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Flawed Study Design Test Answers

Study 1:

- Age discrepancy (an elderly individual will have less strength to exert during an exercise, and therefore less systemic benefits).
- Unmonitored diet among participants.
- Unmonitored supplementation among participants.

Study 2:

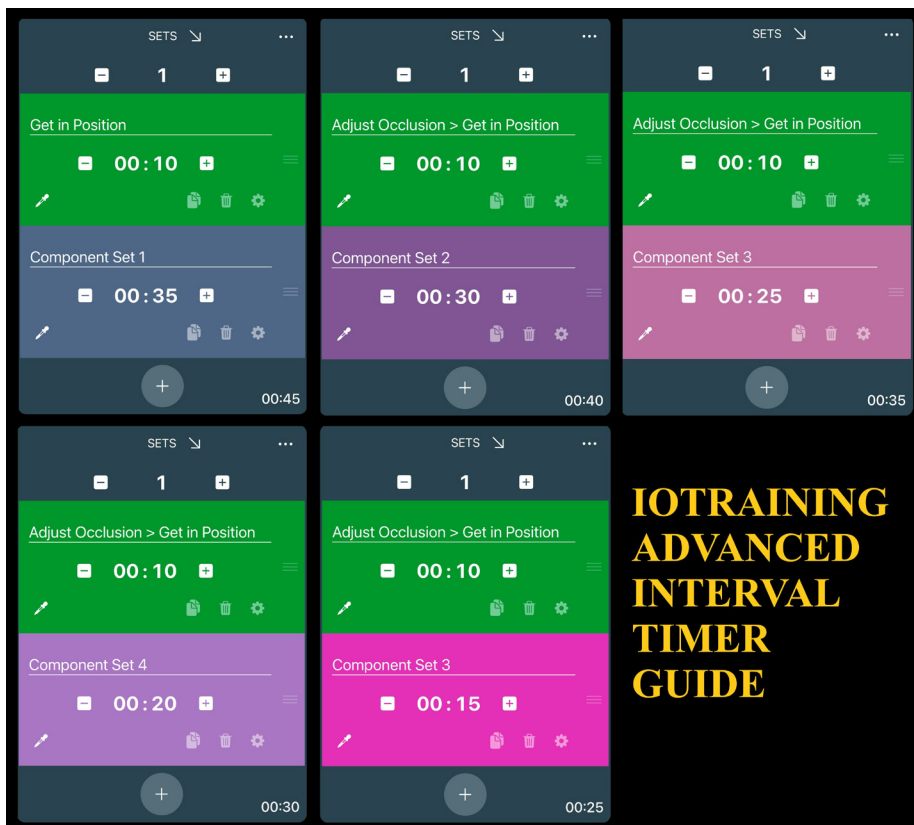
- Assuming and attributing that Green Tea polyphenols are the sole reason for a decrease in blood glucose when Caffeine, a chemical capable of interacting with blood sugar, is present in Camellia Sinensis in very high concentrations.
- Unmonitored diet among participants.
- Unrealistic dosing (Commonly sold and prepared tea will never be as strong as extracts).

Study 3:

- The species of Cinnamon used is not identified, therefore the chemical composition of the Cinnamon used is unknown, leading to serious legitimacy issues of the study.
- The supplier of the Cinnamon is relatively unknown and has no certifications proving purity and lack of contamination.

Interval Timer Guide for IOT

(Suggested for use with Interval Timer Plus App)



IMC Sciences Overview

(Extracted carefully from PubMed & ChatGPT)

Common Dietary Phytochemical Classifications, Examples, & Sources:

- **Anthocyanins (Anthocyanidins: Red-Purple-Blue Pigments):** Delphinidin (Blueberry), Cyanidin (Elderberry), Malvidin (Black Grape).
- **Carotenoids (Yellow-Orange-Red Pigments):** Beta-Carotene (Carrots), Lycopene (Tomato), Lutein / Zeaxanthin (Flower Petals), Capsanthin (Paprika, Cayenne, Red Pepper).
- **Phenolic Acids:** Chlorogenic Acid (Coffee), Caffeic Acid (Chokeberry), Sinapic Acid (Green Olive), Ferulic Acid (Whole Wheat), p-Coumaric Acid (Cloudberry), Vanillic Acid (Sweet Basil).
- **Flavanols:** Catechins (Cocoa, Green Tea).
- **Flavonols:** Quercetin (Elderberry, Chokeberry), Rutin (Capers), Kaempferol (Capers).
- **Flavones:** Luteolin (Chinese Celery, Oregano, Thyme), Apigenin (Parsley).
- **Tannins:** Vescalagin / Castalagin (Oak / Chestnut Bark: Liquor / Wine)
- **Lignans:** Secoisolariciresinol Diglucoside (Flax seeds).
- **Terpenes (Terpenoids):** Linalool (Cilantro), Humulene / Myrcene (Beer).
- **Phytosterols:** Beta-Sitosterol (Barley, Rice), Stigmasterol (Sunflower Seed oil).
- **Saponins:** Ginsenosides (Ginseng).
- **Glucosinates:** Glucoraphanin (Broccoli), Allyl Isothiocyanate (Wasabi, Horseradish, Mustard).
- **Alkaloids:** Caffeine (Tea, Coffee), Nicotine (Tobacco), Piperine (Black Pepper).
- **Other Pigments:** Chlorophyll (Chlorella, Spirulina), Betalains (Beet).
- **Phytoecdysteroids:** Ecdysterone (Spinach, Quinoa).

Myogenic Regulatory Factors and their Functions:

- **Myogenic Differentiation 1 (MyoD):** MyoD serves as a master regulator of skeletal muscle differentiation. It activates the expression of muscle-specific genes and initiates the conversion of precursor cells (myoblasts) into mature muscle cells (myotubes). MyoD also plays a role in muscle regeneration by promoting the activation and proliferation of satellite cells.
- **Myogenic factor 5 (Myf5):** Myf5 is involved in the early specification and commitment of multipotent mesodermal cells to the skeletal muscle lineage during

embryonic development. It activates the expression of genes necessary for muscle cell differentiation and growth, guiding myoblasts towards the skeletal muscle lineage.

- **Myogenin (MyoG):** Myogenin is essential for the terminal differentiation of myoblasts into mature muscle fibers. It regulates the expression of genes involved in myoblast fusion, sarcomere assembly, and muscle-specific protein synthesis. Myogenin also plays a role in muscle repair and regeneration by promoting the formation of new muscle fibers.
- **Myogenic Regulatory Factor 4 (MRF4 or Myf6):** MRF4 contributes to skeletal muscle development by regulating the differentiation and maturation of muscle cells. It is involved in coordinating muscle fiber type specification and the expression of genes associated with fast-twitch muscle fibers. MRF4 also participates in muscle regeneration by activating satellite cells and promoting their differentiation into new muscle cells.
- **Paired Box 7 (PAX7):** Although not considered an MRF, it is a transcription factor crucial for maintaining and activating satellite cells, playing a central role in skeletal muscle regeneration.

Mature Adipocyte Chemical Secretions (Adipokines & Adipocytokines):

- **Adiponectin:** A hormone with anti-inflammatory and insulin-sensitizing properties.
- **Leptin:** A hormone that regulates appetite and energy expenditure.
- **Resistin:** Implicated in insulin resistance and inflammation.
- **Tumor Necrosis Factor-alpha (TNF-alpha):** A pro-inflammatory cytokine.
- **Interleukin-6 (IL-6):** A cytokine with both pro- and anti-inflammatory effects.
- **Plasminogen Activator Inhibitor-1 (PAI-1):** Regulates fibrinolysis and thrombosis.
- **Retinol-binding Protein 4 (RBP4):** Involved in insulin resistance and metabolism.
- **Visfatin:** Implicated in glucose metabolism and inflammation.
- **Angiotensinogen:** Precursor to angiotensin, involved in blood pressure regulation.
- **Chemerin:** Associated with adipogenesis and inflammation.
- **Omentin:** May have anti-inflammatory and insulin-sensitizing effects.
- **Vaspin:** May play a role in insulin sensitivity and obesity.
- **Adipsin:** Involved in complement activation and adipogenesis.
- **Lipocalin-2:** Associated with obesity-related inflammation and insulin resistance.
- **FGF-21 (Fibroblast Growth Factor 21):** Implicated in metabolic regulation and insulin sensitivity.
- **Natriuretic Peptides (ANP, BNP):** Involved in cardiovascular regulation and sodium balance.
- **IL-1 β (Interleukin-1 beta):** Pro-inflammatory cytokine.
- **IL-8 (Interleukin-8):** Chemokine involved in inflammation.
- **IL-10 (Interleukin-10):** Anti-inflammatory cytokine.

Reactive Oxygen Species (Free Radicals) and their effects in high or chronic concentrations:

- **Hydroxyl radical ($\bullet\text{OH}$):** Causes damage to lipids, proteins, and DNA, leading to cell injury and aging.
- **Superoxide radical ($\bullet\text{O}_2^-$):** Impairs cellular function, contributes to inflammation, and damages DNA.
- **Nitric oxide radical ($\bullet\text{NO}$):** Regulates blood pressure, neurotransmission, and immune responses; at high concentrations, can contribute to oxidative stress and tissue damage.
- **Singlet Oxygen ($^1\text{O}_2$) :** Singlet oxygen is formed when molecular oxygen absorbs energy, often from light or certain chemical reactions. Its high reactivity causes it to oxidize biological molecules, leading to cellular damage, oxidative stress, and potential dysfunction or death.
- **Peroxyl radical ($\bullet\text{OOH}$):** Initiates lipid peroxidation, damaging cell membranes and contributing to aging and disease.
- **Alkoxyl radical ($\bullet\text{OR}$):** Causes oxidative damage to lipids and proteins, contributing to aging and disease.
- **Carbon-centered radical ($\bullet\text{CR}_3$):** Formed during lipid peroxidation, contributes to cellular damage and inflammation.
- **Nitroxyl radical ($\bullet\text{NO}_2$):** A component of nitrogen dioxide, a major air pollutant that can damage lung tissue and exacerbate respiratory conditions.
- **Thiyl radical ($\bullet\text{SH}$):** Impairs protein function and can contribute to cellular damage and inflammation.
- **Lipid peroxyl radical ($\text{LOO}\bullet$):** Initiates and propagates lipid peroxidation reactions, damaging cell membranes and contributing to disease.
- **Protein-centered radicals ($\bullet\text{CR}_2$):** Cause damage to proteins, disrupting cellular function and contributing to aging and disease processes.

Growth Factors and their functions:

- **Epidermal Growth Factor (EGF):** Stimulates cell growth, proliferation, and differentiation, particularly in epithelial tissues like skin.
- **Fibroblast Growth Factors (FGFs):** Promote the growth and differentiation of various cell types, including fibroblasts, endothelial cells, and neural progenitor cells, and play roles in tissue repair and regeneration.
- **Platelet-Derived Growth Factor (PDGF):** Stimulates cell proliferation and migration, particularly of mesenchymal cells such as fibroblasts and smooth muscle cells, contributing to wound healing and tissue repair.
- **Vascular Endothelial Growth Factor (VEGF):** Stimulates angiogenesis, the formation of new blood vessels from existing ones, and vasculogenesis, the formation of new blood vessels from precursor cells, promoting tissue vascularization and repair.

- **Insulin-like Growth Factors (IGFs):** Regulate cell growth, proliferation, and differentiation in various tissues, playing roles in growth and development, as well as tissue repair and metabolism.
- **Transforming Growth Factors (TGFs):** Control cell growth, differentiation, and apoptosis, regulating various cellular processes involved in development, tissue repair, and immune responses.
- **Nerve Growth Factor (NGF):** Supports the survival, growth, and differentiation of sensory and sympathetic neurons, playing roles in neuronal development, maintenance, and regeneration.
- **Brain-Derived Neurotrophic Factor (bDNF):** Promotes the survival, growth, and differentiation of neurons in the central nervous system (CNS), influencing synaptic plasticity, learning, and memory.
- **Hepatocyte Growth Factor (HGF):** Stimulates cell proliferation, migration, and morphogenesis, particularly in hepatocytes (liver cells), contributing to liver regeneration and tissue repair.

Blood cells and their functions:

- **Red blood cells (Erythrocytes):** Transport oxygen from the lungs to tissues and carry carbon dioxide back to the lungs.
- **White blood cells (Leukocytes):**
 1. **Neutrophils:** Engage in phagocytosis to ingest and destroy pathogens.
 2. **Lymphocytes:** Play a central role in the adaptive immune response, including B cells, T cells, and natural killer (NK) cells.
 3. **Monocytes:** Differentiate into macrophages or dendritic cells to phagocytose pathogens and present antigens.
 4. **Eosinophils:** Combat parasitic infections and modulate allergic responses.
 5. **Basophils:** Release histamine and other mediators involved in allergic responses and inflammation.
 6. **Platelets (Thrombocytes):** Essential for blood clotting (hemostasis) by forming clots to stop bleeding when blood vessels are injured.

The Brain, its major parts, and their functions:

Cerebrum:

- Responsible for higher cognitive functions such as thinking, memory, perception, and voluntary movement.
- Divided into two hemispheres (left and right), each controlling the opposite side of the body.

Cerebellum:

- Coordinates voluntary movements, balance, posture, and motor learning.
- Helps maintain smooth and coordinated muscle movements.

Brainstem:

- Connects the brain to the spinal cord and regulates basic life-sustaining functions such as breathing, heart rate, and blood pressure.
- Comprises the midbrain, pons, and medulla oblongata.

Diencephalon:

- Thalamus: Acts as a relay station for sensory information (except smell) traveling to the cerebral cortex.
- Hypothalamus: Regulates body temperature, hunger, thirst, sleep-wake cycles, and hormone secretion from the pituitary gland.

Limbic System:

- Involved in emotions, memory, and motivation.
- Includes structures such as the amygdala, hippocampus, and cingulate gyrus.

Basal Ganglia:

- Controls voluntary motor movements, procedural learning, and habit formation.
- Includes structures such as the caudate nucleus, putamen, and globus pallidus.

Cortex:

- The outer layer of the cerebrum, comprises gray matter.
- Responsible for higher cognitive functions such as perception, memory, language, and decision-making.
- Divided into four lobes: frontal, parietal, temporal, and occipital, each with specific functions.

Hippocampus:

- Vital for the formation and retrieval of memories.
- Plays a role in spatial navigation and learning.

Amygdala:

- Involved in processing emotions, particularly fear and aggression.
- Plays a role in emotional memory formation and response.

Pituitary Gland:

- Master gland that regulates hormone production and secretion from other endocrine glands.
- Plays a crucial role in growth, metabolism, and reproduction.

Pons:

- Acts as a bridge between the cerebellum and the rest of the brain.
- Involved in regulating sleep, breathing, and other autonomic functions.

Medulla Oblongata:

- Controls vital autonomic functions such as heartbeat, breathing, and swallowing.

- Regulates reflexes such as coughing, sneezing, and vomiting.

Midbrain:

- Involved in sensory processing, motor coordination, and arousal.
- Contains nuclei responsible for controlling eye movements and pupil dilation.

Thalamus:

- Acts as a relay station for sensory information traveling to the cerebral cortex.
- Plays a role in regulating consciousness, sleep, and alertness.

Hypothalamus:

- Regulates body temperature, hunger, thirst, sleep-wake cycles, and hormone secretion from the pituitary gland.
- Controls the autonomic nervous system and the body's response to stress.

Corpus Callosum:

- Thick band of nerve fibers that connects the two hemispheres of the cerebrum.
- Facilitates communication and coordination between the left and right sides of the brain.

Olfactory Bulb:

- Processes olfactory (smell) information received from the nasal cavity.
- Plays a role in odor detection and discrimination.

Reticular Formation:

- Extensive network of neurons located throughout the brainstem.
- Regulates arousal, attention, and consciousness.

Septum:

- Involved in emotional regulation, memory consolidation, and reward processing.
- Plays a role in social behavior and aggression.

Corpora Quadrigemina:

- Located in the midbrain, consists of four rounded elevations.
- Contains nuclei involved in visual and auditory processing.

Pineal Gland:

- Secretes melatonin, a hormone that regulates the sleep-wake cycle and circadian rhythms.
- Plays a role in seasonal and reproductive functions.

The Cornu Ammonis (CA) areas of the brain:

These are regions of the brain contained within the Hippocampus that are involved in many forms of memory, which are numbered CA1, CA2, and CA3. These CA subfields

play distinct roles in memory processing and have unique cellular and synaptic properties.

The three CA subfields and their relation to memory:

1. CA1 Subfield:

- **Function:** CA1 is involved in the consolidation and retrieval of declarative memories, which are memories of facts and events. It receives inputs from the CA3 region and sends outputs to other areas of the brain, including the entorhinal cortex and neocortex.
- **Cellular Properties:** CA1 pyramidal neurons are characterized by their extensive dendritic arborization and complex synaptic connections. They receive inputs from both the perforant path (from the entorhinal cortex) and the Schaffer collaterals (from CA3 pyramidal neurons).
- **Relation to Memory:** Lesions or dysfunction in the CA1 region can impair the encoding and retrieval of declarative memories. Studies have shown that damage to CA1 can result in anterograde amnesia, where new memories cannot be formed, as well as retrograde amnesia, where previously formed memories are lost.

2. CA2 Subfield:

- **Function:** CA2 is less well-studied compared to CA1 and CA3, but emerging research suggests that it may play a role in social memory and social behavior. It receives inputs from CA3 and sends outputs to CA1 and CA3.
- **Cellular Properties:** CA2 neurons have unique molecular and synaptic properties that distinguish them from neurons in neighboring regions. They express specific receptors and ion channels that contribute to their functional specialization.
- **Relation to Memory:** While less is known about the specific role of CA2 in memory processing, studies in animal models suggest that it may be involved in the recognition and processing of social cues and contexts. Dysfunction in CA2 has been implicated in social memory deficits observed in certain neuropsychiatric disorders.

3. CA3 Subfield:

- **Function:** CA3 is primarily involved in pattern completion, the process by which incomplete or degraded input patterns are restored or completed to retrieve stored memories. It receives inputs from the dentate gyrus and sends outputs to CA1 and other regions of the hippocampus.
- **Cellular Properties:** CA3 pyramidal neurons are known for their recurrent collateral connections, which form a dense network of excitatory synapses within the region. This recurrent connectivity is thought to contribute to the computational properties of CA3, including pattern completion.

- **Relation to Memory:** Lesions or dysfunction in CA3 can impair the ability to retrieve memories from partial or degraded cues, leading to deficits in pattern completion. This has been observed in animal studies and computational models of hippocampal function.

Dopamine Receptors and their behavioral functions:

- **D1 receptor:** Regulates reward, motivation, cognition, and motor control.
- **D2 receptor:** Influences reward, movement, and emotional processing; implicated in addiction and psychosis.
- **D3 receptor:** Linked to motivation, emotion, and addiction; associated with depression and schizophrenia.
- **D4 receptor:** Involved in attention, learning, and memory; associated with ADHD and schizophrenia.
- **D5 receptor:** Plays a role in cognitive processes, motivation, and synaptic plasticity.

Serotonin Receptors and their behavioral functions:

- **5-HT1A receptor:** Regulates mood, anxiety, aggression, and cognition; implicated in depression and anxiety disorders.
- **5-HT1B receptor:** Modulates mood, anxiety, and aggression; involved in addiction and impulsivity.
- **5-HT1D receptor:** Influences pain perception and migraine headaches.
- **5-HT1E receptor:** Less understood; potential role in mood regulation.
- **5-HT1F receptor:** Implicated in migraine headaches.
- **5-HT2A receptor:** Regulates mood, perception, and cognition; involved in hallucinations and psychosis.
- **5-HT2B receptor:** Linked to mood regulation, appetite, and cardiac function.
- **5-HT2C receptor:** Modulates mood, appetite, and addiction; potential target for obesity and depression treatments.
- **5-HT3 receptor:** Involved in nausea, vomiting, and anxiety.
- **5-HT4 receptor:** Influences mood, memory, and gastrointestinal motility.
- **5-HT5 receptor:** Functions not well understood.
- **5-HT6 receptor:** Associated with learning, memory, and cognitive function; potential target for Alzheimer's disease.
- **5-HT7 receptor:** Implicated in mood regulation, cognition, and sleep.

GABA Receptors and their behavioral functions:

- **GABA-A receptor:** Mediates fast inhibitory neurotransmission; regulates anxiety, sedation, and muscle relaxation.

- **GABA-B receptor:** Mediates slow inhibitory neurotransmission; influences mood, sleep, and pain perception.
- **GABA-C receptor:** Less understood; may modulate visual processing and motor control.

VEGF Receptors and their functions:

- **VEGFR-1 (Flt-1):** Involved in regulating angiogenesis, vasculogenesis, and vascular permeability.
- **VEGFR-2 (KDR/Flk-1):** Main mediator of VEGF-induced angiogenesis, promoting endothelial cell proliferation, migration, and survival.
- **VEGFR-3 (Flt-4):** Primarily associated with lymphangiogenesis, regulating lymphatic endothelial cell growth and differentiation.

Muscle Loss Terminology:

- **Sarcopenia:** Age-related loss of muscle mass, strength, and function, leading to decreased physical performance and increased frailty.
- **Atrophy:** Decrease in the size and function of a tissue or organ, such as muscle, due to factors like disuse, injury, or disease.
- **Disuse:** Reduction in muscle activity or movement, leading to loss of muscle mass and strength, typically due to immobilization, sedentary lifestyle, or prolonged bed rest.
- **Cachexia:** Chronic illness-induced muscle loss due to either inflammation or muscle atrophy factors.
- **Denervation:** When nerves that innervate muscles are damaged or severed, the affected muscles lose their neural stimulation, leading to atrophy. This can occur due to conditions such as spinal cord injury, peripheral nerve damage, or motor neuron diseases like ALS (amyotrophic lateral sclerosis).

The Scientific components of Muscle Contraction:

- **Actin:** Actin is a protein that forms thin filaments in muscle cells. It serves as the primary component of the contractile machinery in muscle fibers.
- **Myosin:** Myosin is a motor protein that comprises thick filaments in muscle cells. It contains "heads" that can bind to actin filaments and generate force during muscle contraction.
- **Filaments:** Filaments refer to the long, thread-like structures formed by the assembly of actin and myosin proteins within muscle cells. Actin and myosin filaments interact to produce muscle contraction.
- **Calcium ions:** Calcium ions play a crucial role in muscle contraction by regulating the interaction between actin and myosin. They are released from the

sarcoplasmic reticulum in response to nerve impulses, initiating muscle contraction.

- **Sarcomeres:** Sarcomeres are the basic structural and functional units of muscle contraction. They are composed of overlapping actin and myosin filaments and are responsible for the generation of force and movement in muscle fibers.
- **Sarcoplasmic reticulum:** The sarcoplasmic reticulum is a specialized organelle within muscle cells that stores and releases calcium ions. It plays a central role in regulating intracellular calcium ion concentrations and initiating muscle contraction.
- **ATP hydrolysis:** ATP hydrolysis is the process by which ATP molecules are broken down into ADP (adenosine diphosphate) and inorganic phosphate, releasing energy. This energy is utilized by myosin heads to power the movement of actin filaments during muscle contraction.
- **Myosin heavy chain (MHC):** A large protein composed of multiple subunits found in the myosin protein complex (myosin molecules) within skeletal muscle that determine muscle fiber type, often changing composition depending on exercise or lack thereof. There are four isoforms of MHC:
 1. **MHC-I** (Type 1: Slow Twitch Fibers: Oxidative Fibers).
 2. **MHC-II** (Type IIa: Intermediate fibers: Oxidative & Glycolytic).
 3. **MHC-IIx** (Type IIx: Fast Twitch Fibers: Glycolytic Fibers).
 4. **MHC-IIb** (Type IIb: Fast Twitch Fibers: Glycolytic Fibers: Faster Contraction Speed than MHC-IIx).

The chemical cascade leading to Muscle Contraction:

1. **Neuromuscular Activation:** Muscle contraction is initiated by nerve impulses traveling along motor neurons to the neuromuscular junction, where they stimulate the release of neurotransmitters, typically acetylcholine.
2. **Calcium Ion Release:** The binding of acetylcholine to receptors on the muscle cell membrane triggers the release of calcium ions (Ca^{2+}) from the sarcoplasmic reticulum, a specialized organelle within the muscle cell.
3. **Actin-Myosin Interaction:** Calcium ions bind to regulatory proteins on actin filaments, exposing binding sites for myosin heads. Myosin heads, attached to thick filaments, then bind to actin filaments, forming cross-bridges between actin and myosin.
4. **ATP Hydrolysis:** The energy required for muscle contraction is derived from the hydrolysis of adenosine triphosphate (ATP) to adenosine diphosphate (ADP) and inorganic phosphate (Pi) by the enzyme myosin ATPase. This energy is used by myosin heads to pivot and pull actin filaments towards the center of the sarcomere.
5. **Power Stroke and Sliding Filaments (Muscle Contraction):** As myosin heads pivot, they generate force and slide actin filaments past myosin filaments towards the center of the sarcomere. This shortens the sarcomere and produces muscle contraction.

6. **Relaxation (Muscle Relaxation):** When the nerve impulse ceases, calcium ions are actively pumped back into the sarcoplasmic reticulum, reducing the cytoplasmic calcium ion concentration. This causes the regulatory proteins on actin to return to their original conformation, blocking the myosin-binding sites and preventing further cross-bridge formation. The muscle returns to its original length, and relaxation occurs.

The different types of Autophagy:

1. **Microautophagy:** Direct engulfment of cytoplasmic components by lysosomes for degradation.
2. **Chaperone-Mediated Autophagy (CMA):** Degradation of specific proteins, guided by chaperones like HSC70.
3. **Mitophagy:** Selective degradation of damaged or unnecessary mitochondria.
4. **Pexophagy:** Degradation of peroxisomes, which are involved in lipid metabolism and detoxification.
5. **Ribophagy:** Degradation of ribosomes to manage cellular stress or turnover.
6. **Lipophagy:** Degradation of lipids to regulate energy homeostasis.
7. **Glycophagy:** Degradation of glycogen to maintain glucose levels during nutrient deprivation
8. **Aggrephagy:** Degradation of protein aggregates to prevent toxic accumulation.
9. **Xenophagy:** Degradation of invading microorganisms, a form of host defense.

Resistant Starch:

Resistant Starch are polysaccharides (carbohydrate molecules) that resist digestion, resulting in a lower spike in blood glucose / insulin following consumption, making them healthier choices for not only weight loss purposes, but also life extension purposes.

The four types of Resistant Starch:

1. **RS1 - Physically Resistant Starch:** This type of resistant starch is found in whole or partially milled grains, seeds, and legumes, where it is protected by cell walls or complex structures that resist digestion.
2. **RS2 - Granular Resistant Starch:** Granular resistant starch consists of starch granules that are resistant to digestion due to their crystalline structure or high amylose content.
3. **RS3 - Retrograded Starch:** RS3 is formed when starchy foods such as potatoes, rice, or pasta are cooked and then cooled. The process of cooling causes some of the starch to retrograde or recrystallize into a more resistant form.
4. **RS4 - Chemically Modified Starch:** RS4 refers to starch that has been chemically modified to resist digestion. This type of resistant starch is often added to processed

foods as a functional ingredient to increase fiber content or improve texture. There are dozens of RS4 chemicals, chemicals that promote changes to starch, and I do not believe they are necessary nor healthy for consumption, considering we have natural forms of Resistant Starch.

The food highest in each of the four types of Resistant Starch:

1. RS1 - Physically Resistant Starch:

- *Foods:* Whole or partially milled grains, seeds, and legumes.
- *Examples:* Intact whole grains (such as barley, quinoa, and brown rice), seeds (such as flaxseeds and chia seeds), legumes (such as lentils, chickpeas, and beans)

2. RS2 - Granular Resistant Starch:

- *Foods:* Raw or unripe starchy vegetables and fruits
- *Examples:* Raw potatoes, green bananas, raw plantains, raw corn, raw rice, raw legumes.

3. RS3 - Retrograded Starch:

- *Foods:* Cooked starchy foods that have been cooled.
- *Examples:* Cooked and cooled potatoes, rice, pasta, oats, bread, and corn.

4. RS4 - Chemically Modified Starch:

- *Foods:* Processed foods with added resistant starches
- *Examples:* Low-carb products, fiber-enriched foods, resistant maltodextrin, resistant starch supplements, gluten-free products.

The main layers of the Skin and their relationship to aging:

1. **Epidermis:** The epidermis is the outermost layer of the skin and acts as a barrier to protect the body from external factors such as pathogens, UV radiation, and chemicals. It is primarily composed of keratinocytes, which produce the protein keratin, as well as melanocytes, which produce melanin, the pigment responsible for skin color. The epidermis also contains Langerhans cells, which are involved in the immune response.
 - **Relation to Aging:** Aging can lead to thinning of the epidermis, which can result in increased susceptibility to injury and decreased barrier function. Additionally, aging can affect the turnover of skin cells, resulting in slower wound healing and a duller complexion. Changes in melanocyte function can lead to uneven pigmentation, such as age spots or solar lentigines.
2. **Dermis:** The dermis is the middle layer of the skin and provides structural support and elasticity. It contains various components, including collagen, elastin,

and fibroblasts, which contribute to the skin's strength, flexibility, and resilience. The dermis also contains blood vessels, lymphatic vessels, nerves, and appendages such as hair follicles and sweat glands.

- **Relation to Aging:** Aging can lead to a decrease in the production of collagen and elastin, resulting in loss of skin firmness and elasticity. This can contribute to the formation of wrinkles, sagging skin, and fine lines. Changes in blood vessel structure and function can lead to reduced blood flow and nutrient delivery to the skin, further exacerbating signs of aging.
3. **Hypodermis (Subcutaneous Tissue):** The hypodermis is the innermost layer of the skin and primarily consists of adipose tissue (fat) and connective tissue. It provides insulation, cushioning, and energy storage, as well as anchorage for the skin to underlying structures such as muscles and bones.
- **Relation to Aging:** With age, the hypodermis may undergo changes in fat distribution, leading to loss of volume and support in certain areas of the face and body. This can contribute to the appearance of hollowed cheeks, sunken eyes, and thinning lips. Additionally, changes in connective tissue can affect the overall structure and integrity of the skin.

Receptor Dynamics:

A. Receptor:

- A receptor is a specialized protein molecule located on or within a cell. It binds to specific signaling molecules, such as hormones, neurotransmitters, or drugs.
- Receptors play a crucial role in cellular communication by transducing extracellular signals into intracellular responses, thereby regulating various biological processes.

B. Expression of a Receptor:

- Receptor expression refers to the synthesis or production of receptor proteins by a cell.
- Receptor proteins = receptors, therefore increased receptor expression means the process of forming new receptors.
- Cells can regulate the expression of receptors based on various factors, including developmental stage, physiological conditions, and external stimuli.
- Higher receptor expression can increase the cell's sensitivity to specific signaling molecules, while decreased expression may reduce sensitivity.

C. Activation (Agonism) of a Receptor:

- Receptor activation, or agonism, occurs when a signaling molecule (agonist) binds to its receptor and triggers a cellular response.

- Agonists can mimic the effects of endogenous ligands (natural signaling molecules) or drugs that activate receptors.
- The binding of an agonist to its receptor typically initiates a series of intracellular events, leading to physiological responses such as cell signaling, gene expression, or changes in cellular function.

D. Antagonism of a Receptor:

- Receptor antagonism occurs when a molecule (antagonist) binds to a receptor but does not activate it.
- Antagonists block or inhibit the binding of agonists to the receptor, preventing their effects.
- Antagonists can compete with agonists for binding to the receptor, effectively reducing the receptor's activation by endogenous ligands or drugs.

E. Receptor Binding:

- Receptor binding refers to the specific interaction between a signaling molecule (ligand) and its corresponding receptor.
- When a ligand binds to its receptor, it forms a complex that triggers a cellular response or physiological effect.
- The binding of a ligand to its receptor is typically selective and specific, with each receptor having a particular affinity for certain ligands.

Primary Human Kinesiological Movements and examples:

Basic Movements

1. **Flexion:** Decreasing the angle between two body parts. For example, bending the elbow or knee.
2. **Extension:** Increasing the angle between two body parts. For example, straightening the elbow or knee.

Abduction and Adduction

3. **Abduction:** Moving a body part away from the midline of the body. For example, lifting the arm or leg to the side.
4. **Adduction:** Moving a body part towards the midline of the body. For example, lowering the arm or leg back to the side of the body.

Rotation

5. **Medial (Internal) Rotation:** Rotating a limb towards the midline of the body. For example, rotating the shoulder or hip inward.

- 6. Lateral (External) Rotation:** Rotating a limb away from the midline of the body. For example, rotating the shoulder or hip outward.

Circumduction

- 7. Circumduction:** A circular movement that combines flexion, extension, abduction, and adduction. For example, moving the arm in a circular motion at the shoulder joint.

Special Movements (shoulder, wrist, ankle, etc.)

- 8. Elevation:** Lifting a body part upwards. For example, shrugging the shoulders.
- 9. Depression:** Lowering a body part downwards. For example, returning the shoulders to a resting position after a shrug.
- 10. Protraction:** Moving a body part forward. For example, jutting the jaw forward or rounding the shoulders forward.
- 11. Retraction:** Moving a body part backward. For example, pulling the jaw back or squeezing the shoulder blades together.
- 12. Pronation:** Rotating the forearm so the palm faces downward.
- 13. Supination:** Rotating the forearm so the palm faces upward.
- 14. Dorsiflexion:** Bending the foot upward at the ankle.
- 15. Plantarflexion:** Bending the foot downward at the ankle.
- 16. Inversion:** Turning the sole of the foot inward.
- 17. Eversion:** Turning the sole of the foot outward.
- 18. Radial Deviation (Radial Flexion):** Moving the wrist towards the thumb side.
- 19. Ulnar Deviation (Ulnar Flexion):** Moving the wrist towards the little finger side.
- 20. Opposition:** Moving the thumb to touch the tips of the other fingers.
- 21. Reposition:** Moving the thumb back to its normal position after opposition.

The Major Muscles of the body and their functions:

(Starting from the Neck, and ending with the Calves)

Neck Muscles

1. Sternocleidomastoid (SCM):

- **Function:**
 - **Flexion:** Acting unilaterally, it rotates the head to the opposite side and tilts it laterally to the same side.
 - **Extension:** Acting bilaterally, it extends the head and neck.

2. Trapezius:

- Function:
 - Elevation: Raises and retracts the shoulders.

3. Scalene Muscles (Anterior, Middle, and Posterior):

- Function:
 - Bilateral contraction assists in neck flexion and raises the first rib during forced inhalation.
 - Unilateral contraction causes ipsilateral lateral flexion of the neck and contralateral rotation.

4. Longus Colli:

- Function:
 - Flexion: Flexes the neck.
 - Lateral Flexion: Tilts the neck laterally.

5. Longus Capitis:

- Function:
 - Flexion: Flexes the head and neck.

6. Levator Scapulae:

- Function:
 - Elevation: Elevates the scapula.
 - Downward Rotation: Rotates the scapula downward.

7. Splenius Capitis (Capitis Superior and Capitis Inferior):

- Function:
 - Bilateral contraction extends the head and neck.
 - Unilateral contraction laterally flexes and rotates the head to the same side.

8. Suboccipital Muscles (Rectus Capitis Posterior Major, Rectus Capitis Posterior Minor, Obliquus Capitis Superior, and Obliquus Capitis Inferior):

- Function:
 - Extension: Extend and rotate the head.

Shoulder Muscles

1. Anterior Deltoid:

- Function: The anterior deltoid is primarily responsible for flexion and horizontal adduction of the shoulder joint.
- Specific Functions:
 - Flexion: Raises the arm forward, such as when performing a front raise.
 - Horizontal Adduction: Moves the arm toward the midline of the body, as in a chest fly motion.

2. Middle Deltoid:

- Function: The middle deltoid plays a key role in shoulder abduction, which involves lifting the arm away from the body in the plane of the shoulder.
- Specific Functions:
 - Abduction: Raises the arm laterally, away from the body, such as during lateral raises.

3. Posterior Deltoid:

- Function: The posterior deltoid primarily contributes to shoulder extension, horizontal abduction, and external rotation.
- Specific Functions:
 - Extension: Moves the arm backward, such as during rowing motions.
 - Horizontal Abduction: Moves the arm away from the midline of the body, as in a reverse fly.
 - External Rotation: Rotates the arm outwardly, such as when reaching behind the back.

4. Upper Trapezius:

- Origin: Occipital bone (base of the skull) and nuchal ligament.
- Insertion: Lateral third of the clavicle.
- Function:
 - Elevation: Raises the shoulder girdle, lifting the shoulder toward the ears.
 - Upward Rotation: Rotates the shoulder blade upward, especially in conjunction with elevation.

5. Middle Trapezius:

- Origin: Spinous processes of the upper thoracic vertebrae (T1-T5).
- Insertion: Medial border of the scapula.
- Function:
 - Retraction: Pulls the shoulder blades together toward the spine.
 - Adduction: Moves the scapula toward the midline of the body.

6. Lower Trapezius:

- Origin: Spinous processes of the lower thoracic vertebrae (T6-T12).
- Insertion: Medial border of the scapula.
- Function:
 - Depression: Lowers the shoulder girdle, pulling the shoulder blades downward.
 - Stabilization: Helps stabilize the scapula against the ribcage during arm movements.

7. Levator Scapulae:

- Function:
 - Elevates the scapula.
 - Assists in downward rotation of the scapula.

Arm Muscles

1. Biceps Brachii Long Head:

- Origin: The long head originates from the supraglenoid tubercle of the scapula, which is located above the glenoid cavity.
- Function:
 - Elbow Flexion: The long head of the biceps brachii contributes significantly to elbow flexion, which involves bending the elbow joint and bringing the forearm closer to the upper arm.
 - Shoulder Flexion: Additionally, the long head assists in shoulder flexion, particularly when the arm is in an externally rotated position. This action is important for movements such as lifting objects overhead.

2. Biceps Brachii Short Head:

- Origin: The short head originates from the coracoid process of the scapula, a bony projection located on the anterior aspect of the scapula.
- Function:
 - Elbow Flexion: Similar to the long head, the short head of the biceps brachii is involved in elbow flexion, contributing to the bending of the elbow joint.
 - Stabilization: The short head also helps stabilize the shoulder joint, particularly during movements involving heavy loads or when the shoulder is in an abducted position.

3. Triceps Brachii Long Head:

- Origin: The long head originates from the infraglenoid tubercle of the scapula, which is located below the glenoid cavity.
- Function:
 - Elbow Extension: The long head of the triceps brachii is the primary extensor of the elbow joint. It straightens the elbow, allowing for the forearm to move away from the upper arm.
 - Shoulder Extension: Additionally, the long head assists in extending the shoulder joint when the arm is raised above the head, such as during overhead movements.

4. Triceps Brachii Lateral Head:

- Origin: The lateral head originates from the posterior surface of the humerus, above the radial groove.
- Function:

- Elbow Extension: The lateral head contributes to elbow extension, working together with the long head to straighten the elbow joint.

5. Triceps Brachii Medial Head:

- Origin: The medial head originates from the posterior surface of the humerus, below the radial groove.
- Function:
 - Elbow Extension: The medial head also participates in elbow extension, assisting the other heads in straightening the elbow joint.

6. Forearm Flexor Muscles:

- Function: These muscles primarily flex the wrist joint and fingers.
 - Flexor Digitorum Superficialis: Flexes the middle phalanges of the fingers.
 - Flexor Digitorum Profundus: Flexes the distal phalanges of the fingers.
 - Flexor Carpi Radialis: Flexes and abducts the wrist.
 - Flexor Carpi Ulnaris: Flexes and adducts the wrist.
 - Palmaris Longus: Weakly flexes the wrist and tenses the palmar aponeurosis.
 - Pronator Teres: Pronates the forearm and flexes the elbow.

7. Forearm Extensor Muscles:

- Function: These muscles primarily extend the wrist joint and fingers.
 - Extensor Digitorum: Extends the fingers at the metacarpophalangeal and proximal interphalangeal joints.
 - Extensor Carpi Radialis Longus and Brevis: Extends and abducts the wrist.
 - Extensor Carpi Ulnaris: Extends and adducts the wrist.
 - Extensor Indicis: Extends the index finger.
 - Extensor Pollicis Longus and Brevis: Extend the thumb.
 - Supinator: Supinates the forearm.

Anterior Torso Muscles

1. Pectoralis Major:

- Function:
 - Shoulder Flexion: The pectoralis major assists in flexing the shoulder joint, bringing the arm forward and across the body.
 - Shoulder Adduction: It contributes to adduction, bringing the arm towards the midline of the body.
 - Shoulder Horizontal Adduction: The pectoralis major plays a significant role in horizontal adduction, bringing the arm towards the midline of the body from a position of shoulder abduction.

- Internal Rotation: It assists in internal rotation of the shoulder joint.
- **Note:** The pectoralis major is a large, fan-shaped muscle covering much of the anterior chest wall.

2. Pectoralis Minor:

- Function:
 - Scapular Protraction: The pectoralis minor pulls the scapula forward and towards the midline of the body.
 - Scapular Depression: It lowers the scapula.
 - Scapular Downward Rotation: The muscle rotates the scapula downwards.
- Note: The pectoralis minor is a smaller muscle located beneath the pectoralis major.

3. Serratus Anterior:

- Function:
 - Scapular Protraction: Pulls the scapula forward and around the rib cage.
 - Scapular Upward Rotation: Rotates the scapula upward.

4. Rectus Abdominis:

- Function:
 - Flexion of the Trunk: Contraction of the rectus abdominis muscles brings the rib cage closer to the pelvis, resulting in forward bending of the trunk.
 - Stabilization: Helps stabilize the trunk and pelvis during movements and activities such as lifting, pushing, and pulling.
 - Assists in Forced Exhalation: Contraction of the rectus abdominis aids in expelling air from the lungs during forceful exhalation.

5. External Oblique:

- Function:
 - Trunk Flexion and Rotation: Contraction of the external oblique muscles helps flex the trunk forward and rotate it to the opposite side.
 - Side Bending: The external obliques assist in lateral flexion of the trunk, bending it sideways.
 - Compression of Abdominal Contents: Contraction of the external obliques assists in compressing the abdominal contents, contributing to intra-abdominal pressure.

6. Internal Oblique:

- Function:

- **Trunk Flexion and Rotation:** Contraction of the internal oblique muscles assists in flexing the trunk forward and rotating it to the same side.
- **Side Bending:** The internal obliques assist in lateral flexion of the trunk, bending it sideways.
- **Compression of Abdominal Contents:** Contraction of the internal obliques assists in compressing the abdominal contents, contributing to intra-abdominal pressure.

7. Transversus Abdominis:

- **Function:**
 - **Abdominal Compression:** Contraction of the transversus abdominis muscles compresses the abdominal contents, providing core stability and support.
 - **Assists in Forced Exhalation:** Contraction of the transversus abdominis aids in expelling air from the lungs during forceful exhalation.
 - **Provides Lumbar Stability:** The transversus abdominis acts as a stabilizer for the lumbar spine, helping to maintain proper alignment and prevent injury.

Posterior Torso Muscles

1. Trapezius:

- **Function:**
 - **Upper Fibers:** Elevate and upwardly rotate the scapula (shoulder blade).
 - **Middle Fibers:** Retract the scapula.
 - **Lower Fibers:** Depress and upwardly rotate the scapula.

2. Teres Major:

- **Function:**
 - **Shoulder Adduction:** The teres major assists in adducting the shoulder joint, bringing the upper arm towards the midline of the body.
 - **Medial Rotation:** It also contributes to the medial rotation of the shoulder joint, turning the arm inward.
 - **Extension:** The teres major aids in extending the shoulder joint, moving the arm backward.

3. Teres Minor:

- **Function:**
 - **Shoulder External Rotation:** The teres minor is one of the primary external rotators of the shoulder joint, rotating the arm outward.

- **Stabilization:** It helps stabilize the shoulder joint, particularly during movements involving overhead reaching or throwing.
- **Assists in Adduction:** The teres minor also assists in adducting the arm, bringing it towards the midline of the body.

4. Latissimus Dorsi:

- **Function:**
 - **Shoulder Extension:** Pulls the upper arm downward and backward, as in pulling movements (e.g., pull-ups, rows).
 - **Shoulder Adduction:** Brings the upper arm toward the body.
 - **Shoulder Internal Rotation:** Medially rotates the upper arm.

5. Erector Spinae Group (Iliocostalis, Longissimus, Spinalis):

- **Function:**
 - **Spinal Extension:** Straightens and extends the spine.
 - **Lateral Flexion:** Bends the spine sideways.
 - **Spinal Rotation:** Rotates the spine.

6. Rhomboids (Major and Minor):

- **Function:**
 - **Retraction:** Pulls the scapula towards the spine.
 - **Downward Rotation:** Rotates the scapula downward.

Leg Muscles

1. Gluteus Maximus (Glutes):

- **Upper Fibers:**
 - **Function: Hip Extension**
 - The upper fibers of the gluteus maximus primarily function to extend the hip joint, moving the thigh backward from a flexed position.
- **Lower Fibers:**
 - **Function: Hip External Rotation**
 - The lower fibers of the gluteus maximus contribute to external rotation of the hip joint, turning the thigh outward.

2. Gluteus Medius:

- **Anterior Fibers:**
 - **Function: Hip Flexion, Abduction, and Internal Rotation**
 - The anterior fibers of the gluteus medius assist in flexing the hip joint, moving the thigh forward. They also play a significant role in abduction, lifting the leg away from the midline of the body, and internal rotation of the hip joint.
- **Posterior Fibers:**
 - **Function: Hip Extension, Abduction, and External Rotation**

- The posterior fibers of the gluteus medius contribute to hip extension, abduction, and external rotation of the hip joint.

3. Gluteus Minimus:

- Function: Hip Flexion, Abduction, and Internal Rotation
 - The gluteus minimus assists in flexing the hip joint, abducting the thigh, and internally rotating the hip joint.

4. Quadricep Rectus Femoris:

- Function:
 - Knee Extension: The rectus femoris is the only quadriceps muscle that crosses both the hip and knee joints. It primarily functions to extend the knee joint, straightening the leg from a bent position.
 - Hip Flexion: In addition to its role in knee extension, the rectus femoris assists in flexing the hip joint, bringing the thigh towards the abdomen.

5. Quadricep Vastus Lateralis:

- Function:
 - Knee Extension: The vastus lateralis primarily works to extend the knee joint, assisting in straightening the leg.

6. Quadricep Vastus Medialis:

- Function:
 - Knee Extension: The vastus medialis also primarily functions to extend the knee joint, contributing to the straightening of the leg.

7. Quadricep Vastus Intermedius:

- Function:
 - Knee Extension: The vastus intermedius, like the other quadriceps muscles, plays a key role in extending the knee joint, helping to straighten the leg.

8. Hamstring Biceps Femoris:

- Function:
 - Knee Flexion: The biceps femoris, both the long head and short head, primarily function to flex the knee joint, bending the leg.
 - Hip Extension: Additionally, the biceps femoris assists in extending the hip joint, moving the thigh backward.
 - Lateral Rotation: The long head of the biceps femoris also contributes to the lateral rotation of the thigh at the hip joint.

9. Hamstring Semitendinosus:

- Function:
 - Knee Flexion: The semitendinosus primarily functions to flex the knee joint, aiding in bending the leg.

- Hip Extension: Additionally, the semitendinosus assists in extending the hip joint, moving the thigh backward.
- Medial Rotation: The semitendinosus also contributes to the medial rotation of the thigh at the hip joint.

10. Hamstring Semimembranosus:

- Function:
 - Knee Flexion: The semimembranosus also primarily functions to flex the knee joint, assisting in bending the leg.
 - Hip Extension: Additionally, the semimembranosus assists in extending the hip joint, moving the thigh backward.
 - Medial Rotation: The semimembranosus contributes to the medial rotation of the thigh at the hip joint.

11. Adductor Magnus (Groin):

- Function: Adduction of the Thigh
 - The adductor magnus muscle is the largest and strongest muscle of the adductor group. It primarily functions to adduct the thigh, bringing it towards the midline of the body.
- Other Functions: The adductor magnus also assists in hip extension and stabilization of the pelvis.

12. Adductor Longus and Adductor Brevis (Groin):

- Function: Adduction of the Thigh
 - Both the adductor longus and adductor brevis muscles contribute to adduction of the thigh, pulling it towards the midline of the body.

13. Gastrocnemius (Calf):

- Function:
 - Plantar Flexion: The gastrocnemius is the larger calf muscle and plays a significant role in plantar flexion, pointing the foot downward.
 - Knee Flexion: Additionally, the gastrocnemius assists in flexing the knee joint when the foot is dorsiflexed (bent upward), as in movements such as squatting and lunging.
 - Stabilization: The gastrocnemius helps stabilize the ankle joint during weight-bearing activities like walking, running, and jumping.

14. Soleus:

- Function:
 - Plantar Flexion: The soleus is a deeper calf muscle that primarily contributes to plantar flexion of the foot, particularly when the knee is bent.

- **Stabilization:** The soleus also helps stabilize the ankle joint and control movements of the foot during weight-bearing activities.

15. Plantaris:

- **Function:**
 - **Plantar Flexion:** The plantaris is a smaller calf muscle that assists in plantar flexion of the foot.
 - **Knee Flexion:** It also plays a minor role in flexing the knee joint, particularly when the foot is dorsiflexed.

16. Tibialis Posterior:

- **Function:**
 - **Plantar Flexion:** The tibialis posterior is located deep in the calf and contributes to plantar flexion of the foot.
 - **Inversion:** Additionally, the tibialis posterior assists in inversion of the foot, turning the sole inward.

Fatty Acids and their Carbon Notations (Carbon Atom Identifiers)

Saturated Fatty Acids (SFAs)

- 1. Butyric Acid (C4:0)**
 - Sources: Butter, milk, cheese.
 - Classification: Short-chain.
- 2. Caproic Acid (C6:0)**
 - Sources: Goat milk, certain cheeses.
 - Classification: Short-chain.
- 3. Caprylic Acid (C8:0)**
 - Sources: Coconut oil, palm kernel oil, goat milk.
 - Classification: Medium-chain.
- 4. Capric Acid (C10:0)**
 - Sources: Coconut oil, palm kernel oil, goat milk.
 - Classification: Medium-chain.
- 5. Lauric Acid (C12:0)**
 - Sources: Coconut oil, palm kernel oil.
 - Classification: Medium-chain.
- 6. Myristic Acid (C14:0)**
 - Sources: Coconut oil, palm kernel oil, dairy products.
 - Classification: Medium-chain.
- 7. Palmitic Acid (C16:0)**
 - Sources: Palm oil, meat, dairy products.
 - Classification: Long-chain.
- 8. Stearic Acid (C18:0)**
 - Sources: Beef, cocoa butter, lard.

- Classification: Long-chain.

Monounsaturated Fatty Acids (MUFAs)

1. **Palmitoleic Acid (C16:1)**
 - Sources: Fish oil, macadamia nuts, some animal fats.
 - Classification: Long-chain.
2. **Oleic Acid (C18:1n-9)**
 - Sources: Olive oil, avocados, nuts, seeds.
 - Classification: Long-chain.

Polyunsaturated Fatty Acids (PUFAs)

1. **Linoleic Acid (C18:2n-6)**
 - Sources: Vegetable oils (corn oil, soybean oil, sunflower oil), nuts, seeds.
 - Classification: Omega-6, long-chain.
2. **Alpha-Linolenic Acid (ALA) (C18:3n-3)**
 - Sources: Flaxseed oil, chia seeds, walnuts.
 - Classification: Omega-3, long-chain.
3. **Gamma-Linolenic Acid (GLA) (C18:3n-6)**
 - Sources: Evening primrose oil, borage oil, black currant seed oil.
 - Classification: Omega-6, long-chain.
4. **Arachidonic Acid (C20:4n-6)**
 - Sources: Meat, eggs, dairy products.
 - Classification: Omega-6, long-chain.
5. **Eicosapentaenoic Acid (EPA) (C20:5n-3)**
 - Sources: Fish oil, algae oil.
 - Classification: Omega-3, long-chain.
6. **Docosahexaenoic Acid (DHA) (C22:6n-3)**
 - Sources: Fish oil, algae oil.
 - Classification: Omega-3, long-chain.
7. **Conjugated Linoleic Acid (CLA) (C18:2 c9, t11) (C18:2 t10, c12)**
 - Sources: Meat and dairy products from ruminants (cows, sheep, goats).
 - Classification: Conjugated fatty acid.

Trans Fatty Acids

1. **Elaidic Acid (C18:1 t9)**
 - Sources: Partially hydrogenated vegetable oils, processed foods
 - Classification: Trans-fat.

Glossary

This is not a full list of terminology used in this book, it is an introductory list of biomedical research terminology definitions I have extracted predominately from *ChatGPT* and *arduously* organized alphabetically relating directing to the material within and in relation to the sciences covered in this work.

#

3xTg-AD mice: Transgenic mouse model expressing mutant human genes associated with Alzheimer's disease (APP, PS1, and tau), used to study disease progression and test potential therapies.

4E-BP1/2: Eukaryotic initiation factor 4E (eIF4E)-binding proteins that regulate mRNA translation by binding to eIF4E, modulating protein synthesis.

5-bromo-2'-deoxyuridine (BrdU)-labeled c: Assay used to study cell proliferation and DNA synthesis, involving the incorporation of BrdU into newly synthesized DNA during cell division, followed by immunostaining or detection of BrdU incorporation.

A

A β 25-35: Short fragment of amyloid beta peptide implicated in Alzheimer's disease pathology, known for its neurotoxic effects.

Ablation: Removal or destruction of tissue or cells, often performed surgically or using chemical or thermal methods.

Acetate: Short-chain fatty acid produced by microbial fermentation in the gut, serving as an energy source for various tissues and influencing metabolism.

Adhesion: Process by which cells attach to one another or to the extracellular matrix, crucial for tissue structure, immune responses, and cellular communication.

Aerobic: Metabolic process occurring in the presence of oxygen, producing ATP through oxidative phosphorylation in mitochondria.

Aerobic Respiration: Cellular process using oxygen to break down glucose into ATP, water, and carbon dioxide for energy production.

Acetylcholine (ACh): Neurotransmitter responsible for transmitting signals across synapses in the nervous system, involved in muscle contraction, learning, and memory.

Acetylcholinesterase (AChE): Enzyme that hydrolyzes acetylcholine into choline and acetate, terminating its action at the synaptic cleft.

Actin: Globular protein forming microfilaments involved in cellular structure, motility, and muscle contraction.

Action Potential: Rapid, transient change in membrane potential of excitable cells, propagating along the length of nerve fibers or muscle cells.

Actomyosin: Complex formed by the interaction of actin and myosin filaments during muscle contraction, generating force and movement.

Adaptive Immune System: Branch of the immune system characterized by specificity, memory, and the ability to adapt to new pathogens or antigens.

Adenosine Triphosphate (ATP): Nucleotide molecule serving as the primary energy currency of cells, storing and transferring energy for cellular processes.

Adenosine Monophosphate (AMP): Nucleotide molecule composed of adenine, ribose, and a single phosphate group, serving as a precursor for ATP synthesis.

Adenosine Diphosphate (ADP): Nucleotide molecule composed of adenine, ribose, and two phosphate groups, formed by hydrolysis of ATP.

Adenosine: Nucleoside molecule derived from adenine and ribose, involved in neurotransmission, vasodilation, and modulating immune response.

Adenylate Cyclase: Enzyme catalyzing the conversion of ATP to cyclic AMP (cAMP), a second messenger involved in cellular signaling pathways.

Adipocyte: Cell specialized in storing fat, crucial for energy regulation and body composition, found in adipose tissue.

Adipokines: Signaling molecules secreted by adipose tissue, regulating metabolism, inflammation, and energy balance, including leptin and adiponectin.

Adipose Tissue: Connective tissue composed of adipocytes (fat cells) storing energy in the form of triglycerides and regulating metabolism.

Afferent Neuron: Sensory neuron transmitting information from peripheral receptors to the central nervous system (brain or spinal cord).

Affinity: Measure of the strength of binding between a ligand and its receptor, determined by the dissociation constant (K_d).

Agonist (Receptor): Molecule that binds to a receptor and activates its signaling pathway, mimicking the effects of endogenous ligands.

AICAR (5-Aminoimidazole-4-carboxamide ribonucleotide): Activator of AMP-activated protein kinase (AMPK), used in research to mimic the effects of exercise on metabolism.

Amino Acid: Organic molecule containing an amino group, carboxyl group, and variable side chain, serving as the building blocks of proteins.

Ammonia: A colorless gas with a pungent odor, composed of nitrogen and hydrogen, produced through the breakdown of nitrogen-containing compounds, such as amino acids, during metabolism.

AMP-activated protein kinase (AMPK): Cellular energy sensor activated by low ATP levels, regulating metabolism, autophagy, and mitochondrial biogenesis.

AMPA Receptors: Ionotropic glutamate receptors mediating fast excitatory neurotransmission in the central nervous system.

Amyloid precursor protein (APP): A transmembrane protein involved in synaptic function, whose abnormal processing can lead to amyloid plaque formation, associated with Alzheimer's disease.

Anaerobic: Metabolic process occurring in the absence of oxygen, generating energy through glycolysis and fermentation.

Androgens: Steroid hormones, such as testosterone, responsible for male sexual development and reproductive function, also influencing muscle growth and metabolism.

Angiogenesis: The process of new blood vessel formation from pre-existing vessels, crucial for tissue growth, wound healing, and tumor development.

Antagonist (Receptor): Molecule that binds to a receptor and blocks its activation by endogenous ligands, inhibiting downstream signaling pathways.

Antibody: Protein molecule produced by B cells in response to specific antigens, capable of binding to and neutralizing pathogens or foreign molecules.

Antigen: Molecule recognized by the immune system as foreign, triggering an immune response, including antibodies and T cell activation.

Antinociception: The physiological process of reducing or blocking the perception of pain signals in the nervous system.

Apoptosis: Programmed cell death characterized by controlled dismantling of cellular components, crucial for tissue homeostasis and development.

APP/PS1 mice: Transgenic mice model expressing human amyloid precursor protein (APP) and presenilin 1 (PS1) genes, commonly used in Alzheimer's disease research.

APPsw mice: Transgenic mice model expressing mutant amyloid precursor protein (APP), often used to study amyloid plaque deposition in Alzheimer's disease.

Astrocyte: Star-shaped glial cells in the brain and spinal cord, providing structural support and metabolic regulation to neurons.

Atrogenes: Genes involved in muscle atrophy, including MAFbx and Atrogin-1, encoding E3 ubiquitin ligases that target muscle proteins for degradation.

Atrogin-1: Muscle-specific E3 ubiquitin ligase involved in ubiquitin-mediated proteolysis and muscle atrophy.

Area Under the Curve (AUC): Measure of the total exposure to a drug or substance over time, calculated by integrating the concentration-time curve.

Autocrine: Signaling mechanism in which a cell secretes signaling molecules (autocrine factors) that act on the same cell or cells of the same type.

Autophagy: Cellular process of degrading and recycling damaged organelles and proteins, promoting cell survival during stress and starvation.

ANCOVA (Analysis of Covariance): Statistical method used to compare group means while accounting for the influence of one or more covariates.

Autofluorescence: Natural fluorescence emitted by certain molecules (e.g., flavins, lipofuscin) upon excitation by light, often used for imaging and diagnostic purposes.

Axons: Long, slender projection of a nerve cell (neuron) that conducts electrical impulses away from the cell body to other neurons or effector cells.

B

BALB/cJ mice: Inbred strain of laboratory mice commonly used in biomedical research due to their docile nature and susceptibility to various diseases.

Basic Fibroblast Growth Factor (bFGF): Growth factor involved in cell proliferation, differentiation, and angiogenesis, promoting tissue repair and regeneration.

Bax: Pro-apoptotic protein belonging to the Bcl-2 family, involved in the intrinsic pathway of apoptosis by promoting mitochondrial outer membrane permeabilization.

Bcl-2: Anti-apoptotic protein belonging to the Bcl-2 family, inhibiting apoptosis by regulating mitochondrial membrane integrity and caspase activation.

B-Catenin: Protein involved in Wnt signaling pathway, regulating gene expression and cell proliferation during development and tissue homeostasis.

B Cells: Type of white blood cell involved in adaptive immunity, producing antibodies and mediating humoral immune responses.

Bioavailability: The proportion of a drug or substance that enters the bloodstream and becomes available for systemic circulation or distribution to target tissues after administration.

Biochemical Cascade: Series of interconnected biochemical reactions or signaling events, often amplifying and transmitting cellular signals or responses.

Brown fat: A type of adipose tissue that generates heat by burning calories, helping to regulate body temperature and metabolism.

BTBR mice: Inbred strain of laboratory mice commonly used as a model for autism spectrum disorders due to their social deficits and repetitive behaviors.

Butyrate: Short-chain fatty acid produced by microbial fermentation of dietary fiber in the colon, serving as an energy source for colonocytes and regulating gene expression.

C

C2C12 myoblast: Murine skeletal muscle cell line commonly used in cell culture studies of myogenesis and muscle differentiation.

C57BL/J mice: Inbred strain of laboratory mice commonly used in biomedical research for their genetic homogeneity and susceptibility to specific diseases.

CA1-CA3: Subfields of the hippocampus involved in memory formation and spatial navigation, susceptible to damage in neurodegenerative diseases.

Caenorhabditis elegans: Transparent, free-living nematode used as a model organism in genetic and developmental studies.

Calcineurin: Calcium-dependent protein phosphatase involved in signal transduction pathways regulating gene expression, metabolism, and muscle function.

Calcium/Calmodulin-Dependent Protein Kinase Kinase Beta (CaMKKB): Protein kinase activated by calcium/calmodulin complex, regulating cellular responses to calcium signals.

Calmodulin: Calcium-binding protein involved in intracellular signaling pathways, regulating the activity of various enzymes and proteins.

Calpains: Enzymes responsible for protein cleavage involved in various cellular processes like cell migration, apoptosis, and signal transduction.

CAM assay (Chorioallantoic Membrane assay): Method used to assess angiogenesis and tumor growth by implanting tissue or cells onto the chorioallantoic membrane of chick embryos.

cAMP Response Element-Binding protein (CREB): Transcription factor activated by cAMP signaling, regulating gene expression in response to various stimuli.

Carbohydrate: Organic compound composed of carbon, hydrogen, and oxygen atoms, serving as a major source of energy and structural component in living organisms.

Caspases: Proteolytic enzymes involved in apoptosis and inflammation, cleaving cellular substrates and promoting cell death.

Catalase (CAT): Enzyme that catalyzes the decomposition of hydrogen peroxide into water and oxygen, protecting cells from oxidative stress.

Catecholamine: Class of neurotransmitters and hormones, including dopamine, norepinephrine, and epinephrine, involved in regulating mood, arousal, and stress responses.

Catalyze: To accelerate or facilitate a chemical reaction without undergoing any permanent change or being consumed in the process.

CD8T Cells: Cytotoxic T lymphocytes expressing CD8 co-receptor, involved in cell-mediated immunity by recognizing and killing infected or abnormal cells.

Cellular Remodeling: Process of structural and functional changes in cells, tissues, or organs, often in response to physiological stimuli or pathological conditions.

Cell Viability: Measure of the ability of cells to survive and proliferate under specific conditions, often assessed using various assays.

Ceramide: Lipid molecule involved in cell signaling pathways regulating apoptosis, cell differentiation, and stress response.

Cerebrospinal fluid: Clear, colorless fluid circulating around the brain and spinal cord, providing cushioning and nutritional support.

Cell Membrane: Phospholipid bilayer surrounding the cytoplasm of cells, regulating the passage of molecules and ions into and out of the cell.

Chelation: Chemical process of forming a complex between a metal ion and a chelating agent, used to remove toxic metals from the body or inhibit metal-dependent enzymes.

Chromatin: Complex of DNA, histone proteins, and other proteins, forming the structural basis of chromosomes and regulating gene expression.

Cmax: Maximum concentration of a drug or substance achieved in the body after administration, often used as a pharmacokinetic parameter.

Chronic unpredictable stress: A laboratory model inducing stress in mice via varied and unpredictable stressors over time, used to study stress-related behaviors and physiological responses.

Coenzyme: Non-protein organic molecule required for the activity of certain enzymes, often serving as a carrier for chemical groups or electrons.

Collagen: Fibrous protein providing structural support and strength to tissues such as skin, tendons, and bones, forming the extracellular matrix.

Colocalization: Spatial overlap or coincidence of two or more molecules or structures within cells, indicating potential interaction or functional relationship.

Conditioned place preference: Behavioral paradigm used to measure the rewarding effects of drugs or environmental stimuli by associating them with specific contexts or environments.

Conduction: The transmission or propagation of electrical impulses or signals within biological tissues or along neural pathways.

Corona: A layer of proteins that forms on the surface of nanoparticles when they come into contact with biological fluids, capable of influencing biological barrier entry.

Costamere: Protein complex linking the sarcomere to the sarcolemma and extracellular matrix, providing structural support and transmitting force during muscle contraction.

Control (Study design): A group in an experiment used as a baseline for comparison with the experimental group receiving the intervention.

CUPRAC (Cupric Ion Reducing Antioxidant Capacity): Assay used to measure the total antioxidant capacity of biological samples based on their ability to reduce cupric ions to cuprous ions.

Cross maze: Behavioral test used to assess spatial learning and memory in rodents by requiring them to navigate through intersecting arms to find a hidden goal.

Cross-sectional Area (muscle): Measure of the area of a muscle perpendicular to its longitudinal axis, often used to assess muscle size or hypertrophy.

Cued memory: Recollection of information triggered by a specific cue or stimulus associated with the original learning experience.

Cyclic adenosine monophosphate (cAMP): A signaling molecule involved in numerous cellular processes, including metabolism, gene expression, and neurotransmission.

Cytochrome: A heme-containing protein involved in electron transport in cellular respiration and other metabolic processes.

Cytokine: Signaling molecule secreted by immune cells, regulating inflammation, immune responses, and cell-to-cell communication.

Cytotoxicity: Ability of a substance or agent to cause cell death or damage, often assessed in vitro using cell viability assays.

D

2,2-diphenyl-1-picrylhydrazyl (DPPH): A stable free radical compound used to assess antioxidant activity in substances. It changes color upon reduction by antioxidants.

DAF-16: Transcription factor involved in the regulation of lifespan and stress response in *Caenorhabditis elegans*, homologous to mammalian FOXO proteins.

DAF-2: Insulin/insulin-like growth factor receptor in *Caenorhabditis elegans*, regulating lifespan, stress resistance, and development.

DAT (Dopamine Transporters): Membrane proteins that regulate the reuptake of dopamine from the synaptic cleft into presynaptic neurons, terminating its action.

Deacetylation: Removal of acetyl groups from histone proteins by histone deacetylases (HDACs), associated with gene repression and transcriptional silencing.

Dendrite: Branched extension of a neuron's cell body, receiving signals from other neurons and conveying them toward the cell body.

Dentate Gyrus: Region of the hippocampus involved in learning and memory processes, particularly spatial memory and pattern separation.

Desmin: Intermediate filament protein found in muscle cells, maintaining structural integrity and providing mechanical support to muscle fibers.

ddY mice: Outbred strain of laboratory mice commonly used in toxicology and carcinogenicity studies due to their genetic diversity.

Differentiation: Process by which cells become specialized in structure and function during development or tissue regeneration.

DNA: Molecule carrying genetic information in all living organisms, consisting of a double helix structure composed of nucleotide base pairs.

DNA Fragmentation: Breakage of DNA molecules into smaller fragments, occurring during apoptosis or DNA damage.

DNA Repair: Cellular process that restores damaged DNA to its original state, maintaining genomic stability and preventing mutations.

DOMS (Delayed Onset Muscle Soreness): The vital and delayed inflammatory intramuscular rise in COX-2 expression experienced following highly damaging or acutely experienced exercise leading to enhanced nociception (soreness), and muscle hypertrophy.

DOPAC (3,4-Dihydroxyphenylacetic acid): Metabolite of dopamine formed by the action of monoamine oxidase (MAO), used as a marker of dopamine turnover.

Dopamine: Neurotransmitter involved in reward, motivation, motor control, and various cognitive functions, implicated in addiction and neurological disorders.

Downregulation: Process of reducing the expression or activity of a gene, protein, or cellular component, often in response to specific signals or conditions.

Downstream Pathway: Sequence of biochemical reactions or signaling events initiated by activation of a cell surface receptor or intracellular molecule.

DMSO (Dimethyl sulfoxide): Solvent commonly used to dissolve hydrophobic compounds and drugs for cell culture or in vivo experiments.

Drosophila melanogaster: Common fruit fly used as a model organism in genetics, developmental biology, and neuroscience research.

Duchenne muscular dystrophy: Inherited neuromuscular disorder characterized by progressive muscle weakness and wasting due to mutations in the dystrophin gene.

Dysbiosis: Imbalance or disruption of the normal microbial community (microbiota) in a particular environment, associated with various diseases or conditions.

E

Edema: Accumulation of fluid in the interstitial spaces, causing swelling and tissue inflammation.

EdU Assay (5-ethynyl-2'-deoxyuridine Assay): Method used to label proliferating cells by incorporating EdU into newly synthesized DNA during DNA replication.

Eight-arm radial maze: Behavioral test used to assess spatial learning and memory in rodents by requiring them to visit all arms of a maze to find food rewards.

Electroencephalography (EEG): A non-invasive technique used to record and analyze electrical activity in the brain.

Electromyography: Diagnostic technique used to assess the electrical activity of muscles, often used to diagnose neuromuscular disorders.

Elevated plus maze: Behavioral test used to assess anxiety-like behavior in rodents by measuring the time spent in open and closed arms of a plus-shaped maze elevated above the ground.

ELISA (Enzyme-Linked Immunosorbent Assay): Laboratory technique used to detect and quantify proteins or other molecules based on antigen-antibody interactions.

Encode: Process of converting genetic information into functional proteins or RNA molecules, regulated by gene expression and transcriptional machinery.

Endocytose: Process by which cells internalize extracellular molecules or particles by invaginating the cell membrane to form vesicles.

Endothelial Progenitor Cell: Multipotent cell derived from bone marrow or vascular tissues, capable of differentiating into endothelial cells and promoting vascular repair and angiogenesis.

Enhanced: *A person that uses Anabolic Steroids, or Growth Hormone, giving them a myogenic and lipolytic advantage.*

eNOS (Endothelial Nitric Oxide Synthase): Enzyme responsible for producing nitric oxide (NO) in endothelial cells, regulating blood vessel dilation and blood pressure.

Entropy: A measure of disorder or randomness in a system, often associated with the dispersal of energy or the tendency towards equilibrium.

Enzyme: Protein catalyst facilitating chemical reactions in living organisms by speeding up the rate of specific biochemical reactions.

Epigenetic: Heritable changes in gene expression or cellular phenotype that do not involve alterations in DNA sequence, often mediated by modifications to histones or DNA methylation.

Epinephrine (Adrenaline): Hormone and neurotransmitter that mediates the body's "fight or flight" response, increasing heart rate, blood pressure, and energy availability.

ERK1/2 (Extracellular Signal-Regulated Kinase 1/2): Subtype of MAPK activated by growth factors and mitogens, regulating cell proliferation and survival.

Estrogens: Steroid hormones, such as estradiol, responsible for female sexual development and reproductive function, also influencing bone density and cardiovascular health.

Erythrocyte: Red blood cell responsible for transporting oxygen from the lungs to tissues and carbon dioxide from tissues to the lungs.

Eukaryote: Organism with cells containing a nucleus and membrane-bound organelles, distinct from prokaryotes.

Excitatory Postsynaptic Potential (EPSP): Depolarization of the postsynaptic membrane in response to neurotransmitter binding at excitatory synapses, increasing the likelihood of an action potential.

Excitotoxicity: Pathological process resulting from excessive activation of excitatory neurotransmitter receptors, leading to neuronal damage or death.

Expression (Genetic): Process by which genetic information encoded in DNA is converted into functional gene products, such as proteins or RNA molecules.

Extracellular: Outside the cell, referring to the external environment surrounding cells or tissues.

Extracellular Matrix: Supportive network surrounding cells, influencing cellular behavior and regulating tissue function and structure.

F

FAK (Focal Adhesion Kinase): Protein kinase involved in integrin-mediated signaling, regulating cell adhesion, migration, and survival.

Fermentation: Metabolic process that generates ATP by converting carbohydrates into organic acids or alcohol in the absence of oxygen.

Fibrillogenesis: Process of forming fibrillar structures from protein monomers or peptides, occurring in various biological processes such as collagen formation.

Fibroblast: Connective tissue cell responsible for producing extracellular matrix components such as collagen and fibronectin, involved in wound healing and tissue repair.

Fibrosis: Pathological process characterized by excessive deposition of extracellular matrix components such as collagen, leading to tissue scarring and dysfunction.

Flt-1: Vascular endothelial growth factor receptor 1 (VEGFR-1), involved in angiogenesis, vascular permeability, and endothelial cell survival.

Fold (describing mathematical change): Measure of change in quantity or concentration, expressed as a multiple or ratio relative to a reference value.

Follistatin: Protein that binds and inhibits activin, a member of the TGF-beta superfamily, regulating cell proliferation, differentiation, and metabolism.

FOXO4: Transcription factor belonging to the FOXO family, involved in regulating cellular processes such as apoptosis, metabolism, and oxidative stress response.

FRAP (Fluorescence Recovery After Photobleaching): Technique used to study the dynamics of fluorescently labeled molecules within living cells by bleaching a defined region and monitoring fluorescence recovery over time.

Free radical scavenger: A substance that neutralizes harmful free radicals by donating electrons, thereby reducing oxidative stress and cellular damage.

fMRI: Functional Magnetic Resonance Imaging, a neuroimaging technique measuring brain activity by detecting changes in blood flow.

Frontal lobe: Brain region responsible for higher-level functions such as decision-making, planning, and voluntary movement control.

G

GABA (Gamma-Aminobutyric Acid): Inhibitory neurotransmitter in the central nervous system, regulating neuronal excitability and anxiety.

Genetic code: Instructions within DNA or RNA determining the sequence of amino acids in proteins during cellular protein synthesis.

GFAP (Glial Fibrillary Acidic Protein): A protein primarily found in astrocytes, used as a marker for these cells in neural tissue.

Glucocorticoid: Steroid hormone produced by the adrenal glands, regulating metabolism, immune response, and stress adaptation.

Glutathione peroxidase (GPx): An enzyme that catalyzes the reduction of hydrogen peroxide and organic hydroperoxides, protecting cells from oxidative damage.

Glycolysis: Metabolic pathway converting glucose into pyruvate, generating ATP and NADH in the cytoplasm.

Glial Cell: Non-neuronal cells of the nervous system, including astrocytes, oligodendrocytes, and microglia, providing support and regulating neuronal function.

Glial Cell line-derived neurotrophic Factor (GDNF): Neurotrophic factor promoting the survival and differentiation of neurons, particularly dopaminergic neurons, implicated in neuroprotection and neuroregeneration.

Glial fibrillary acidic protein (GFAP): Intermediate filament protein found in glial cells, such as astrocytes and Schwann cells, providing structural support and regulating cellular processes.

Gluconeogenesis: Metabolic process synthesizing glucose from non-carbohydrate precursors such as amino acids or glycerol, maintaining blood glucose levels during fasting.

Glutamate: Major excitatory neurotransmitter in the central nervous system, involved in synaptic transmission, learning, and memory.

Glutathione: Tripeptide (gamma-glutamyl-cysteinyl-glycine) antioxidant involved in cellular defense against oxidative stress and detoxification of reactive oxygen species.

Glutathione S-transferase: Enzyme that catalyzes the conjugation of glutathione to electrophilic compounds, facilitating their detoxification and elimination.

Glycine: Inhibitory neurotransmitter in the central nervous system, regulating neuronal excitability and motor control.

Glycolysis: The metabolic pathway that breaks down glucose into pyruvate, producing ATP and NADH as energy sources.

Golgi Tendon: Sensory receptor located in tendons, responding to changes in muscle tension and providing feedback to the central nervous system.

GSK3B (Glycogen Synthase Kinase 3 Beta): Serine/threonine protein kinase involved in cell signaling pathways regulating glycogen metabolism, apoptosis, and cell fate.

H

H2O2 (Hydrogen Peroxide): Reactive oxygen species (ROS) produced as a byproduct of cellular metabolism, involved in signaling and oxidative stress.

Half-Life: Time required for the concentration of a substance in the body to decrease by half through elimination or metabolism.

Heme oxygenase 1: Enzyme involved in heme catabolism, converting heme into biliverdin, carbon monoxide, and iron, with antioxidant and cytoprotective effects.

Hemodynamic: Relating to the forces and factors involved in the circulation of blood within the body, including blood pressure, flow, and resistance.

Heritability: Proportion of phenotypic variation in a population attributed to genetic factors, often estimated using twin or family studies.

HIF-1a (Hypoxia-Inducible Factor 1 Alpha): Transcription factor regulating cellular responses to hypoxia, promoting adaptation to low oxygen conditions.

Histamine: Biogenic amine involved in allergic reactions, inflammation, and neurotransmission, released by mast cells and basophils.

Histone Acetylation: Post-translational modification of histone proteins by acetyl groups, associated with gene activation and transcriptional activity.

Histone Code Hypothesis: Theory proposing that specific patterns of histone modifications act as a "code" regulating chromatin structure and gene expression.

Homeostasis: The body's ability to maintain stable internal conditions despite external changes, ensuring optimal functioning of cells and organs.

Homing (Cellular): Directed migration of cells to specific tissues or organs guided by chemical signals or receptors.

Homovanillic acid: Metabolite of dopamine, formed by the action of monoamine oxidase (MAO), used as a biomarker for dopamine turnover in the brain.

Hormone: Signaling molecule secreted by glands or cells into the bloodstream, regulating various physiological processes in distant target tissues.

Hormesis: Biphasic dose-response phenomenon characterized by low-dose stimulation and high-dose inhibition of biological processes or toxicological effects.

Hormetic: Biological response characterized by biphasic dose-response curves, where low doses of a stressor have beneficial effects, while high doses are harmful.

HPLC analysis: High-performance liquid chromatography (HPLC) technique used to separate, identify, and quantify components in complex mixtures, based on their interaction with a stationary phase and mobile phase.

Humoral Immunity: Branch of the immune system involving the production of antibodies by B cells, providing defense against pathogens circulating in bodily fluids.

HUVEC (Human Umbilical Vein Endothelial Cells): Primary cell culture model derived from human umbilical veins, commonly used in vascular biology and angiogenesis research.

Hyperplasia: Increase in the number of cells in a tissue or organ, resulting from cell proliferation.

Hypothalamic Pituitary Axis (HPA): A regulatory system involving the hypothalamus, pituitary gland, and adrenal glands, controlling stress response and hormone secretion.

Hypoxia: Condition characterized by decreased oxygen levels in tissues or organs, often associated with ischemia or inadequate blood supply.

I

ICAM-1 (Intercellular Adhesion Molecule-1): A cell surface protein involved in the adhesion of leukocytes to endothelial cells during inflammation and immune responses.

Immunocytochemistry: Laboratory technique used to visualize and localize specific proteins or antigens within cells using antibodies and fluorescent or enzymatic detection methods.

Immunoglobulins: Family of proteins comprising antibodies, involved in immune responses by recognizing and binding to specific antigens.

Immortalized (cell line): A population of cells that have been altered to bypass normal cellular aging processes, allowing them to proliferate indefinitely in culture while maintaining their original genetic characteristics.

Inhibitor of kappa B alpha (IkBa): A protein that regulates the activity of the transcription factor NF- κ B by sequestering it in the cytoplasm.

iNOS (Inducible Nitric Oxide Synthase): Enzyme responsible for producing nitric oxide (NO) in response to inflammatory stimuli, involved in host defense and immune responses.

In silico docking: Computational technique used to predict the binding interactions between small molecules (ligands) and protein targets (receptors), aiding drug discovery and design.

Insult: Biological or environmental stressor causing injury or damage to cells or tissues, triggering adaptive responses or pathological processes.

Intercellular: Between cells, referring to communication or interactions occurring among neighboring cells.

Interferons: Group of cytokines involved in antiviral defense, immune regulation, and modulation of inflammatory responses.

Interleukin: Group of cytokines produced by leukocytes and other cells, regulating immune responses, inflammation, and hematopoiesis.

Interstitial fluid: Fluid surrounding cells in tissues, transporting nutrients, gases, and waste products between cells and blood vessels.

Intraperitoneal (administration): Method of drug or substance administration involving injection into the peritoneal cavity, often used in animal studies for systemic delivery.

In vitro: Latin term meaning "in glass," referring to experiments or observations conducted outside of living organisms, often in cell culture or artificial environments.

In vivo: Latin term meaning "within the living," referring to experiments or observations conducted in living organisms.

Ion: Atom or molecule with a net electrical charge due to the loss or gain of electrons.

Ion Channel: Transmembrane protein that forms a pore in the cell membrane, allowing selective passage of ions across the membrane.

I/R-injury: Ischemia/reperfusion injury, referring to tissue damage caused by the restoration of blood flow following a period of ischemia or reduced blood supply.

Ischemia: Insufficient blood supply to tissues or organs, often leading to tissue hypoxia and cell damage or death.

Isoform: Variant form of a protein or RNA molecule encoded by the same gene, differing in sequence or splicing pattern, often exhibiting distinct functions.

J

JNK (c-Jun N-terminal Kinase): Subtype of MAPK activated by stress stimuli, regulating apoptosis, inflammation, and cell differentiation.

K

Kinase: Enzyme that catalyzes the transfer of phosphate groups from ATP to specific substrates, regulating their activity or function.

KO (knockout) mice: Genetically modified mice lacking a specific gene of interest, used to study the function and effects of the deleted gene.

Krebs Cycle: Metabolic pathway occurring in mitochondria, oxidizing acetyl-CoA to produce ATP, NADH, and FADH₂ for oxidative phosphorylation.

L

Leptin: Hormone secreted by adipose tissue, regulating appetite, energy expenditure, and body weight by acting on the hypothalamus.

Ligand: A molecule that binds specifically to a receptor, enzyme, or other biomolecule, triggering a biological response.

Lipase: Enzyme released from the pancreas into the small intestine that breaks down lipids (fats) into glycerol and fatty acids, facilitating digestion and absorption.

Lipid: Organic compound insoluble in water, including fats, phospholipids, and steroids, serving as structural components of cell membranes and energy storage.

Lipid Bilayer: Double layer of phospholipid molecules forming the basic structure of cell membranes, regulating the passage of molecules and ions into and out of cells.

Lipid Peroxidation: The process in which reactive oxygen species (ROS) attack and degrade lipids in cell membranes, leading to cellular damage and dysfunction.

Lipoblast: Immature fat cell precursor, forming adipocytes in adipose tissue, contributing to fat storage and metabolism.

Lipopolysaccharide (LPS): Molecule found in the outer membrane of Gram-negative bacteria, acting as a potent immune stimulant and eliciting inflammatory responses.

Lipoxygenase: Enzyme responsible for the synthesis of leukotrienes and other lipid mediators from arachidonic acid, involved in inflammation and immune responses.

L-NAME (N-nitro-L-arginine methyl ester): Nitric oxide synthase inhibitor used in experimental studies to block the production of nitric oxide (NO) and study its physiological roles.

Long Term Depression: Persistent decrease in synaptic strength following low-frequency stimulation, involved in synaptic plasticity and memory processes.

Long Term Potentiation: Persistent increase in synaptic strength following high-frequency stimulation, thought to underlie learning and memory formation.

Lymph Node: Secondary lymphoid organ containing lymphocytes and immune cells, filtering lymph and facilitating immune responses to pathogens or antigens.

M

Macroautophagy: Type of autophagy involving the formation of autophagosomes to sequester cytoplasmic components for degradation.

Macrophage: Immune cell derived from monocytes, involved in phagocytosis, antigen presentation, inflammation, and tissue repair.

MAFbx: Muscle-specific E3 ubiquitin ligase involved in ubiquitin-mediated proteolysis and muscle atrophy.

Malondialdehyde (MDA): Reactive aldehyde produced as a byproduct of lipid peroxidation, commonly used as a marker of oxidative stress.

MAPK (Mitogen-Activated Protein Kinase): Protein kinase involved in signaling pathways regulating cell proliferation, differentiation, and survival.

Master Regulator: Key regulatory molecule or gene controlling the expression of multiple downstream genes or pathways, often critical for cell fate determination or developmental processes.

Matrix metalloproteinases (MMP): Family of enzymes involved in remodeling the extracellular matrix, regulating cell migration, tissue repair, and angiogenesis.

MCP-1 (Monocyte Chemoattractant Protein-1): Chemokine involved in the recruitment and activation of monocytes/macrophages during inflammation and immune response.

Mdx mice: Mouse model of Duchenne muscular dystrophy, characterized by a mutation in the dystrophin gene, resulting in muscle degeneration and weakness.

Mechanosensor: Cell membrane protein or ion channel that detects mechanical stimuli and converts them into intracellular signals, influencing cellular responses.

Mechanotransduction: Conversion of mechanical stimuli into cellular signals, regulating various physiological processes such as touch sensation, hearing, and muscle contraction.

Medical Nihilism: A philosophical skepticism or disbelief in the effectiveness or value of medical interventions or knowledge.

MEF2 (Myocyte Enhancer Factor 2): Transcription factor regulating muscle development, differentiation, and adaptive responses to exercise.

Memory Cells: Long-lived immune cells capable of recognizing and responding to specific antigens upon re-exposure, providing immunological memory.

Metabolism: Collective biochemical processes in organisms involving conversion of nutrients into energy and essential molecules for growth, maintenance, and function.

Methylation: Addition of methyl groups to DNA or histone proteins, regulating gene expression and chromatin structure.

Microbiome: Community of microorganisms (bacteria, fungi, viruses) residing in a particular environment, such as the human gut, skin, or soil.

Microglia: Resident immune cells of the central nervous system, involved in immune surveillance, inflammation, and synaptic remodeling.

Microvessel: Small blood vessel, including arterioles, venules, and capillaries, facilitating nutrient and oxygen exchange in tissues.

Mineral: Inorganic element essential for the proper functioning of enzymes, proteins, and other biological molecules in the body.

Mislocation: Abnormal or incorrect localization of cellular components, proteins, or organelles, contributing to cellular dysfunction or disease.

Mitochondria: Membrane-bound organelles responsible for generating ATP through aerobic respiration and regulating various metabolic processes in eukaryotic cells.

Mitochondrial Biogenesis: Process of generating new mitochondria within cells, regulated by signaling pathways in response to energy demands or metabolic stress.

Mitochondrial Fusion: Process by which individual mitochondria merge together to form a larger mitochondrial network, facilitating exchange of contents and DNA.

Monocyte: Type of white blood cell involved in innate immunity, differentiating into macrophages or dendritic cells and mediating phagocytosis and antigen presentation.

Morris water maze: Behavioral test used to assess spatial learning and memory in rodents by requiring them to find a submerged platform in a pool of opaque water using spatial cues.

Morphological: Pertaining to the form, structure, or shape of an organism, organ, or tissue.

Motor Neuron: Neuron that transmits signals from the central nervous system to muscle fibers, controlling muscle contraction and movement.

Motor Unit: Functional unit consisting of a motor neuron and the muscle fibers it innervates, controlling muscle contraction.

MRF4: Transcription factor belonging to the myogenic regulatory factors (MRFs), regulating myoblast proliferation and differentiation during muscle development.

mRNA (Messenger RNA): RNA molecule transcribed from DNA and serving as a template for protein synthesis, carrying the genetic information from the nucleus to the cytoplasm.

mTOR (mammalian Target Of Rapamycin): Serine/threonine protein kinase regulating cell growth, metabolism, and autophagy in response to nutrient and energy availability.

mTORC1-2 (mammalian Target Of Rapamycin Complex 1-2): Protein complexes containing mTOR kinase, regulating cell growth, protein synthesis, and metabolism.

MTT assay (3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide assay):

Laboratory technique used to measure cell viability and proliferation based on the metabolic reduction of MTT dye by living cells.

Multinucleate: Having multiple nuclei within a single cell, characteristic of certain cell types such as skeletal muscle fibers or some fungi.

Multivariate: Statistical analyses and models that involve multiple variables simultaneously, aiming to understand complex relationships among them.

Muscle RING Finger 1 (MuRF1): Muscle-specific E3 ubiquitin ligase involved in ubiquitin-mediated proteolysis and muscle atrophy.

Muscarinic Acetylcholine Receptors (mAChR): Mediate responses to acetylcholine, influencing diverse processes including neurotransmission, smooth muscle contraction, and glandular secretion.

Muscle Contraction: Process by which muscle fibers generate tension and exert force on bones or other tissues, resulting in movement or stabilization of body parts.

Muscle Progenitor Cell: Precursor cell involved in muscle development and repair, capable of differentiating into myoblasts and myocytes.

Myelin: Insulating sheath surrounding axons in the nervous system, facilitating faster propagation of action potentials.

Myelin Sheath: Lipid-rich membrane surrounding axons, formed by oligodendrocytes in the central nervous system and Schwann cells in the peripheral nervous system.

Myoblast: Precursor cell involved in muscle development and repair, capable of differentiating into mature muscle cells (myocytes).

Myocyte: Muscle cell responsible for generating force and movement through contraction.

Myofiber: Single muscle cell composed of myofibrils and surrounded by endomysium, contributing to muscle contraction.

Myofibril: Contractile organelle within muscle cells composed of repeating sarcomere units, responsible for muscle contraction.

Myogenic Fusion: Process by which myoblasts fuse together to form multinucleated myotubes or muscle fibers during muscle development or repair.

Myoglobin: Oxygen-binding protein found in muscle cells, storing and releasing oxygen for aerobic metabolism during muscle contraction.

Myonuclei: Nuclei within muscle fibers responsible for regulating protein synthesis, repair, and adaptation in response to exercise or injury.

Myosin Heavy Chain: Protein component of myosin filaments in muscle cells, determining muscle fiber type and contractile properties.

Myostatin: Negative regulator of muscle growth and development, inhibiting the proliferation and differentiation of muscle cells, targeted in efforts to enhance muscle mass.

Myotube: Multinucleated muscle cell formed by the fusion of myoblasts during muscle development or regeneration.

N

NCAM: Neural Cell Adhesion Molecule, a protein involved in cell-to-cell adhesion, signaling, and neural development.

Nerve Impulse: Electrical signal transmitted along nerve fibers (neurons), propagating action potentials for communication between neurons or with effector cells.

NeuN: A neuron-specific nuclear protein used as a marker to identify and study neurons in brain tissue.

Neural Stem Cell: Multipotent cell capable of self-renewal and differentiation into various neural cell types, found in the central nervous system.

Neurite: Any projection from the cell body of a neuron, including axons and dendrites.

Neuroblastoma: Cancer arising from immature nerve cells, often occurring in children and originating in the adrenal glands or sympathetic nervous system.

Neuromuscular Junction: Synapse between a motor neuron and a muscle fiber, where neurotransmitter release triggers muscle contraction.

Neuromuscular Synapse: Synaptic connection between a motor neuron and a muscle fiber, mediating the transmission of nerve impulses and initiation of muscle contraction.

Neuronal Excitation: Process by which neurons generate action potentials in response to stimuli, leading to the transmission of electrical signals along nerve fibers.

Neuronal Inhibition: Process by which neurons reduce or suppress the generation of action potentials in response to inhibitory signals, regulating neural activity.

Neuropeptides: Small protein molecules acting as neurotransmitters or neuromodulators in the nervous system, regulating various physiological functions.

Neutrophil: Type of white blood cell involved in innate immunity, phagocytosing pathogens and releasing inflammatory mediators.

Neurotransmitter: Chemical substance released by neurons to transmit signals across synapses, influencing the activity of target cells.

Neurotrophic Factor: Growth factor promoting the survival, differentiation, and function of neurons, essential for neuronal development and maintenance.

Nicotinamide adenine dinucleotide (NADH): A coenzyme involved in cellular energy production, transferring electrons in metabolic reactions, particularly in glycolysis and the citric acid cycle.

Nicotinic Acetylcholine Receptor (nAChR): Ligand-gated ion channel receptor for acetylcholine, mediating fast synaptic transmission at neuromuscular junctions and in the central nervous system.

Nitric oxide (NO): A colorless, odorless gas molecule that acts as a signaling molecule in the body, regulating various physiological processes such as vasodilation, neurotransmission, and immune response.

Nitric oxide synthases (iNOS-eNOS-NOS): Enzymes that produce Nitric oxide from Arginine.

Nitrotyrosine: Biomarker of oxidative stress formed by the reaction of reactive nitrogen species with tyrosine residues in proteins.

NMDA Receptors: Ionotropic glutamate receptors involved in synaptic plasticity and memory formation, activated by the neurotransmitter glutamate.

Nociception: The physiological process of detecting and transmitting signals related to tissue damage or potential injury, leading to the sensation of pain.

Non-rapid eye movement sleep (NREM): A stage of sleep characterized by absence of rapid eye movements and slower brain waves.

Norepinephrine: Neurotransmitter and hormone involved in the body's stress response, regulating heart rate, blood pressure, and arousal.

Normoxia: Normal oxygen levels in tissues or organs, required for cellular respiration and metabolism.

Nuclear Factor erythroid 2-related factor 2 (Nrf-2): Transcription factor regulating the expression of antioxidant and detoxification genes in response to oxidative stress.

Nuclear Factor kappa-light-chain-enhancer of activated B cells (NF- κ B): Transcription factor involved in immune response, inflammation, and cell survival.

Nucleotide: Basic building block of nucleic acids (DNA and RNA), composed of a sugar, phosphate group, and nitrogenous base.

Nucleus: Membrane-bound organelle containing the genetic material (DNA) of eukaryotic cells, regulating gene expression and cellular activities.

Nucleus Accumbens: Brain region part of the reward pathway, involved in motivation, pleasure, and addiction, particularly to drugs of abuse.

Null: Genetically engineered organism lacking a specific gene or gene function, used to study the role of the gene in development or disease.

O

Occipital lobe: Brain area primarily responsible for visual processing.

Oil Red-O staining: Histological technique used to visualize lipid droplets in tissues, staining neutral lipids such as triglycerides and cholesterol esters.

Oligodendrocyte: A type of glial cell in the central nervous system responsible for producing myelin, which insulates axons and facilitates efficient nerve signal transmission.

Ornithine decarboxylase: An enzyme that catalyzes the conversion of ornithine into putrescine, a key step in the biosynthesis of polyamines, essential molecules involved in cell growth, proliferation, and differentiation.

Oxidative Stress: Imbalance between the production of reactive oxygen species (ROS) and antioxidant defense mechanisms, leading to cellular damage.

Oxidization: Chemical reaction involving the loss of electrons or gain of oxygen atoms, often associated with oxidative stress and damage.

Oxytocin: Hormone and neurotransmitter involved in social bonding, childbirth, lactation, and maternal behavior.

P

p38: Subtype of MAPK activated by stress stimuli, regulating inflammation, apoptosis, and cellular responses to environmental stressors.

P70S6K: Protein kinase involved in the mTOR signaling pathway, regulating protein synthesis and cell growth in response to nutrient availability.

Paracrine: Signaling mechanism in which cells secrete signaling molecules (paracrine factors) that act locally on nearby cells.

Particulate Matter (PM_{2.5} / PM₁₀): Fine or coarse solid particles and liquid droplets suspended in the air, categorized by size.

Parietal lobe: Brain area involved in processing sensory information, spatial perception, and integration of sensory and motor signals.

Pathogen-associated molecular patterns (PAMPs): Molecules derived from pathogens, such as bacteria, viruses, or fungi, that are recognized by the innate immune system through pattern recognition receptors (PRRs).

PAX7: Transcription factor expressed in muscle satellite cells, regulating their self-renewal and differentiation during muscle regeneration.

PCR (Polymerase Chain Reaction): Laboratory technique used to amplify specific DNA sequences through cycles of denaturation, annealing, and extension, enabling detection and analysis of DNA.

Peer-reviewed: The process in which scholarly work, such as research papers, is evaluated by experts in the same field before publication to ensure its quality, validity, and relevance.

Peptide: Short chain of amino acids linked by peptide bonds, serving various biological functions as hormones, neurotransmitters, or signaling molecules.

Pericyte: Contractile cell found in the walls of capillaries and small blood vessels, involved in regulating blood flow and vessel integrity.

Peroxisome proliferator-activated receptors (PPARs): Nuclear receptors regulating gene expression involved in metabolism, inflammation, and cellular differentiation.

Peroxisome proliferator-activated receptor gamma coactivator 1-alpha (PGC1 α): A transcriptional coactivator regulating mitochondrial biogenesis and energy metabolism.

PGC1 α (Peroxisome proliferator-activated receptor gamma coactivator 1-alpha):

Transcriptional coactivator involved in regulating mitochondrial biogenesis and metabolism.

pH: Measure of the acidity or alkalinity of a solution, determined by the concentration of hydrogen ions present.

Phagocytosis: Process by which cells engulf and internalize solid particles or pathogens, forming phagosomes for degradation and antigen processing.

Pharmacodynamics: Study of the biochemical and physiological effects of drugs on the body, including their mechanisms of action and dose-response relationships.

Pharmacokinetics: Study of the absorption, distribution, metabolism, and excretion of drugs in the body, determining their concentration-time profiles and bioavailability.

Phenotype: Observable characteristics or traits of an organism, resulting from interactions between genetic factors and environmental influences.

Phosphatase and tensin homolog (PTEN): Tumor suppressor protein regulating cell growth, survival, and metabolism by inhibiting the PI3K/Akt signaling pathway.

Phosphoinositide 3-Kinase (PI3K): Enzyme involved in cell signaling pathways regulating cell growth, survival, and metabolism.

Phospholipase-D: Enzyme catalyzing the hydrolysis of phospholipids to generate phosphatidic acid, involved in cell signaling and membrane remodeling.

Phosphorylation: Post-translational modification of proteins by adding a phosphate group, regulating protein activity, localization, and interactions.

Phylogenetic: Relating to the evolutionary history and relationships between organisms, often represented as phylogenetic trees based on genetic or morphological data.

Physoxia: Physiological oxygen levels in tissues or organs, optimal for cellular function and homeostasis.

Phytoncide: Volatile organic compounds emitted by plants with antimicrobial properties, thought to have health benefits when inhaled.

Pigment: Colored molecule or substance that absorbs and reflects specific wavelengths of light, giving tissues or structures their characteristic color.

Polysaccharide: Carbohydrate molecule composed of multiple sugar units linked together, serving as energy storage molecules (e.g., glycogen) or structural components (e.g., cellulose).

Postsynaptic: Refers to the region of a synapse, typically on the receiving end of a signal, where neurotransmitter receptors are located and where neurotransmitters bind to initiate a response in the receiving neuron.

PPAR α (Peroxisome proliferator-activated receptor alpha): Nuclear receptor involved in fatty acid oxidation, lipid catabolism, and energy homeostasis, primarily in liver, heart, and skeletal muscle.

PPAR γ (Peroxisome proliferator-activated receptor gamma): Nuclear receptor involved in adipogenesis, lipid metabolism, and insulin sensitivity.

Presynaptic: Refers to the region of a synapse, typically on the transmitting end of a signal, where neurotransmitters are stored and released into the synaptic cleft to signal the postsynaptic neuron.

Programmed Cell Death: Cellular process regulated by specific signaling pathways, leading to controlled cell elimination, crucial for development and tissue homeostasis.

Proliferation: Process of cell division and increase in cell number, essential for growth, development, and tissue repair.

Promoter (Genetic): Regulatory region of DNA located upstream of a gene, controlling the initiation of transcription and gene expression.

Propionic Acid: Short-chain fatty acid produced by microbial fermentation in the gut, serving as an energy source and metabolic precursor, implicated in various health effects.

Protease: Enzyme released from the pancreas, mouth, & stomach that breaks down proteins into smaller peptides or amino acids, essential for various biological processes.

Proteasome: Cellular structure responsible for degrading and recycling proteins tagged with ubiquitin, maintaining protein homeostasis.

Protein Kinase B (AKT): Serine/threonine protein kinase involved in cell survival, growth, and metabolism, activated by growth factors and insulin signaling.

Protein Synthesis: Cellular process of translating genetic information from mRNA into functional proteins, involving transcription, translation, and post-translational modifications.

Proton: Positively charged subatomic particle found in the nucleus of atoms, contributing to the electrical potential across biological membranes and energy metabolism.

Proton leak: Leakage of protons across biological membranes, uncoupling the flow of protons from ATP synthesis in mitochondria, dissipating energy as heat.

Purines: Nitrogenous bases found in DNA and RNA, including adenine and guanine, and their derivatives such as ATP and GTP.

Pyroptosis: Form of programmed cell death characterized by inflammatory response and cell swelling, triggered by inflammasome activation.

Pyruvate: Three-carbon compound formed during glycolysis, serving as a substrate for the Krebs cycle or fermentation pathways.

Q

N/A

R

Radial arm water maze: Behavioral test used to assess spatial learning and memory in rodents by requiring them to navigate through a maze to find a hidden platform submerged in water.

Rapamycin: Macrolide antibiotic and immunosuppressant drug that inhibits the mTOR signaling pathway, used in research to study cell growth and metabolism.

Reactive Oxygen Species: Chemically reactive molecules containing oxygen, such as superoxide, hydrogen peroxide, and hydroxyl radical, involved in oxidative stress and signaling.

REM: Rapid Eye Movement, a stage of sleep characterized by vivid dreams and rapid eye movements, often associated with memory consolidation.

Retraction: Scientific term meaning the withdrawal or removal of a previously published research article, typically due to errors, ethical concerns, or misconduct discovered after publication.

RNA: Ribonucleic acid molecule involved in various cellular processes, including protein synthesis (mRNA), gene regulation (miRNA), and catalysis (ribozymes).

RT-PCR (Reverse Transcription Polymerase Chain Reaction): Variant of PCR used to amplify and quantify RNA molecules by first converting them into complementary DNA (cDNA) using reverse transcriptase.

S

SAMP8 mice: Accelerated aging mouse model commonly used in research on age-related cognitive decline and neurodegenerative diseases.

Satellite Cell: Quiescent stem cell located in skeletal muscle, activated during muscle injury or exercise to proliferate and differentiate into myoblasts for muscle repair.

Sarcoplasmic Reticulum: Specialized endoplasmic reticulum found in muscle cells, storing and releasing calcium ions for muscle contraction.

Sarcolemma: Cell membrane of muscle fibers, essential for excitation-contraction coupling and transmission of action potentials.

Sarcomere: Contractile unit of muscle composed of overlapping actin and myosin filaments, responsible for muscle contraction.

Second Messenger: Intracellular signaling molecule generated in response to activation of cell surface receptors, transmitting and amplifying extracellular signals.

Senescence: Biological process of aging or deterioration in cells, tissues, or organisms, characterized by reduced cellular function and increased vulnerability to stress and disease.

Serotonin: Neurotransmitter and neuromodulator involved in mood regulation, sleep-wake cycles, appetite, and other physiological processes.

SGK1 (Serum and Glucocorticoid-Regulated Kinase 1): Serine/threonine protein kinase regulated by growth factors and stress signals, involved in cell survival and ion transport.

SH-SY5Y cell: Human neuroblastoma cell line widely used in neuroscience research, modeling neuronal differentiation, function, and pathology.

Short Chain Fatty Acids (SCFAs): Organic acids typically composed of fewer than six carbon atoms, produced by the bacterial fermentation of dietary fibers in the colon.

Signal Transduction: Process by which extracellular signals are transmitted into the cell, leading to cellular responses or changes in gene expression.

Singlet Oxygen: Reactive oxygen species (ROS) formed by the excited state of molecular oxygen, capable of damaging cellular components.

siRNA (Small interfering RNA): Synthetic RNA molecule designed to target and silence specific genes by inducing degradation of complementary mRNA molecules.

Sleep spindle: Brief bursts of brain activity during stage 2 non-REM sleep, believed to play a role in memory consolidation.

Slow-wave sleep: A stage of deep sleep characterized by slow brain waves (delta waves), important for physical and mental restoration.

Smooth Muscle: Involuntary muscle tissue found in the walls of internal organs, responsible for peristalsis and regulating organ function.

SPECT Scan (Single Photon Emission Computed Tomography): Imaging technique used to visualize and measure radioisotope distribution in tissues, providing functional information about organ function or blood flow.

Splice: Process of removing introns and joining exons in pre-mRNA molecules during gene expression, generating mature mRNA transcripts.

Sprague-Dawley rat: Common strain of laboratory rat used in biomedical research for toxicology, pharmacology, and physiology studies.

STAT3 (Signal Transducer and Activator of Transcription 3): Transcription factor activated by cytokine signaling, regulating immune response, cell proliferation, and survival.

Substance P: Neuropeptide involved in pain perception and inflammation, released by sensory neurons in response to noxious stimuli.

Subunit (Receptor): Protein component of a receptor complex responsible for ligand binding and signal transduction.

Superfamily: A large group of related proteins or genes with similar structures or functions, often sharing evolutionary ancestry and biochemical characteristics.

Superoxide Dismutase (SOD): Enzyme that catalyzes the dismutation of superoxide radicals into oxygen and hydrogen peroxide, protecting cells from oxidative damage.

Swiss mice: Outbred strain of laboratory mice derived from a mixture of different strains, commonly used in pharmacology.

Synapsin 1: Neuronal phosphoprotein involved in regulating neurotransmitter release and synaptic vesicle trafficking.

Synaptogenesis: Process of forming new synapses between neurons, crucial for establishing neuronal circuits during development and synaptic plasticity.

Synaptic Cleft: Narrow gap between presynaptic and postsynaptic neurons, where neurotransmitters are released and bind to receptors, transmitting signals.

Synaptic Vesicles: Small membrane-bound organelles within presynaptic neurons, containing neurotransmitters that are released into the synaptic cleft.

Synapse: Junction between two neurons or between a neuron and an effector cell, mediating communication through neurotransmitter release and synaptic transmission.

T

T-Cells: Type of white blood cell involved in cell-mediated immunity, including helper T cells, cytotoxic T cells, and regulatory T cells.

Temporal lobe: Brain region associated with auditory processing, memory, emotion, and language comprehension.

Terminal deoxynucleotidyl transferase dUTP nick end labeling (TUNEL): A technique used to detect DNA fragmentation in apoptotic cells, indicating programmed cell death.

Terminal Half-Life: Time required for the concentration of a substance in the body to decrease by half during the elimination phase after reaching steady-state conditions.

Thiobarbituric acid reactive substance: Compound formed by the reaction of thiobarbituric acid with lipid peroxidation products, used as a marker of oxidative stress.

Time-under-tension (TUT): Training variable referring to the total duration a muscle is under strain during a set, coined by Charles Poliquin.

T-maze: Behavioral test used to assess spatial learning and memory in rodents by requiring them to choose between two arms of a maze to find a reward.

Toll Like Receptor: Pattern recognition receptor involved in innate immune response, recognizing pathogen-associated molecular patterns (PAMPs) and activating immune cells.

Transactivator: Protein that binds to DNA regulatory sequences and activates transcription of target genes, regulating gene expression.

Transcription: Process of synthesizing RNA molecules from DNA templates, mediated by RNA polymerase enzymes.

Transforming Growth Factor beta (TGF- β): A Cytokine involved in regulating cell growth, differentiation, and wound healing, with diverse effects on various cell types.

Trolox equivalent antioxidant capacity (TEAC): Measurement of antioxidant capacity that compares a substances' ability to neutralize free radicals with Trolox (vitamin E analog).

Tropomyosin: Protein associated with actin filaments in muscle cells, regulating muscle contraction by blocking myosin-binding sites on actin.

Tropomyosin receptor kinase A (TrkA): Receptor tyrosine kinase activated by nerve growth factor (NGF), regulating neuronal survival, growth, and differentiation.

Troponin: Regulatory protein complex associated with actin filaments in muscle cells, controlling the interaction between actin and myosin during muscle contraction.

TRPM8 (Transient Receptor Potential Melastatin 8): Ion channel activated by menthol and cold temperatures, involved in cold sensation and thermoregulation

TRPV1 (Transient Receptor Potential Vanilloid 1): Ion channel activated by various stimuli, including capsaicin (from chili peppers) and heat, involved in pain perception and thermoregulation.

Trypsin: Enzyme that breaks down proteins into smaller peptides by cleaving peptide bonds, found in the digestive system.

Tuberous sclerosis protein complex 1-2: Protein complexes containing TSC1 (hamartin) and TSC2 (tuberin), regulating the mTOR signaling pathway and cellular growth.

U

Ubiquitin ligases: Enzymes that attach ubiquitin molecules to proteins, marking them for degradation by the proteasome.

Ultra-performance liquid chromatography (UPLC): Advanced form of liquid chromatography with improved resolution, sensitivity, and speed, used for separating and analyzing complex mixtures.

Urea: A nitrogenous waste product formed in the liver from ammonia and excreted by the kidneys in urine.

UVB (Ultraviolet B): Type of ultraviolet radiation with wavelengths between 280 and 320 nanometers, capable of penetrating the skin and causing DNA damage.

V

Vasculogenesis: The formation of new blood vessels from precursor cells, typically during embryonic development or tissue regeneration.

VCAM-1 (Vascular Cell Adhesion Molecule-1): A cell surface protein involved in the early adhesion of leukocytes to endothelial cells during inflammation.

VEGF-A (Vascular Endothelial Growth Factor A): Growth factor promoting angiogenesis and vascular permeability, involved in wound healing, tissue repair, and tumor vascularization.

Ventricle (Heart): Hollow chamber of the heart responsible for pumping blood to the lungs (right ventricle) and the rest of the body (left ventricle).

Vitamin: Essential organic nutrient required in small amounts for various metabolic processes and physiological functions in the body.

Volatile Organic Compound (VOC): Organic chemical compound with high vapor pressure at room temperature, often emitted as gases from various sources including plants, pollutants, or metabolic processes.

Voltage-gated Calcium Channels (VGCCs): Transmembrane protein channels that open in response to changes in membrane potential, allowing calcium ions to enter cells.

W

Western Blot: Laboratory technique used to detect and quantify specific proteins in biological samples, based on protein separation by gel electrophoresis and detection using antibodies.

White fat: Energy-storing adipose tissue mainly storing lipids.

Wild-type mice: Mice that have not been genetically altered and serve as the control group in experiments involving genetically modified mice.

Wound scratch analysis: Assay used to study cell migration and wound healing in vitro, involving the creation of a cell-free area (scratch) in a monolayer of cells, followed by monitoring of cell migration into the wound area.

X

N/A

Y

YAP1 (Yes-associated protein 1): Transcriptional co-activator involved in the Hippo signaling pathway, regulating cell proliferation, survival, and organ size.

Y-maze: Behavioral test used to assess spatial working memory in rodents by measuring their spontaneous alternation between three arms of a maze.

Z

Zymogen: Inactive precursor form of an enzyme, requiring cleavage or modification for activation, often to prevent premature enzyme activity.

General Supplement Index

Acetic Acid: Pg. 556
Agmatine: Pg. 612
Alcohol: Pg. 466
Alpha-GPC: Pg. 662
Alpha-lipoic acid: Pg. 653
Alpha-Linolenic acid: Pg. 393
Ally-Isocyanate: Pg. 623
Ascorbic acid: Pg. 336 / 657
Aspirin: Pg. 308
B-Hydroxy-B-Methyl Butyrate (HMB): Pg. 306
B-Vitamins: Pg. 348
Bacillus Coagulans: Pg. 426
Barley Grass: Pg. 385
Beta-Alanine: Pg. 339 / 664 / 779
Beta-Carotene: Pg. 344
Betaine: Pg. 316
Betahydroxybutyrate: Pg. 431
Wild Blueberries: Pg. 325
Camellia Sinensis: Pg. 370
Capric acid / Caprylic acid: Pg. 394
Cannabidiol: Pg. 303
Chromium: Pg. 361
Coffee: Pg. 368
Conjugated Linoleic acid: Pg. 617
Copper: Pg. 437
Citric acid: Pg. 431
Creatine: Pg. 318
Dehydroepiandrosterone: Pg. 315 / 424
Docosahexaenoic acid / Eicosapentaenoic acid: Pg. 389
Echinacea: Pg. 425
Epigallocatechin Gallate: Pg. 326 / 643
GABA: Pg. 614 / 637
Gamma-Oryzanol: Pg. 628
Glutathione: Pg. 361
Glycine / Serine: Pg. 164 / 232 / 290 / 739 / 784
Hibiscus Sabdariffa: Pg. 317
Hydroxytyrosol: Pg. 313 / 948

Iodine: Pg. 335
Kombucha: Pg. 358
L-Arginine: Pg. 430
L-Aspartic acid: Pg. 436
L-Carnitine: Pg. 322
L-Citrulline: Pg. 429
L-Glutamine: Pg. 432
L-Histidine: Pg. 616
L-Ornithine: Pg. 346 / 441
Lactobacillus Rhamnosus: Pg. 427 / 510
Lactoferrin: Pg. 347
Lauric acid: Pg. 445 / 627
Lithium: Pg. 168 / 351
Lion's Mane: Pg. 313
Lutein: Pg. 335
Magnesium: Pg. 331
Melatonin: Pg. 354
Nicotine: Pg. 416
Oleuropein: Pg. 310
Piperine: Pg. 464 / 625
Potassium: Pg. 345
Quercetin: Pg. 299 / 657
Raspberry Ketone: Pg. 624
Rooibos: Pg. 356
Rutin: Pg. 307
Selenium: Pg. 351 / 641
Sildenafil: Pg. 427
Silymarin: Pg. 301
Sulforaphane: Pg. 358
Taurine: Pg. 435
THC: Pg. 480
Theaflavins: Pg. 371 / 664
Vitamin D3: Pg. 350
Vitamin E: Pg. 339
Vitamin K: Pg. 338
Yohimbine: Pg. 622
Zinc: Pg. 351 / 782

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