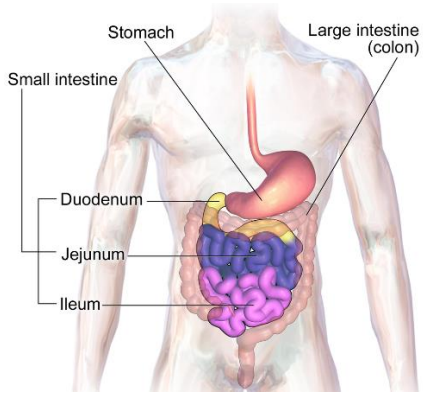
APLGO Behind the Science Product Call – BRN and MLS

Q & A With Tina D'Angelo and Mary Esther Gilbert, MSc HN, BSc NSP

August 12, 2024

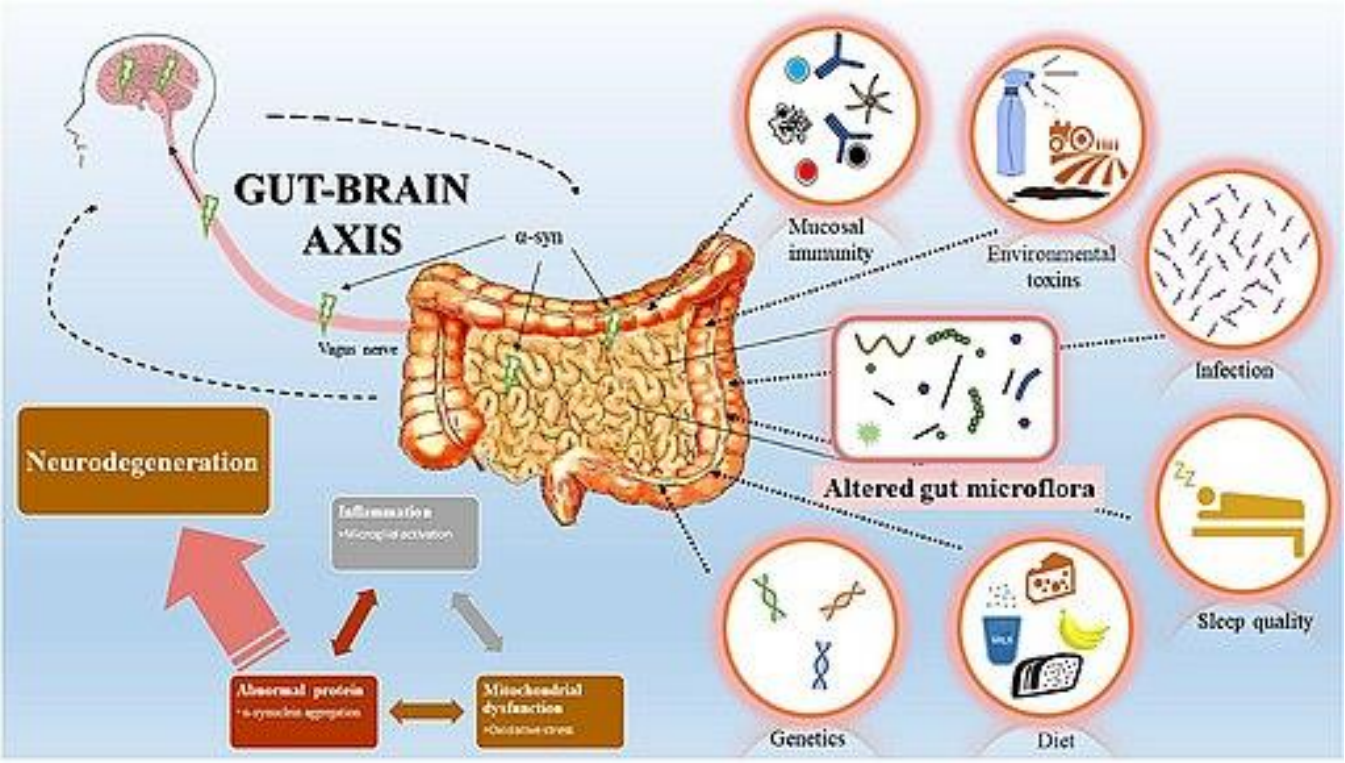
1. Can you explain the gut-brain connection and its significance in overall health?

- The **gut** includes the entire gastrointestinal tract (stomach and intestines).



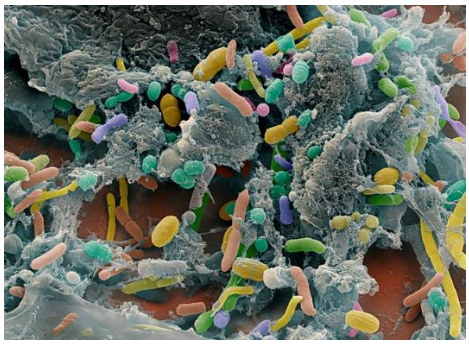
Bruce Blaus, 2014

- **Gut-brain axis** – the multi-directional communication network that links the enteric (digestive tract) with the central nervous system.
    - Involves the endocrine (hormone-producing glands) and immune system communications with the brain.
    - Includes nerve connections to the gastrointestinal tract allowing the brain to influence intestinal actions including influencing immune cell responses and actions.
    - The gut in communication with the brain influences mood, cognition, and mental health.



Chao Yin-Xia et al - 2020 - Creative Commons Wiki

- **Fluctuation of bacteria** in the intestines (enteric microbiota) extensively influences gut-brain communications via the vagal nerve.
    - Vagal nerve transports signals between the brain, heart, and digestive system.
    - Moods such as anxiety, depression, autism spectrum conditions are linked to gastrointestinal disruptions such as irritable bowel syndrome.
    - Diet is shown to influence the gut microbiome; this microbiota influences brain chemistry and behavior independently.
    - Microbes have been found to affect the neural network responsible for controlling stress responsiveness.



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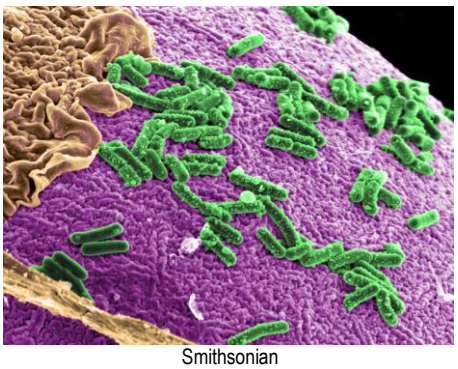
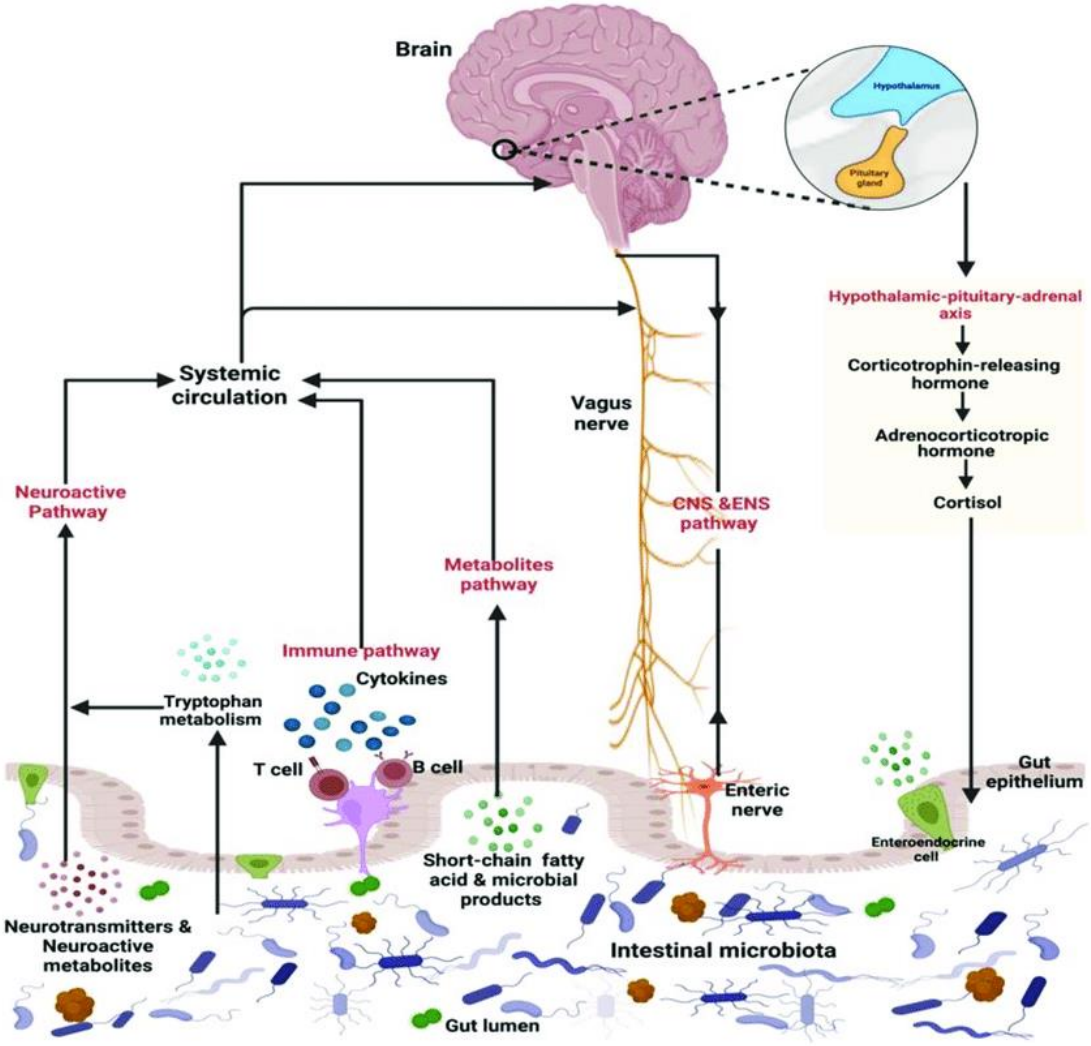


Smithsonian

- There are **4 major pathways of the gut-brain axis**: neurologic, endocrine, humoral (body fluids, immune responses)/metabolic, and immune system communications.

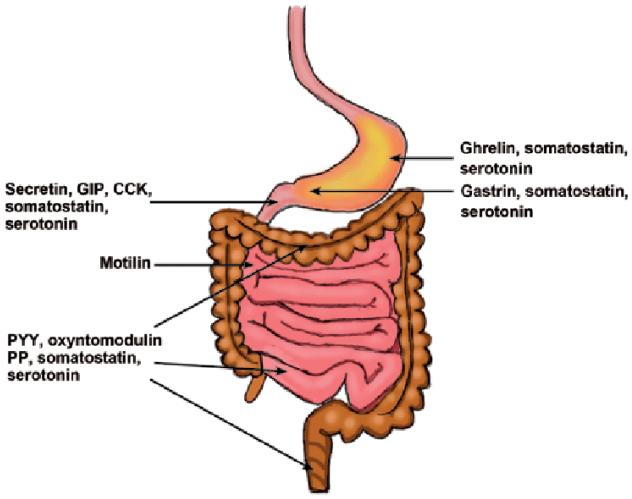


Gut-Microbiota Brain Bidirectional Communication Pathways – Creative Commons

1. ***Neurologic pathway***: the vagus nerve, the enteric nervous system, and the activity of neurotransmitters within the gastrointestinal (GI) tract.
    - Gut microbiota influence the central nervous system by the release of neuroendocrine hormones and neurotransmitter activity.
2. ***Endocrine (glandular/hormonal production) pathway***: microbiota affects nutrient availability, and influences such actions as responses to extreme heat or cold, and pain; sleep-wake cycle regulation, blood pressure regulation, and neurotrophic (growth, maintenance, survival of nerves) functions.
3. ***Humoral/Metabolic pathway***: enterocytes (cells of the intestines) in response to metabolites' interactions with bacterial fermentation of dietary carbohydrates, produce short-chain fatty acids (SCFAs) that influence hormone-like actions, modulate the immune response system, and communicate with nerve cells via the *sympathetic branch* of the *autonomic nervous system*.
    - SCFAs cross the blood-brain barrier and influence proper brain development, tissue homeostasis, and behavior modulation.
    - Disruptions to SCFA metabolism and communication is implicated in autism, as immune microphage cells' task is to remove damaged neurons (nerve cells) and infections is impaired.
4. ***Immune System Communications pathway***: inflammation in gastrointestinal tract (GI) is influenced by gut microbiome and other mediators such as interferon-gamma that occurs during disruption of microbiota (dysbiosis) populations leading to conditions such as irritable bowel syndrome (IBS).
    - In IBS, abnormal microbiota populations (anerobic bacteria) activate immune responses in the mucosal tissues, affect epithelial (cells lining the gut) permeability, and disrupt the enteric (stomach) nerves, resulting in both brain-gut and gut-brain dysfunctions.
    - Gut-brain axis disruptions affect intestinal motility and secretion, and affect cell malfunctions of the intestinal endocrine (glands located in the intestine) and immune system functions.
    - Acute stress acts on the GI tract affecting healthy bacterial colonies and mRNA gene expression encoding; *tight junctions* between cells serve as protective entrances to cell membranes, including the blood-brain barrier.

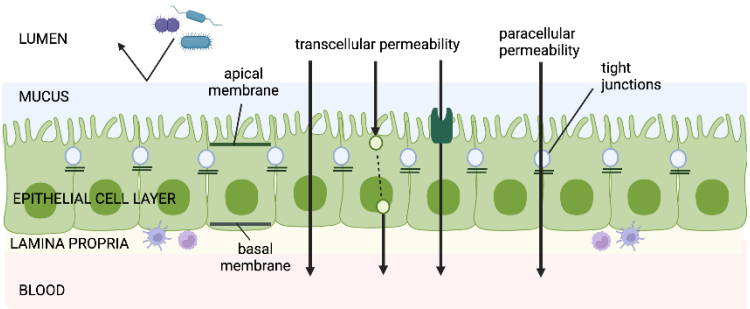
(Appleton, 2018) (Hill, et. al., 2019) (Puri, 2023)

Endocrine Cells in the Gastrointestinal Tract



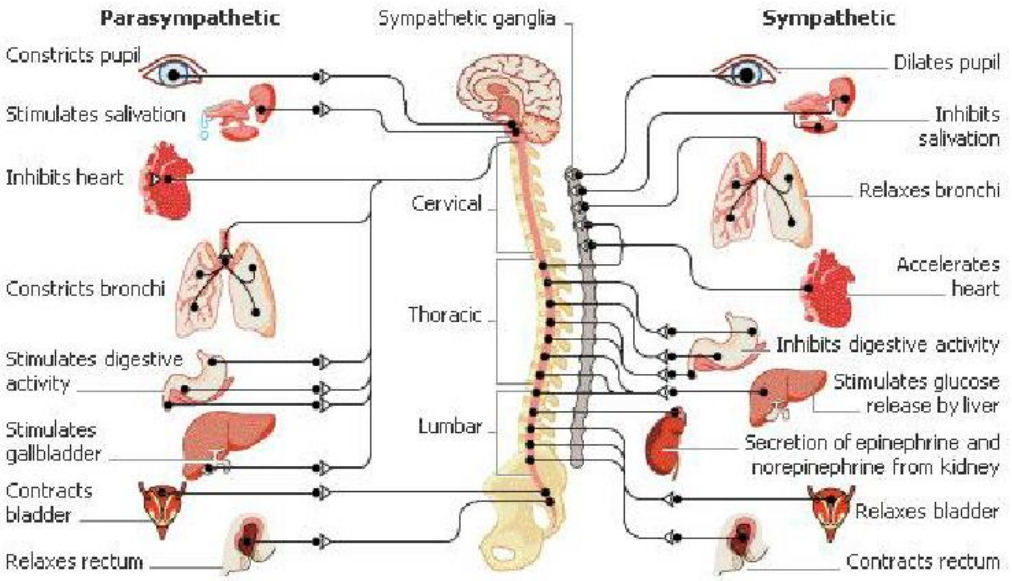
El-Salhy et al, 2016

Tight Junctions Between Cells in the Intestine



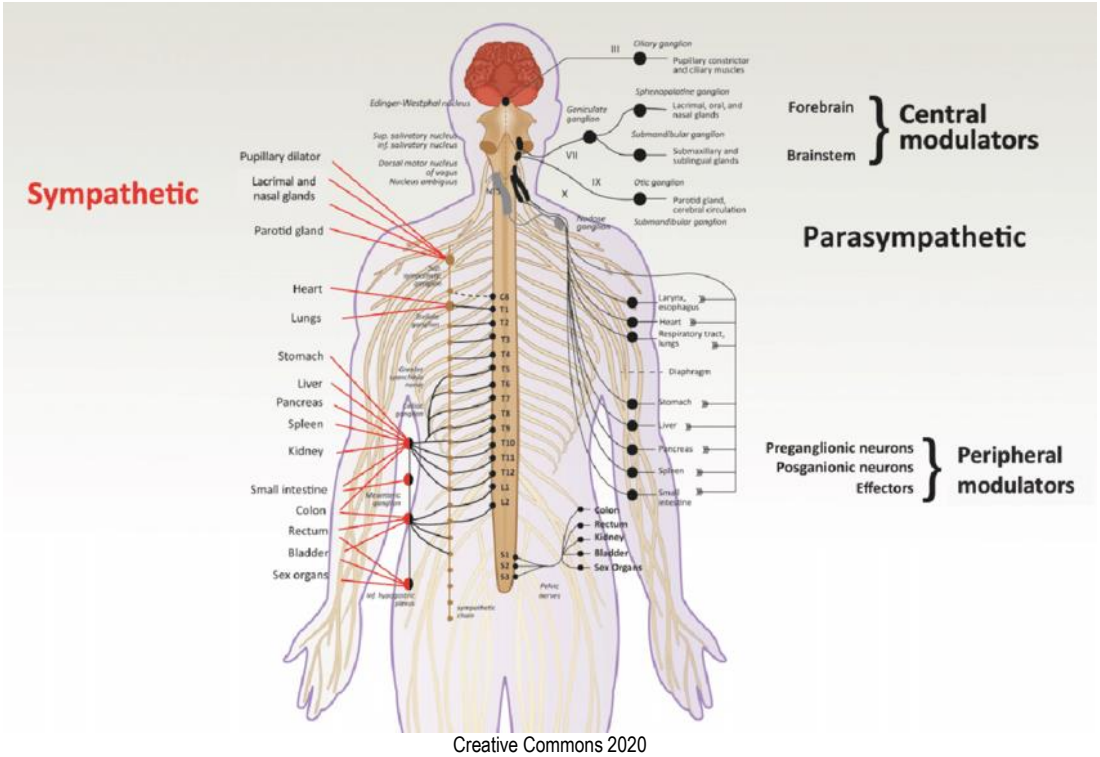
AOP Wiki

The Autonomic Nervous System in the Humoral Metabolic Pathway



Pedro Sanchez – 2008

The Autonomic Nervous System in the Humoral Metabolic Pathway (Alternate View)



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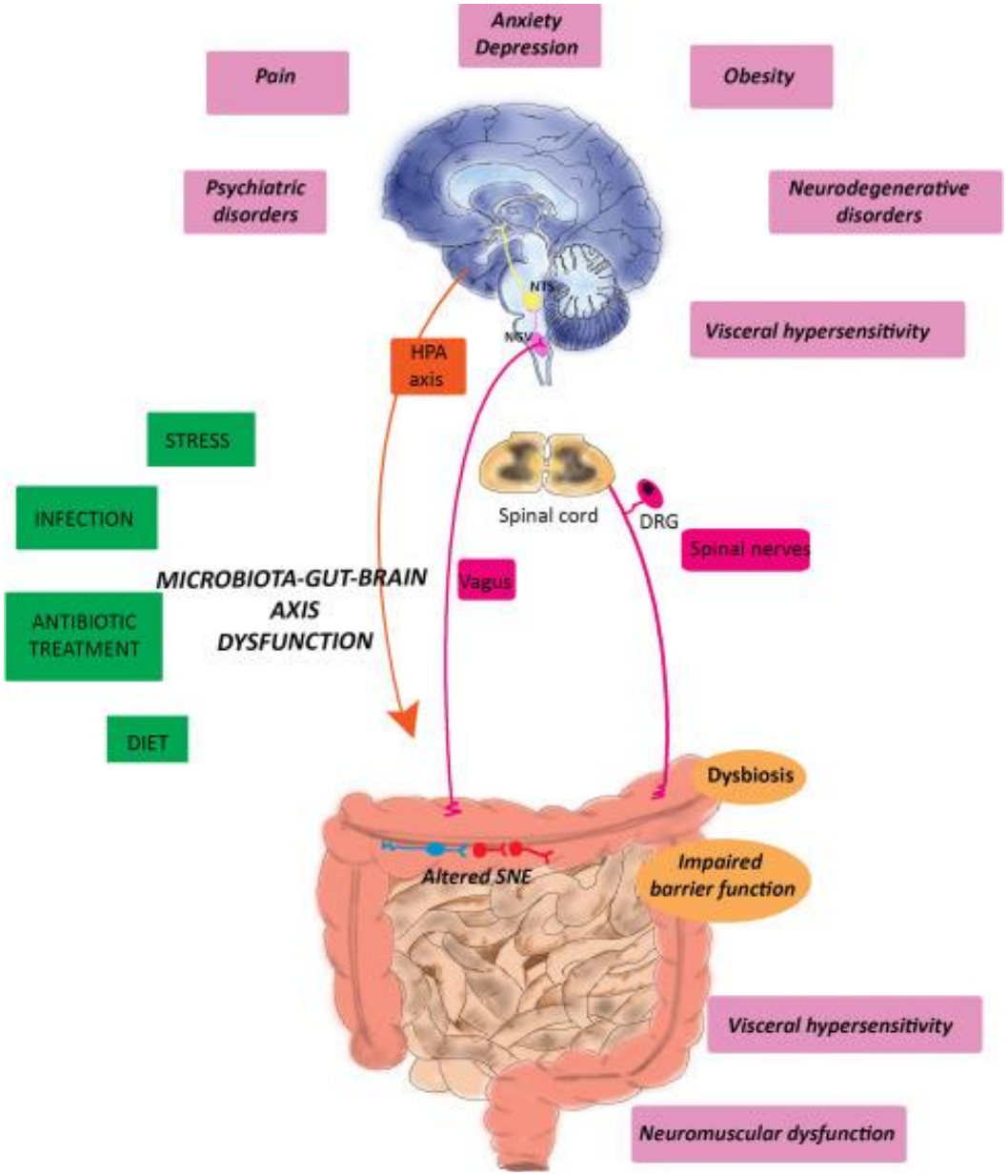
2. What role does the gut microbiome play in cognitive function, and mental health disorders such as anxiety and depression?

Britannica's definition of Cognition: *"the states and processes involved in knowing, perception, and judgement. Cognition includes all conscious and unconscious processes by which knowledge is accumulated, such as perceiving, recognizing, conceiving, and reasoning. Also, cognition is a state or experience of knowing that can be distinguished from an experience of feeling or willing."*

Microbiota Gut-Brain Axis Dysfunctions



Michela Bistoletti, et al., *Progress in Molecular Biology and Translational Science*, 2020

3. How does inflammation in the gut affect brain health?

- The brain and gastrointestinal tract are critical sensory organs that detect, relay, integrate, and respond to signals received from both the body's internal environment, and the external environment.
- Responses to the monitoring of the environment inform the body's systems of its physiological status.
    - Gut-brain or GI tract-Central Nervous System maintains *bidirectional communication signals* to regulate and respond to inflammation, and maintain immune system homeostasis via the *humoral, immune, endocrine, and neuronal pathways*. [See question no. 1.]
    - *Immune cells are the first line of defense in response to inflammation*, and can also migrate to the brain and other tissues.
    - The gut microbiota are the key regulators of immune cells in gut-brain communications, directing immune cells to act upon inflammation-associated health conditions of the GI and neurological system.

(Agirman, 2021)

4. What key nutrients in BRN and MLS are known to support a healthy gut-brain connection?

BRN

Functional Phytonutrient Plant Compounds in BRN

Digestion, Intestines: pectins, catechins, organic acids (malic, tartaric, citric, chlorogenic, salicylic, arabic, boric, ascorbic), carotenes, flavonoids quercetin, rutin, kaempferol and isorhamnetin, and beneficial plant pigments such as the catechins, inulin, saponins, lignins, phenolic acids, caprylic acid.

Brain, Nerves: acetylsterylglycosides, alkaloids and plant steroidal lactones, phenolic compounds such as flavonols quercetin and catechins, tannins, ellagitannins, phenolic acids, anthocyanins, curcuminoids, terpenoids, saccharides, luteolins, apigenins, syringentin and laricitin, choline, flavonoids, flavonol glycosides, ginkgolides, bilobalide, proanthocyanidins, ginsenosides, polysaccharides.

MLS

Functional Phytonutrient Plant Compounds in MLS

Digestion, Intestines: organic acids gallic, caffeic, ellagic; quercetin, organic acids gallic, caffeic, ellagic; quercetin.

Brain, Nerves: linalool, geraniol, terpinene, alpha-terpineol, hydrocarbons, gamma terpenine, r-cymene, limonene, camphene, and myrcene, oleic acid, polyphenols, trigonelline.
(Gilbert, 2021)

MLS

(Excerpt from "Potent Superfoods for Lifelong True Health" by Mary Esther Gilbert ©2021)

Artichoke Leaf	Contains prebiotic fiber inulin, promotes beneficial microorganisms in the intestines, aiding digestion, immunity against illness-causing microorganisms.
Carnation, Seed (Clove)	Strengthens the stomach and liver functions, antimicrobial. Phenolic compounds: reactive metabolites, molecularly bind to toxic metals, eliminate aluminum, lead.
Chamomile, German, Flower	Aids digestion, gastric ulcers, gastrointestinal problems, gallstones, irritable bowel syndrome (IBS).
Cinnamon Bark	Liver anti-inflammatory. Antimicrobial (bacterial, fungi, yeast). Flavonoids in cinnamon have free-radical-scavenging activities similar to superoxide dismutase (SOD), an enzyme that splits and neutralizes the free radical molecule. Protects colon aerobic bacterial environment.
Coriander Seed	Consists of potent antioxidant and antimicrobial essential oil components vital for growth and proper brain functioning. Improves digestion, alleviates flatulence. Used throughout the world for dyspeptic conditions, anxiety, insomnia, loss of appetite. Anti-anxiety effects, able to remove toxic metals from the body.
Cranberry	Recommended exhaustion, lack of appetite. Helps excrete radioactive substances, heavy metals lead, cobalt, cesium, strontium. Anti-inflammatory, anti-microbial.
Currant, Black	Natural antibiotic or antibacterial action. Increases antimicrobial activity of antibiotics tenfold (penicillin, tetracycline, biomycin).Polyphenols improve cognitive performance, slowed cognitive decline in aging, neuroprotection. Helps eliminate heavy metals, radioactive isotopes of strontium, cobalt and other radioactive elements, and many other environmental toxins.
Dandelion Root	Antiviral, anti-tuberculosis, antifungal, antithelmintic and anti-carcinogenic properties. Used in cases of poisonings, intoxications, poor appetite, gastritis, gastrointestinal aid, supports liver and digestive functions. Probiotic (precursor to the formation of beneficial bacterial in the lower intestine).
Fenugreek Seed, Common	Carminative (reduces flatulence), eases constipation. Alleviates gastritis and gastric ulcers. Has mucilaginous fiber, soothes and heals inflamed tissues, sweeps the colon of waste. Helps prevent degradation of nerve cells in the brain during neurodegenerative diseases. Stimulates renewal and formation of brain cells.
Ginger Root	Alleviates peptic ulcers, repairs stomach lining, prevents intestinal parasites. High in choline: supports nerve, brain, memory, cognition, learning, muscle movement. Antibacterial, antiviral, antifungal and anti-inflammatory. Contains essential fatty acid linoleic acid for producing critical fatty acids for cell membrane maintenance, brain and nervous system functioning. Rids the body of accumulated toxic waste.
Grapefruit	Antifungal, antibacterial, antimicrobial, antiprotozoal, antiseptic, antiviral. Improves spleen and stomach functioning. Effectively inhibits proliferation of bacteria: Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, and Bacillus subtilis.
Licorice Root	Liquiritigenin (LTG) reduces toxinoses (illness caused by toxins released by a living bacteria cell even after the bacteria has been destroyed by the immune system), Works against the yeast Candida albicans.
Mandarin	Anthelmintic agent against parasitic worms, antifungal, antiviral and antibacterial. Digestive aid: helps maintain proper stomach acid/base balance, preventing ulcers and infections of the stomach. Antioxidant essential oil limonene shown to elevate mood, relieve stress, anticarcinogenic. Helps remove toxins via kidneys and colon. Beneficial organic compounds oxygen, nitrogen, sulfur, for generating other compounds in human metabolism. Known to calm attacks of epilepsy, convulsions, and hysteria; relieve stress, anxiety.
Papaya	Contains the proteolytic enzyme, papain, which breaks down protein. Helps prevents constipation. Effective against worms and other intestinal parasites. Effective for gastrointestinal disorders, gastric and duodenal ulcers. Anti-inflammatory, antimicrobial: antifungal, anti-amoebic, antibacterial, histaminergic (aids production of histamines, the immune response to irritations such as allergens). Helps reduce likelihood of ulcers. Effective for dyspeptic problems (indigestion that affects moods, irritability or depression) in those who cannot digest the wheat protein gliandin, in gluten.
Pumpkin Seed	Contains cucurbitin, a toxin that eliminates parasites; is nontoxic to humans. Contains essential nutrient choline, important precursor for the neurotransmitter acetylcholine. Helps maintain the nervous system muscle memory and control, cell membrane signaling.
Purple Coneflower Root	A blood cleaner: actively cleans the lymphatic system, blood, kidneys and liver. Anti-viral, antibacterial, anti-inflammation.
Sweetie, Oro Blanco	Restores liver function, leads to normal functioning of digestive tract. Contains polyphenolic flavonoid compounds naringin and narirutin, shown to have an effective antioxidant effects.Strengthens the immune system, assists in efficient elimination of bacteria, pathogenic organisms that cause infections, and aids in fighting viruses. Prevents development of preeclampsia, a dangerous health complication of high blood pressure, swelling of hands and feet, and protein in the urine.

(Gilbert, 2021)

BRN

(Excerpt from "Potent Superfoods for Lifelong True Health" by Mary Esther Gilbert ©2021)

Apple	Prevents micromegaly (abnormal growth hormone production from the pituitary gland, the brain master gland that controls all other endocrine glands). Proven to improve brain function during mental workloads. Improves intestinal tract function and environment. Decreases lipid oxidation or abnormal utilization of fats due to cell-damaging free radicals (foreign chemicals, stress chemicals produced by the body).
Ashwagandha	Increases resistance to various infections, strengthens the immune system. Adaptogenic, anxiolytic (helps stabilize bodily processes, promotes homeostasis or biochemical equilibrium). Decreases cellular sensitivity to stress, stress reduction effects due to phytochemicals sitoindosides and acylsterylglucosides. Protects against gastric ulcers. Has a cognition-promoting effect (the formation of new dendrites or neuropathway extensions of the nerve cells); helpful with memory deficit and neurodegenerative diseases (Alzheimer's, Huntington's, Parkinson's diseases).
Asparagus	Effective against liver toxicity; contains enzymes that metabolize, neutralize and eliminate the toxic effects of alcohol's ethanol, alcohol dehydrogenase and aldehydes dehydrogenase. Contains inulin, an important digestive support nutrient. Contains flavonoids quercetin, rutin, kaempferol and isorhamnetin. Corrective properties for: biliousness (bile-related liver disorder or gastric distress), dysentery, inflammation, jaundice, as a vermifuge for parasitic worms such as schistosomiasis (disease caused by parasitic flatworms called schistosomes)
Bilberry	Is effective in nerve cell-signaling pathways. Protects and ensure proper gene expression, repair, and stabilization of DNA genetic code. Antineoplastic effects - helps prevent formation of abnormal tissue growths. Prevents inflammation leading to oxidative stress and leading to dementia.
Coffee (Young Green Coffee Bean)	Contains antioxidant phenolic acid; protects against cell damage and cell malfunctioning. Contains caffeine; stimulates hypothalamus gland production of catecholamines: epinephrine (adrenaline) and norepinephrine (noradrenaline) quickly sent to the brain, heart, and muscles via the nervous system normally in response to social or mental stress or a physical threat in the "fight or flight" response. Fight or flight response, a temporary biochemical state, allows one to cope with demands in one's environment that require alertness and self-protection. Caffeine also stimulates adrenaline production in the medulla of the adrenal glands and some central nervous system neurons. Adrenaline is rapidly released into the bloodstream, stimulating organs to react with specific "fight or flight" responsive actions, triggering dilation of the air passages in the respiratory system to allow more oxygen delivery to the muscles, triggering the blood vessels to re-direct blood to major muscle groups and the heart and lungs, reducing the body's ability to feel pain. Adrenaline also increases strength and performance, and heightens the sense of awareness. *Contains caffeic acid* – hydroxycinnamic acids, a sub-class of antioxidant, anti-inflammatory, free radical-neutralizing polyphenols, that reduce oxidative stress leading to dementia and rapid aging. Contains vitamin P (bioflavonoids or rutin); increases capillary strength and permeability, reducing capillary fragility (weakened blood vessels). Coffee components help modulate oxidative stress, preventing inflammation and various chronic degenerative conditions such as Parkinson's and Alzheimer's.
Damiana Leaf	Uses: anxiety neurosis associated with depression, nervous dyspepsia, gastrointestinal problems, constipation. Anti-mycobacterial, destroys the genus *Actinobacteria*, over one hundred fifty species that cause serious diseases in mammals. Adaptogenic, helps stabilize the body's biochemical processes, maintaining homeostasis during stress. Used in cases of nervous breakdowns, depression, nervous prostration or neurasthenia (extreme mental and physical fatigue due to excessive emotional stress
Ginger Root	Has positive effects on the lining of the stomach; prevents intestinal parasites. High in choline, a biochemical that supports nerve, brain and muscle movement functions. High in caprylic acid, a beneficial saturated fatty acid that is antibacterial, antiviral, antifungal and anti-inflammatory. Contains a primary essential fatty acid linoleic acid, from which the body makes other critical fatty acids for cell membrane maintenance, brain and nervous system. A universal remedy for ridding the body of accumulated toxic waste.
Ginkgo Leaf	Phytochemicals help improve memory, reduce anxiety, normalize sleep. Blocks formation of blood clots, cleans lymph, improves blood circulation, eliminates headaches, alleviates dizziness. Strengthens arteries, veins, capillaries; improves symptoms of Alzheimer's, vascular dementia (brain damage caused by multiple strokes), memory, concentration, depression, dizziness. Flavonoids and terpenoids help improve memory and learning ability, improve microcirculation, increase hypoxia tolerance in brain cells (ability to tolerate oxygen deficiency). Active compounds, free radical scavenging antioxidants: flavonol glycosides, ginkgolides, bilobalide, proanthocyanidins that protect nerve cells from damage, influence various nerve transmission systems critical in cognition (perception, discernment, comprehension, insight). Active compounds enhance cholinergic processes (the releasing of or responding to acetylcholine, a chemical released by nerve cells that sends signals to other cells) in the brain's hippocampus, the center of the autonomic (involuntary or unconscious) nervous system, and influences emotions and spatial working memory. Influences cholinergic transmissions associated with increased brain electrical activity through improved cerebral blood flow in the visual cortex, the portion of the cerebral cortex that receives and processes impulses from the optic nerves.

Ginseng, Asian, Root (Panax)	Protects against nerve or neurodegenerative disorders. Improves mental and physical performance; enhances ability to take on physical loads without increasing the need for more oxygen consumption. Improves mental work capacity, endurance and recuperation after exhaustive physical loads; has anti-fatigue, anti-depressive, anti-stress, anti-anxiety effects and cognition enhancing properties. Ginsenosides have a stimulatory effect on the brain through the release of chemicals that affect cell-to-cell nerve signaling resulting in improved alertness. Contains saponins that repair nerve cells, have antidepressant effects, protect against stroke, Parkinson's disease by increasing neurotransmitters dopamine, noradrenaline, and 5-hydroxytryptamine. **A**daptogenic, anti-inflammatory, anti-fatigue, anti-stress, immunomodulatory. Ginsenosides triterpenoid glycosides protect neurons against neurodegenerative disorders, enhance memory, learning, improve cognitive performance. Ginsenosides shown to increase neuron cell lifespan, repair structural damage, improve nerve cell axons and dendrite growth for communication and transmissions between nerve cells. Ginsenosides increase uptake of choline, vital for the structuring of cell membranes, and modulate acetylcholine (Ach), a neurotransmitter in cell signaling important for improving cognitive impairment deterioration due to aging.
Ginseng, Siberian, Root (Eleuthero)	Combats weakness and fatigue, improves physical performance in high intensity exercise. Improves brain activity: protects cognition, improves ability to focus, alertness, an anti-inflammatory, neuroprotective. Prevents the degenerative biological, chemical and physical effects of stress.
Green Tea	Contains antioxidant polyphenols: flavanols and flavonoids, and phenolic acids. Prevents narrowing of blood vessels, strengthens blood vessel walls, helps prevent atherosclerosis, heart, brain and blood vessel conditions. Antimicrobial, antiviral, anti-inflammatory, antiarthritic, helps rid body of toxins and heavy metals.
Magnolia Vine Fruits (Schisandra)	Contains *Schisandra* lignans; used for weakness and fatigue. Defense against pathogenic or illness-causing fungi and bacteria. Anti-inflammatory, antimicrobial, hepatoprotective (protects the liver), prevents osteoporosis. Contains triterpenoids found to induce cancer cell self-destruction, reduce inflammatory responses, remove toxins in the liver, improve immune functions that destroy viruses, inhibit the growth of bacteria and *Candida albicans* yeast growths. Contains sesquiterpenes, monoterpene antioxidants: antimicrobial, antifungal and antibacterial. Improves reflex actions, effects on the central nervous system in enhanced physical performance. Effective adaptogenic agent in improving athletic overexertion, boosts muscle strength, lung capacity, and mental strain and mental performance.
Turmeric Root	Helps the immune system deal with psychological stress. Supports bones and joints; reduces joint pain and swelling through decreased production of cyclo-oxygenase 2 enzymes (COX-2 inhibitor). Contains antioxidants that scavenge free radical foreign molecules (synthetic chemicals from processed foods, agrichemicals, industrial chemicals); protect against free radical damage to cell membranes and DNA. Reverses brain and age-related conditions, prevents shrinking of the brain's hippocampus that functions for learning and memory. Contains curcumin, shown to cross the blood-brain barrier; improves the neurodegenerative process of Alzheimer's disease by preventing plaques that narrow circulatory passages in the brain.
Water Hyssop Leaf	Shows improvement in cognitive performance: reasoning, attention, memory, language, attainment of information, increased choice reaction time, retention of new information. Effective in stimulating and maintaining nerve and brain cells, enhances memory, speed of memory. Highly studied for mechanisms of action upon the nervous system and brain. Enhances acetylcholine function, promoting enhanced attention and memory processing. Contains neurotransmission-enhancing properties that delay the mental degenerating effects of aging.

(Gilbert, 2021)

5. By the same token, how does the deficiency of certain nutrients affect cognitive functions and brain health?

A full range of nutrients are required for the complex bidirectional communication system of bacteria colonizing the intestines (the gut microbiome) and plays a crucial role in maintaining cognitive and other brain functions.

Optimal brain health (optimal nourishment) enables a person to comprehend, cope, and adjust their own cognitive, psychological, emotional and behavioral functioning.

Nutritional and Other Factors That Affect Cognition:

- Various factors that impair cognition:
  - Age-related changes:
    - Neural degeneration
    - Depression
    - Type 2 diabetes
    - Mid-life hypertension
    - Mid-life obesity
    - Physical inactivity
    - Low education or lack of acquiring knowledge.
  - Biochemical imbalances leading to mood disorders.
  - Substance abuse, including alcohol and smoking.
  - Degenerative diseased conditions in the various body systems.

- Modifiable lifestyle factors that maintain cognition:
    - Full range nutrient diet and nutrients: animal-derived protein.
    - Physical activity
    - Social interactions

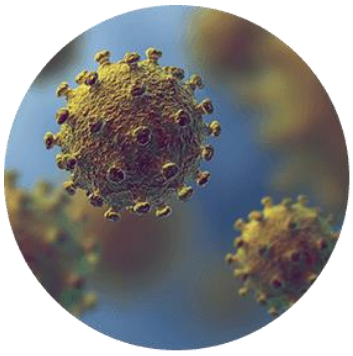
- Factors to consider on brain development and functioning:
  - Genetic predisposition.
  - Early childhood experiences leading to behavioral dysfunction and increased risk for chronic disease.
  - Nutritional deficiencies in impaired early brain development; optimal nourishment ensures proper brain development that outweighs a less nurturing environment.

- Relationship between gut microbiome and brain function:
  - Critical nutrition factors that are required for cognition:
    - **Vitamins (A, D, Vitamin B complexes)**.
      - Vitamin D (cholecalciferol) from sunlight exposure.
      - Vitamin A from fish oils, or carotenoids that are converted to Vitamin A as needed.
    - **Plant-derived minerals**.
      - Iron for transporting oxygen to brain and all body systems.
      - Preventing iron-deficiency anemia (IDA) associated with cognitive, mental and motor impairment, impaired coordination, attention, memory, executive function (planning, problem-solving, reasoning).
      - *[Note: do not take iron supplements. Iron is best utilized from meats, fish, and poultry with foods rich in Vitamin C. Iron overload impairs neurophysiological mechanisms that enhance oxidative stress and nerve cell death, and associated with decline in motor and cognitive functions.]*
      - Iodine deficiency - shown to have a link between prenatal iodine deficiency and cognitive development, and is a preventable cause of mental retardation. Deficiencies in postnatal children may result in thyroid failure leading to hypothyroidism, linked to deficits in cognitive functioning, spelling and reading deficits.

        - *[Note: iodine supplements are not recommended; seafoods from Arctic waters are a good source of iodine.* In balance with other mineral-rich foods, research shows that iodized salt may be a cautionary measure to help prevent thyroid disorders.
    - Phytochemicals, especially **polyphenols** and **phenolic acids**.
    - Maintenance of beneficial gut microbe populations in the intestines (*live* anaerobic bacteria and beneficial yeast populations) by including various types of **dietary plant fibers** (soluble, insoluble) from whole foods: fruits, vegetables, legumes, wholegrains and nuts.
        - Prevent overgrowths of illness and disease-causing, anaerobic microorganisms.
        - Required for producing other important byproducts needed in metabolism or system maintenance.
        - Needed for breaking down and recycling bile after digestion.
        - Helps teach immune system memory to identify and destroy harmful microbes (anaerobic bacteria, viruses, fungi, parasites).
    - **Avoiding excess dietary fats**; balancing animal fats with monounsaturated fatty acids (MUFA) in nuts, seeds, fruits (olive, avocado, dark chocolate/cacao).
    - A varied, balanced diet of **animal-derived proteins, whole food fats and carbohydrates such as root vegetables, beans, legumes, 100% whole grains) and fresh, enzyme-active fruits, berries, greens, herbs, raw nuts and seeds** improves cognition:
        - Attention capacity
        - Processing speed
        - Working memory
        - Immediate recall
        - Recognition
        - Executive function (planning, organizing, strategizing, multitasking, remembering details, controlling impulses for appropriate behavior).

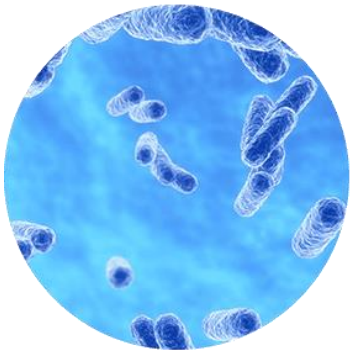
(Black, 2003) (Gilbert, 2021) (Puree, 2023)

Illness or Disease-Causing Gut Microbiome (Anerobic)

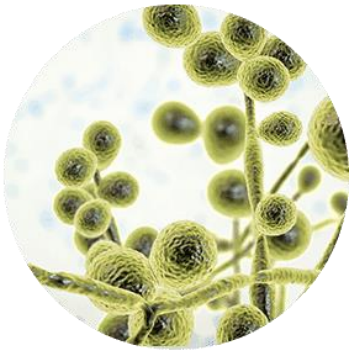


Virus

Parasite



Bacteria



Fungi

Institute for Biomedical Research

6. How do genetic factors interact with nutrition to influence cognitive function?

- **Correlations between nutrition and cognitive functioning** indicate that they are affected by:
    - *Environmental influences and circumstances*.
    - *Lifestyle choices*.
    - *Genetic characteristics form early in utero* as the Central Nervous System (CNS) and the Enteric Nervous System (ENS) or gastrointestinal tract are influenced in their development by the nutritional status of the mother.
        - *The genetics of the developing fetal, the mother's gut-brain microbiome interactions and communications are critical for the baby's neurodevelopment.*

    - Epigenetics (how cells control gene activity without changing the sequence of genes in the DNA).
    - Neuroplasticity – the link between genetics and environmental factors that affect cerebral structure and resulting functional changes.
        - The brain grows and evolves in response to life experiences by growing new nerve communication pathways and networks.
        - Gut-brain health in the aging affects cognitive functions, helps prevent cognitive impairments, and motor, executive, attention, memory, language and visuospatial functions.

- **Common health conditions due to dysbiosis** (disrupted microbiome balance) of the cardiovascular, immune, and endocrine/glandular/hormonal systems are correlated with cognitive impairments due to *inflammatory markers initiated through the immune system as a result of unhealthy lifestyle and poor nutrition choices*.

- **Nutrients that play a role in the gut-brain axis**:
    - **PUFAs**
        - Prevent neurodegeneration, increase hippocampal neurogenesis, neuronal and microglia cell density, dentritic arborization of neurons, and reduce apoptosis, astrocytosis and lipofuscin accumulation.
        - Improve neurotransmission, cell signaling by improving neuronal cell membrane fluidity, increased receptor number and ionic channels functions.
        - Docosahexanoic acid (DHA) is the most abundant of the PUFAs in brain cell membranes. Deficiency leads to learning and memory impairments.
    - **Polyphenols** curcumin, resveratrol, flavonoids – anti-inflammatory, neuroprotective, help increase Brain-Derived Neurotrophic Factor (BDNA)
        - Associated with improvements in cognitive performance over time in the elderly.
    - **Vitamin B Complex** – improve cognitive functions.
        - Vitamins B_6, B_{12}, and folate (folacin, folic acid) deficiencies include loss in brain volume, cognitive and memory decline.
    - **Vitamin D_3 (cholecalciferol)** – improve attention and working memory; deficiency correlates with cognitive decline, executive function impairments (disruption of the brain's ability to control thoughts, emotions, behavior).
    - **Vitamin E (tocopherols) –** influences the gut microbiota-brain communications and helps prevent cognitive decline.

- **Disruption of the beneficial aerobic intestinal microbes** that help regulate the gut-brain axis can lead to:
    - Neurogenerative diseases
    - Loss of intestinal permeability and impaired ability to block absorption of toxic substances that stimulate release of inflammatory proteins such as cytokines that can reach the brain and cause inflammatory conditions and nerve degeneration.

(Gilbert, 2023) (Johnson, 2009) (Polverino, 2021)

7. And how do our Acumullit SA drops help address this?

- Phytonutrient compounds in the drops' botanicals are well proven to *maintain optimal populations of various microflora* or microbiome environments in the gastrointestinal tract, or gut.

- Phytonutrients in the drops also are known to *aid the immune system in destroying illness or disease-causing microorganisms* in order for them to not become overgrown and challenge the beneficial oxygen-loving gut microflora.

- Phytonutrients in the drops are quickly and easily absorbed into the circulatory system where these vital nutrients *needed for the two-way communication pathways between the gut-brain and brain-gut axis* are delivered.
- Phytonutrients in the drops help *ensure the communications for the repair, maintenance, and correct regeneration* of nerve, brain, immune, and endocrine/glandular/hormonal so that cells can maintain optimal cognitive functions and other brain activities.

- Phytonutrients in the drops contain the *genetic information of plant DNA* that the body's own DNA deciphers, accepts and utilizes to repair and correct its own communication capacity and the trillions of other cellular processes.

8. How do you see the future of nutritional research in understanding and enhancing cognitive functions, especially now having access to our cutting edge innovative rapid DNA drops?

- More research is needed in the study of how nutrient and phytonutrient actions play their roles in the gut-brain/brain-gut axis, considering that the many organ systems involved communicate and have a direct impact on cognitive functioning.

- It is the Acumullit SA Technology that puts the DNA drops ahead of their time since the formulations contain a diverse range of the very plant DNA and other plant cell components, and phytonutrients and other nutrient factors that are all required to repair, maintain, and protect those vital communications between the gut-brain/brain-gut axes.

- Healthcare technology must evolve toward accurate diagnostics that can pinpoint the root causes of degenerative health conditions (as in diagnostics using current biophotonics technology).

- Continue scientific research in discovering and revealing to the public how to apply the ever growing accumulation of vast scientific knowledge.

- To recognize that the ancient healing knowledge gathered and preserved through the ages in applying functional botanicals for one's personal health management is continually being confirmed scientifically for its efficacy in protecting and correcting the body's capacity to protect its inner environment and restore itself to proper functioning.

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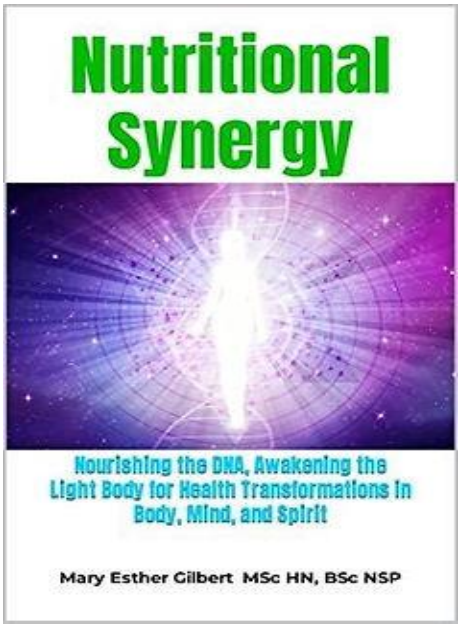

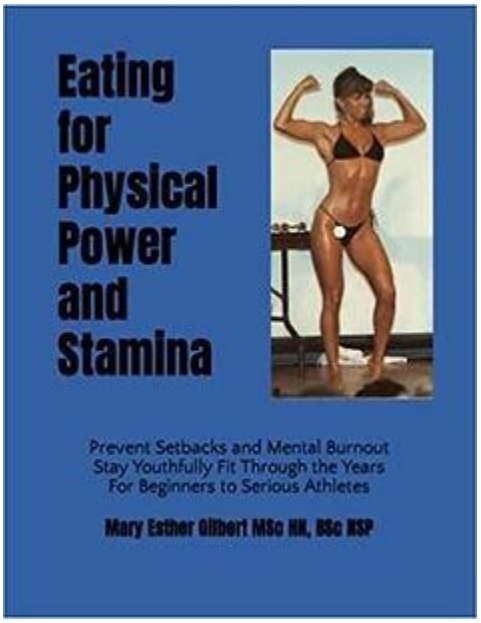

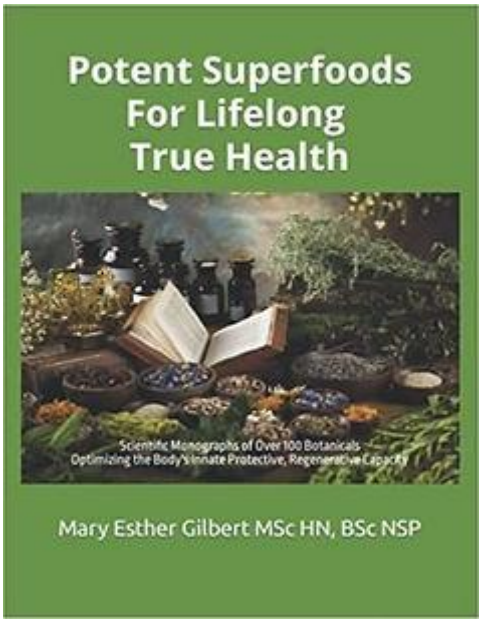

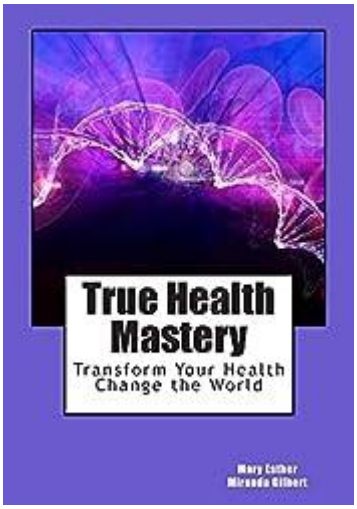

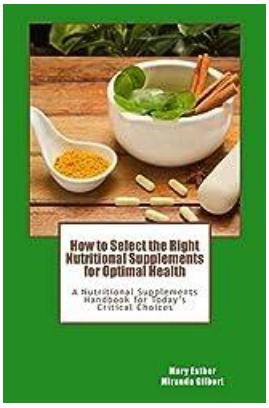

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