when I was researching how to reengineer my own health best. I had always been taught to believe that the brain had a larger DHA omega 3 component than an omega 6 level and it turned out I was dead wrong. The brain makes up 2-3{a7b724a0454d92c70890dedf5ec22a026af4df067c7b55aa6009b4d34d5da3c6} of our body weight (BW) but has a 100 to 1 ratio of ***06 to 03 within it normally***. It appears the 0mega 6 to omega 3 ratios and their relationship to phosphotidyl choline and phosphotidyl serine ratios are **most critical** for cell membrane signaling of environmental signals to our brain. The amount of these moities in the brain is totally tied to the biochemistry of calcium efflux and calmodulin function. These function is completely tied to the electromagnetic field of the sun and Earth at the time child forms in utero. The omega 6/3 ratio is critical for protein confirmational bending in the lipid membrane structure after proteins are made in the brain. This single insight made me realize that mammals do something special with their omega 3's and 0mega 6´s for some environmental reason.

It appears in certain diseases of the brain, the ratio's gets dramatically altered, and may actually be a good biomarker for us to use diagnosis and prognosis in neurodegenerative disorders and epigenetic diseases. Skin makes up 4{a7b724a0454d92c70890dedf5ec22a026af4df067c7b55aa6009b4d34d5da3c6} of our Body Weight and has 1000 to 1 ratio of O6 to O3 normally. Skeletal muscle makes up 50{a7b724a0454d92c70890dedf5ec22a026af4df067c7b55aa6009b4d34d5da3c6} of our Body Weight and sets its O6/3 ratio at a 6 to 1. Our internal organs, make up

9{a7b724a0454d92c70890dedf5ec22a026af4df067c7b55aa6009b4d34d5da3c6} of our BW have the lowest ratios at 4 to 1. Adipose tissue sits at 22 to 1 ratio and makes up 15-35{a7b724a0454d92c70890dedf5ec22a026af4df067c7b55aa6009b4d34d5da3c6} of our total BW depending upon how fat or thin we are. The trend is the lower the metabolic rate of the tissue the lower the amount of DHA is present. It appears metabolic rates are highly dependent upon the DHA in the tissue. Why Is that?

DHA IS A PROXY FOR METABOLIC RATES AND TISSUE PHYSIOLOGY ABILITIES:

Since the brain has the highest metabolic rate of any tissue in the human body, DHA concentrates in it to improve energy efficiency.

PERFORMANCE ATHLETE ALERT: There is an evolutionary reason for this fact buried in performance physiology. DHA is not burned for energy in humans. Once it is obtained it is avidly retained and reused. It is protected from oxidation by the brain's massive antioxidant system. this involves iodine, Vitamin E, glutathione, DHEA, Oxytocin, and melatonin in life. The brain makes up 2-3{a7b724a0454d92c70890dedf5ec22a026af4df067c7b55aa6009b4d34d5da3c6} of our body weight but consume 20-25{a7b724a0454d92c70890dedf5ec22a026af4df067c7b55aa6009b4d34d5da3c6} of whole body energy! It is the ultimate energy hog! This is why I often refer to it as our Ferrari engine in our head. It performs rapidly but requires serious resources to remain functioning optimally. Most of the energy in the brain is tied to phospholipid recycling for cell membrane recycling. This was reported by Purdon and Rapoport in 2007. Most people in the research circles think DHA is concentrated in the brain because of conformational fluidity of DHA, but this does not appear to be the case because melting points

past the first three double bonds in PUFA's does not alter melting point abilities of other PUFA's substantially. Turner's paper (cited below) has even deeper implications for humans. It appears that DHA lipids allow humans membranes to do some unique electrophysiologic things that few other mammals can do. DHA acts as a metabolic neuro-physiologic pacemaker to amazing biochemical abilities. DHA appears to directly impact and influence the metabolism of the **whole organism** via an impact on the basal metabolic rate because of the linear relationship in how the Na/K ATPase functions.

TRUTH BOMB ALERT: Read this again carefully: This is significant as the sodium-potassium pump accounts for some 20{a7b724a0454d92c70890dedf5ec22a026af4df067c7b55aa6009b4d34d5da3c6} of the basal metabolic rate but approximately 60{a7b724a0454d92c70890dedf5ec22a026af4df067c7b55aa6009b4d34d5da3c6} of the energy utilization in the brain. This expands all cellular performance like no other physiologic attribute in any mammal on this planet. This is precisely why humans have special abilities that no other mammal does. This physiologic dynamic is what really powers the human brain so efficiently. It is tied to the ability to carry current on these cell membranes. These neocortical cells abut the CSF that is filled with water to further improve energy efficiency by increasing oxygen release with increased blood blood to the cortex. How this happens is called quantum magic.

TRUTH BOMB #2: Our biggest attribute is the ability to think. This allows us to radically change the environment that we are ideally adapted to. It has allowed us to dominate all habitats and create havoc in most of them as well. **The real human miracle of our minds is not that we can see the world as it is……but that we can see it as it is not, and then change it.**

If we think and act incorrectly, we can quickly recalibrate and overcome it. Conversely, we seem to be a prisoner to our

paleo-cortex (older less evolved brain), and resist change even when we know it must occur. Many times we will subjugate the best interests of our survival to suit our emotional needs or desires. ***The real paradox of humanity is that our reasons for the things we do are often weak but our sentiments to do them remain quite strong.*** **Interestingly, we have overcome that liability as a species many times so far in our history already.** Some of us even find comfort in that ability at times.

BACK TO THE METABOLIC BRAIN:

This is how the brain solved its energy constraint and it is also how the heart and kidney do it too! The more tissue omega 3 DHA they have the more efficient that are to make energy. This is found in their physiologic ability to make ATP. ATP is the key to all life and performance by unfolding proteins to have access to more water binding. Adding CT to the mix is gravy for this performance. Cold increases certain types of conduction in a biologic system. The lower the temperature the more DHA can be applied to a cell's membranes. This is why deep sea mammals have so much tissue DHA {a7b724a0454d92c70890dedf5ec22a026af4df067c7b55aa6009b4d34d5da3c6}. They need it to maintain performance in ridiculous cold seas over 10,000 feet deep where life almost comes to a standstill. This directly implies that performance is improved dramatically by increasing tissue omega three levels. I wonder if any cross fitters or performance athletes realize this foundational fact yet? I tried to tell them this in Austin in March and the Paleo fx, but they just thought bacon and offal are enough. The physical culturists just scoffed and laughed at the suggestion and deferred to their "pyramid leaders" who had no clue about this neural biochemistry and what it might mean for our species solution to Optimal. I

warned them proof was coming, but they chose to align themselves with a meme over being open minded to what the science reveals. ***Ignorance may be bliss for some, but it wont help you live longer or perform better with bad data.*** I think they are operating their businesses with a lot of flawed assumptions from data they have been fed.

NON GEEKS: Our lipids are physiologic superior because of the DHA and iodine contained in the neural lipids of our brain. This feature is a DEFINING feature of our species and is supported only by a marine food chain. Still think bacon and offal are that important for your solution to optimal health? Ask questions when you are not sure of something. You might find a better answer or a better question to ask about getting to optimal.

HOW ABOUT THE EYE?

***This is where the circadian signals first begin to register in the brain's SCN*. (Think CT 4 and 6)**

NON GEEKS: I told you the suprachiasmatic nucleus was a big deal to aging and biology in the massively important CT-6. When your ability to signal light is altered through your eye you die quicker.

GEEKS: What does make a difference in paper is the biochemical reactivity of G-protein coupled receptors and DHA because of the addition of that last double bond in DHA. When neural lipids have that last cis double bond unique things begin to happen when proteins are embedded in the lipid bilayer loaded with DHA. For example in the eye, the G-protein called

rhodopsin, a light sensing protein, markedly alters its biochemistry and metabolism in its interaction with DHA. DHA actually changes the abilities of rhodopsin to allow it to transduce light quickly because it is able to solubilize rhodopsin more strongly than the saturated fat , palmitate in the cell membrane. When DHA is removed from the cell membrane we lose the ability to transduce light. This has been experiementally shown in infant retina who were deficient in DHA. This effect is mediated by the pi electron cloud I spoke about in Brain Gut 5. It is a quantum effect directly on the biochemistry of the neural lipid's interactions with these G coupled proteins.

It is specific to DHA alone. Again, DHA is only found in the marine food chain in quantities enough to build a human brain. The better signaling that occurs in the eye is then passed to the SCN. Optimal signaling in the SCN, means the correct signals will be transduced in the brain to control the giant pharmacy in our hypothalamus that controls the hormones that control our circadian biology and our health. When the signaling is poor because of low DHA and iodine content in the eye, the ability to signaling correctly is eroded and aging and disease follow there after. We laid that foundational work out in Brain Gut 11. Light can kill us just as well as a fired bullet or a bad western diet can. The only difference is the intensity and time scale. The result, however, is identical.

IF DHA SUPPORTS HIGH METABOLIC FUNCTION WHAT DOES THAT MEAN FOR NEOLITHIC DISEASE GENERATION?

GEEKS: It also turns out that these G- proteins are ubiquitous in all human neural tissues and impart tremendous abilities that we find in the human brain. We also learned recently that human neural tissues are exquisitely vulnerable to low dietary DHA supply early in life. This is a time when

the brain places severe demands on the omega 3 supply to create new structural lipids in neurons. When the diet is low in DHA in infants, functional deficits become very common. In adults who are DHA starved (SAD or the standard paleo diet), the brain becomes very effective at preserving and maintaining its DHA levels, while it depletes other tissues DHA levels. This is why the tissue omega 3 to six ratio's in humans can be quite instructive to the astute clinician when taking care of patients in the clinic. When you eat a diet deficient in the DHA your other tissues and organ become depleted of them very quickly very quickly. The eye is one of those tissues that loses its DHA content quickest. This is why eye diseases are all linked with the inability to have accurate circadian signaling that leads to diseases of aging. This is what a cataract is at its foundation. As this physiologic process progresses we wind up with macular degeneration. This is what macular degeneration is all about. It's incidence and prevalence in the modern world are sky rocketing too. Read this link. It is also why people with macular degeneration tend to age faster than one would expect when we look at their labs and their other tissues like arteries. We talked about how the SCN affects aging and circadian signaling in CT 4, and the CT-6 blog series.

DHA LOSS IN ADULTS = SUB-OPTIMAL OFFSPRING:

In adult humans, the DHA deficiency does not just affect the brain composition, in the medium term in the adult life cycle. We usually do not see functional deficits in adults until later in life. Alzheimer's Disease and Parkinson's Disease are great examples of this. If these adult humans happen to have offspring while they also have a DHA and iodine deficit, we will see the functional deficits in their children's neuro-physiology very quickly. This is where autism, spectrum disorders, depression and other neurologic disease manifest today in clinical medicine. Modern medicine has no

answers for these disease because they do not realize they are the result of the epigenetic draining of the brain of DHA and iodine. Yes, these diseases are nutritional diseases at their foundational core. This is the major reason why modern medicine is oblivious their real causes. We do not understand the links of diet to bioenergetics. Life fails without a constant source of efficient energy. ***A body without ATP is called a corpse. An organ with an ATP deficit is called an organ in failure.*** For example, congestive heart disease or heart failure is a loss of ability to make ATP efficiently.

Also, as a human ages, their total body DHA stores are used up by the brain if the diet is not re supplied constantly with DHA. The cellular process of autophagy which occurs during sleep, is when DHA is replaced and replenished in our sleep. Melatonin is a critical anti-oxidant hormone in this biologic process. This is why a low melatonin level is associated with many neuro-cognitive diseases in modern man. It is also seen in epithelial cancer generation in humans because of how their circadian cycles are uncoupled from our cell cycle that controls cellular growth. We covered that in Brain gut 11 as well.

DHA and FACTOR X = *a sped up epigenetics.*

Moreover, this is why all neurodegenerative disorders are now becoming more common place in the the 40's and 50's instead of later in life, as we saw 50 years ago in epidemiologic studies. This data has been verified consistenly in shift workers over the last 25 years but has yet to make a major impact in clinical medicine because modern medicine is not privy to the importance of circadian biologic signals and optimal health. The SAD has been steadily and massively depleted of DHA, as the diet has become more industrialized and man made. This is now obvious to anyone in the world. The problem is modern medicine has not yet realized the

functional changes of this effect in their patients as yet. Supplementing with fish oil is not the answer to a bad diet as some have advocated in their books. Fish oil can not over come a bad diet, or even a marginally good paleo template, contrary to what you have been led to believe.

Moreover, it has huge implications for a mammal with a large brain, like us, because we rely on massive DHA stores to function well. The paleo diet will supply some animal based omega 3 DHA, compared to a SAD, but not nearly enough for the optimal functioning of our type of brain. To replenish dwindling stores and iodine to help offset neolithic disease, we need a constant marine source. If you understand how DHA works in human tissues, with their high physiologic functions and metabolism, it should become clear why a diet steeped in shellfish contains the precise nutrient density for a mammal with a big brain and a physiologic need for an efficient system to support its high metabolism. No tissue uses more ATP and oxygen than neurons. Man made food leads to illnesses called neolithic diseases primarily because of the loss of ability to make ATP well in organs.

This ability also extends to other organs to really have a major clinical impact on the physiologic function of all organs, but especially of those of organs with high metabolic rates, like the brain and heart. If you are following this blog well, it should be no longer be a surprise to you now why heart disease is the number one killer in humans today. If your brain is deficient in DHA so will your heart. And your heart also needs a massive supply of oxygen and ATP. When it does not get it heart failure and a heart attach are the result. The story about DHA and iodine is all about bioenergetics. Any tissue that has massive bio-energtics requirements, needs massive supplies to DHA and iodine to run optimally long term. When you do not have this present, neolithic disease is the result.

THE REAL REASON WHY SEAFOOD MATTERS TO THE HEART:

It also should be intuitive now why dietary DHA content correlates with cardiac health in most modern studies now. The answer is simple. DHA preserves its ability to perform optimally, because of its high metabolic and physiologic demands placed upon the organ, namely the heart. The same is true of the human brain. Here is where form meets function once again for evolutionary fractal design. This is why we are seeing higher incidence and prevalence of neurodegeneration, depression and anxiety, and brain tumor formation today. The best way to avoid brain and heart ailments is to replenish your DHA with a constant source of brain specific nutrients, like iodine. These nutrients specifically improve the physiologic metabolic demands that organs can function upon. If you eat the Epi-paleo Rx you are essentially fine tuning your Ferrari engine up constantly your whole life while you age. Moreover, as you age and your organs slowly fail, as they use up all their stem cells, doing this even becomes more important for health and longevity as we age. This is why the Mediterranean diet is also consistently found to correlate with longevity. It is a function of the DHA and iodine in the diet from seafood and salt, that imparts the ability to perform better physiologically over time and not much else for humans.

Summary:

Human brain evolution was hampered by two major constraints in evolution that radically changed in transitional apes. The first was the a **metabolic constraint** of an alternative fuel source to supply an "energy hog" forming in our skulls over the last 6 million years. This conundrum was solved by Mother Nature by the development of subcutaneous fat for brain construction to feed the bioenergenics of the massive neuronal network we evolved from chimps. Chimps do not have this subcutaneous fat layer because they have a rudimentary brain. The metabolic neuro-physiology of the brain alone, dictates

this evolutionary move and nothing else. This will be further expanded later in the series.

The **structural constraint** of brain growth was solved by dramatically altering the use of DHA to alter cell membrane signaling. Because DHA has unique signaling properties, it allowed for a more complex array of signaling than was seen previously in primate history and this removed the structural constraint on neurons being connected in many new ways to impart the many unique abilities our species possesses. Iodine helped further this by providing massive antioxidant protection to the massive increases in synaptic density in the human brain. DHA is is the single most important lipid in our evolutionary history because it allowed us to connect more neurons to many more new places within the transitional ape's cerebral cortex. This exaptation then allowed for the explosion in cognitive abilities we see in the hominid family tree.

Now, hopefully, you are beginning to see why Brain Gut 6 is really Homo's solution to the amazing metabolic rates required by the human heart and brain. It is also why we have unique abilities compared to chimps too. The human brain is where all signaling begins to optimize physiologic function.

Once it fails……..your health and performance fails. Welcome to my new reality and maybe your new reality too.

NON GEEKS: These next 3 paragraphs from Cite 1 will destroy your current reality if you buy the meme of the current "paleo pyramid theme":

"Broadhust *et al.* provide compelling evidence that the

discovery and subsequent multi-generational exploitation of seafood coincides with the rapid expansion of the cerebral cortex that is unique to modern humans. The brains of 42 modern mammalian species were studied by Crawford *et al.* and found to be similar in brain chemistry, particularly in the predominant use of DHA in the membrane-rich neural tissues at synapses and in the retina. They found that *Homo sapiens* are characterized by the disproportionately large brain size in proportion to the body. In every other land-based mammalian species they studied, brain size decreased logarithmically with increases in body size.

Crawford *et al.* argue that these findings are explained if the relative rate of brain to body growth was rate-limited by the inadequate biosynthesis of DHA in the liver. Support for this theory is given by evidence that in the absence of a significant source of preformed DHA in the food chain, **land-based mammalian brains did not substitute the 22-carbon omega-6 fatty acid**, docosapentaenoic acid (DPA 22:5n-6), despite its abundance. Thus, they argue, ***it was brain size that was sacrificed, not the degree of unsaturation in the phospholipid membranes.***

TRUTH BOMB ALERT #3: ***For those of you who don't get this importance here it is simply stated: If you think eating bacon and offal alone is optimal, the opposite might be true.***
Your brain will shrink over time as you age and we can see it on a CT or an MRI scan. Try that on for size as you live your life.

By comparison with early humans, the gross expansion of **grey matter** and enlarged cerebral cortex coincides with increased intelligence in modern humans. The decline in myelination from non ketotic diet leads to autoimmune issues in our modern world. Perhaps the most widely held theory of evolution explains the growth of human intelligence as due to an interaction between tool making, language development and brain expansion. However, Cunnane and Crawford argue that

brain expansion due to the discovery of a convenient source of high-quality dietary nutrients is likely to have preceded both the expansion of the grey matter and the development of language and tools making." Becker's work on the DC current from myelin points to the explosion of neuro immune and autoimmune diseases in our modern world. Those nutrients that support grey and white matter expansion in humans are all found in the marine food chain of Brain gut 5.

Become aware of what you might not know.

When you know better you do better. Period.

CITES:

1. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3257695/ (Major link to why Epi-paleo Rx was homo's solution by evolution)

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3. Broadhurst, c.L. et al. Brain specific lipidsfrom marine Lacustrine, or terrestrial food resources: Potential imapcton early African Homo Sapiens. Comp Biochem Physiol. B. Biochem Mol Biol. 131: 653-673

4. Budkowski, P. Crawford, M.A. 1985. ALA as a regulator of metabolism of A: Dietary implications of the ration-6:n-3 fatty acids. Proc. Nutr. Soc 44:221-229

5. Bourre, J.M. et al. The effects of dietary alpha linelenoic

acid on the compensation of nerve membranes, enzymatic activity, amplitude of the elctrophysiologic parameters, resistance to poisons and performance of learning tasks in rats. J. Nutr 119 (12): 1880-92.

6. Crawford, M.A. et al. Evidence for the unique function of DHA during the evolution of the modern hominid brain. Lipids 34:S39-s47.

7.http://www.ncbi.nlm.nih.gov/pubmed/14610651 (The Turner paper referenced in the blog)

8.Muriel E., Ruiz J., Ventanas J., Antequera T. Free-range rearing increases (n-3) polyunsaturated fatty acids of neutral and polar lipids in swine muscles. Food Chem. 2002;78:219–225.