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Go on a trip!

QUADRANTS OF **LIFE**

Gauge life's measures, traverse life's quadrants



Editor's Note

Life is never a linear, one-dimensional progression, but rather a cohesive system of four interdependent dimensions: body, metabolism, mind, and ethics. The name of this journal, *Quadrants of Life*, reflects these four dimensions—sports rehabilitation, nutrition and metabolism, neuroscience, and bioethics—establishing a framework for understanding life which integrates scientific principles with humanistic values, providing a solid foundation for the pursuit of health and setting clear boundaries for the exploration of life.

The body is the primary vessel of life, and life thrives on movement—yet movement inevitably brings pains. For high-school students passionate about sports, we often suffer from discomfort in muscles, joints, and ligaments, which can interfere with daily classes and training, and even lead to missing important competitions. Through the section of Sports Injuries and Rehabilitation, I hope to deliver accessible science that helps everyone recognize bodily pain signals, take appropriate preventive measures, and achieve effective recovery, so that we can maintain health while staying active.

Nutrition and metabolism constitute the internal processes that sustain life. Today, weight loss, fat reduction, calorie management, and metabolic regulation have attracted widespread public attention. Many people depend on daily takeout for meals and treat milk tea as their primary beverage, or turn to blind dieting and extreme calorie restriction, ignoring individual metabolic differences and disrupting the body's internal balance. Through the section of Nutrition and Metabolism, I hope to help you understand nutrition, grasp the principles of metabolism, learn to live harmoniously with food, discover a dietary approach suited to your own needs, and safeguard long-term physical and mental well-being.

The brain serves as the most vital command center of human life. It regulates our perception, emotions, memory, thinking, and behavior. High-school students often face intense academic pressure, making it common for them to experience poor concentration, mood fluctuations, and sleep disturbances—conditions that easily trigger inner conflict and chronic self depletion. The hidden realms of the Brain section invites you into the brain's intricate structure, helps you grasp its functional principles, explores everyday psychological puzzles, and unlocks the ultimate code for self-awareness, self-regulation, and personal achievement.

Science has no boundaries, but life has ethical boundaries. As life and health sciences advance rapidly, we open up greater possibilities for human life, yet face constant choices and challenges regarding the very essence of human existence. From everyday decisions about physical and mental well-being to broader questions of perceptions of life, value judgments, and self-restraint, bioethics underpins every aspect of human life. Drawing on classic cases from the summer school's "Bioethics" course, the Ethical Myths section guides you toward a more compassionate understanding of life—beyond cold scientific rules—to embrace a humane perspective, honor life, care for your body and mind, and live with richness and ease.

Quadrants of Life will uphold its founding mission of "empowering health through science and safeguarding life through humanity", stay closely attuned to high-school students' *real-life* experiences, disseminate evidence-based health knowledge, and jointly explore the psychological and physical challenges encountered along their growth journey.

**May we find balance between our body and mind within the quadrants of growth,
and embrace our own youth with calmness.**

Haoxuan Deng
Editor-in-Chief
Quadrants of Life
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CONTENTS

- 01 Leg Soreness After Exercises? First, Figure Out Whether It's Normal Muscle Soreness or "Shin Splints"
- 03 Knee Pain Below the Kneecap? Let's Talk About the Common "Patellar Tendinitis" in Ball Sports
- 05 Caloric Deficit: The Core Principle of Losing Fat and Building Muscle
- 07 Basal Metabolism and the Three Macronutrients: Unlocking the Science Behind Diet for Fat Loss and Body Shaping
- 09 Unveiling the Wonders of the Brain: How Neurons Think and Communicate
- 11 Sculpting Our Brains: From Neural Development to the Secrets of Learning and Memory
- 13 Rethinking Life's Final Chapter: Choice, Dignity, and the Ethics of Assisted Dying
- 16 Reframe the Abortion Debate: Rigorous Philosophical Inquiry
- 19 Instructions for Authors

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Editor-in-Chief: Haoxuan Deng

Email: haoxuandeng0822@163.com

CONTACT US

Phone: +1 979-739-4728

Email: haoxuandeng0822@163.com



Leg Soreness After Exercises?

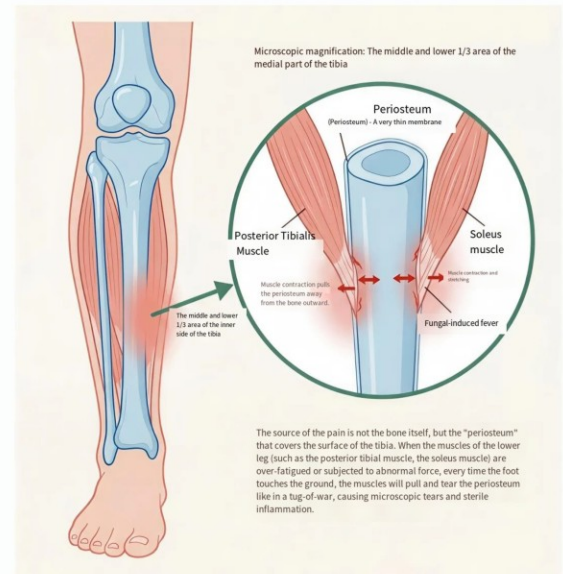
First, Figure Out Whether It's Normal Muscle Soreness or “Shin Splints”

After exercising, you may sometimes feel discomfort. Firstly, it's important to clearly distinguish whether it's a normal reaction or an injury.

Normal muscle soreness typically peaks 12 to 24 hours after exercise, commonly known as “delayed onset muscle soreness”. This kind of soreness is usually more noticeable when lying down or at night, yet it tends to ease with movement and there is no swelling in the affected area. For example, after an 800-meter or 1000-meter running test in PE class, you might feel a dull ache in your thighs or calves, but it usually resolves on its own in two to three days without affecting normal walking or daily activities.

However, **the sports injuries we need to watch out for** usually cause pain right after exercise, or pain that progressively worsens. This pain is sharp, stabbing, or tearing in nature and occurs in a specific localized area. Most importantly, it does not improve with rest—movement actually increases the pain—and is frequently accompanied by redness, swelling and bruising. For example, if your wrist suddenly clicks and hurts during heavy bench press, you may later find it difficult to even twist a bottle cap or turn your wrist normally.

Let's talk about a common sports injury which often troubles track and field athletes: shin splints.



1. How did it happen?

Periostitis is essentially an inflammation of the lower leg, commonly occurring in sports that involve frequent running and jumping, such as sprinting and high jumping. Common causes include a sudden increase in training volume, improper landing technique during running—such as landing too hard—or prolonged exercise on hard surfaces like concrete or brick pavement. Particularly in winter, when outdoor running tracks become compacted and harder, the risk of periostitis increases.

2. What are the symptoms?

The most typical symptom of periostitis is a dull or pulling pain in the middle to lower portion of the shinbone (on the medial and anterior sides). The area doesn't hurt when left alone, but becomes intensely painful when pressed. Pain often occurs suddenly during the middle to later stages of running, or immediately after stopping. It's especially noticeable when you stand on your toes or push off forcefully with your toes. In more severe cases, pain may occur even during normal walking, making it difficult to lift the leg, and the front part of the shin may become red, warm, and swollen.

Sports Injuries and Rehabilitation

3. How to prevent and recover?

1) Prevention: The most important step is to thoroughly warm up and stretch before exercising. Additionally, train with appropriate intensity and stop high-impact running and jumping (such as hurdle jumps, single-leg squats, or back kicks) immediately if you feel even slight pain in your calves. Finally, maintain relaxed movements, cushion your landings properly, and try to exercise on indoor synthetic tracks during winter.

2) Recovery: Regularly use a foam roller to massage your calves, stretch the back of your legs against a wall, perform foot relaxation and heel raises standing on tiptoes. During rest, continue applying heat therapy and elevate your legs on a chair to promote blood circulation.



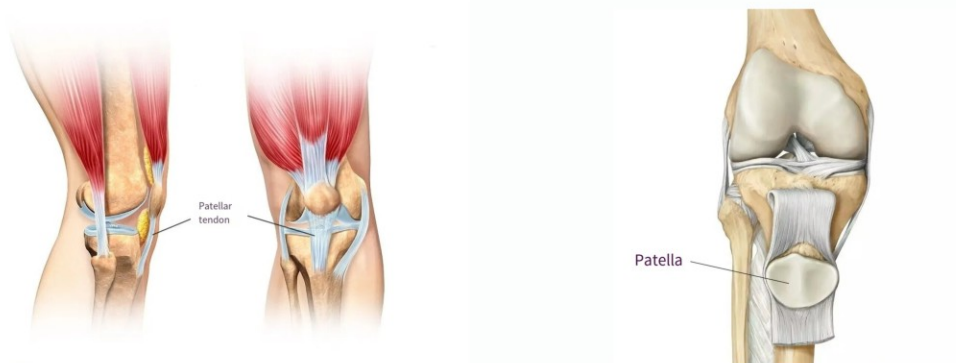
Based on my personal experience, the most effective approach is to completely rest and consistently apply heat therapy. If you don't take time off when in pain and resume running as soon as you feel slightly better, it's extremely likely to relapse. Some people believe that stopping training will affect performance, but for sustainable training and competitive results, I recommend taking a temporary break rather than persistent overtraining.

Knee Pain Below the Kneecap? Let's Talk About the Common "Patellar Tendinitis" in Ball Sports

Students who frequently play basketball or volleyball may have experienced a dull ache below the kneecap, which is most likely caused by patellar tendinitis.

1. What is patellar tendinitis?

Simply put, the patellar tendon is a strong ligament that connects the kneecap to the shinbone and extends from the quadriceps muscle. Its primary function is to stabilize the knee joint. This ligament is naturally very robust, making it difficult for most people to tear it. Therefore, pain associated with it is usually due to chronic damage caused by prolonged overuse. Sports such as basketball and volleyball involve frequent jumping, which is why patellar tendinitis is usually known in medicine as "jumper's knee".



2. Why do you get patellar tendinitis?

In addition to prolonged high-impact running and jumping, muscle imbalances between the legs, excess body weight, or improper movement posture that causes other areas to compensate can place extra strain on the knees. Furthermore, as people age, the elasticity and resilience of the patellar tendon gradually decline, increasing the risk of injury.

The main symptom of patellar tendinitis is pain directly below the kneecap. You may not feel any discomfort while walking normally, but during activities such as jumping, squatting, or going up and down stairs, there will be noticeable pain in this area. In severe cases, the pain can persist continuously, even interfering with sleep at night.

3. How to do rehabilitation exercises in daily life

We won't discuss complex medical emergency procedures here, but instead recommend a few simple rehabilitation exercises you can do at home (provided you don't experience any sharp pain during the movements).

1) Massage and Stretching: Use your hands or a foam roller to massage and relax the major muscles associated with the knee joint, such as the front of the thigh (quadriceps), back of the thigh (hamstrings), and calf muscles. After releasing tension, perform gentle stretches to gradually increase joint mobility. Hold each stretch for 30 seconds on one side, alternate sides, and repeat for 3 sets.

Sports Injuries and Rehabilitation

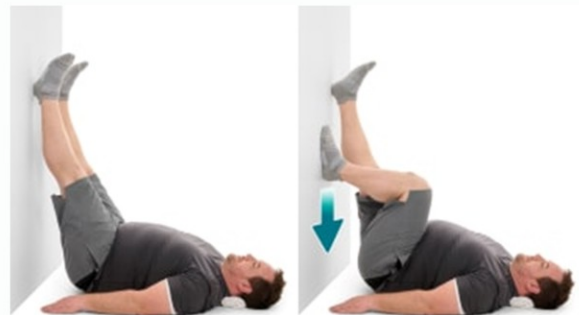
Standing Quadriceps Stretch: Stand with one hand holding onto a wall or chair for balance, and use the other hand to pull your foot toward your buttocks. Keep your knees together and feel the stretch in the front of your thigh.

Standing forward Hamstring Stretch: Place one foot in front and the other behind, and keep the front leg straight and the back leg slightly bent. Slowly lean your upper body forward while keeping your back straight, shift your weight onto the back leg, and feel the stretch in the back of the thigh.

Lunge Calf Stretch: Step forward into a lunge position, and keep the back leg straight with the heel firmly planted on the ground and toes pointing forward. Lean your body forward to feel a stretch in the middle to lower part of the calf muscle of the back leg.

Lunge Soleus: Step forward into a lunge position, and bend the back knee slightly while keeping the heel firmly on the ground. Shift your weight forward so that the sensation of tightness is lower and closer to the area above the achilles tendon.

2) Heel-to-Wall Push: Lie flat on your back with your buttocks 60-80 cm away from the wall, keeping your entire back pressed firmly against the floor. Bend one knee slightly at 50°-70° and use your heel to press against the wall, resisting the force without sliding your leg. Hold for 10-15 seconds, then relax for 20 seconds. Next, fully straighten the knee and again press the heel against the wall for another 10-15 seconds. Perform 8-10 repetitions on each side, alternate legs, and repeat for 3 sets.



3) Wall Sit: Keep your back flat against the wall, with the back of your head, upper back, and buttocks touching the wall. Step forward about one arm's length, feet shoulder-width apart, toes pointing forward. Bend your knees to 30°-45°—do not squat down to 90°—and keep your weight on your heels, ensuring your knees do not go past your toes. If you feel a sharp pain below the kneecap, immediately stand up and reduce the depth of the squat. Perform each set for 30 seconds, rest for 60 seconds between sets, and complete 3 sets in total.



4) Squat-to-Stand: Choose a high chair, place your feet flat on the floor shoulder-width apart, and lean your body slightly forward while keeping your back straight. Slowly lower yourself down over 3 seconds, gently touching the seat with your buttocks without fully sitting down. Then stand up smoothly and steadily in 3 seconds, shifting your weight onto your entire foot and keeping your heels on the ground without sudden movements. Perform 8-10 repetitions per set, rest for 60 seconds between sets, and complete 3 sets in total.

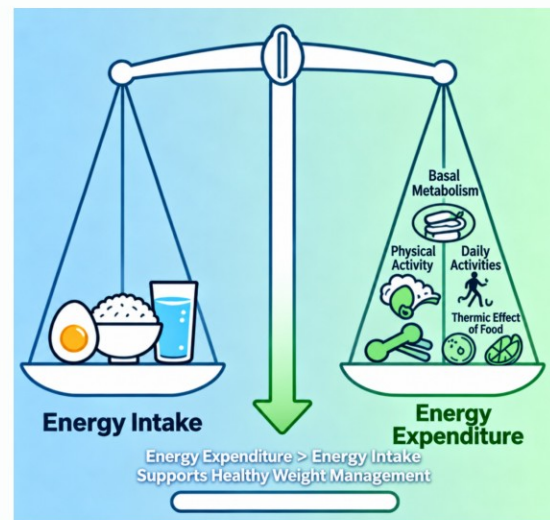
5) Seated Leg Extension: Sit on the edge of a bed or a high stool, lift one foot off the ground and point your toes upward. Actively contract the front thigh muscles to straighten the knee without forcing fiercely, then slowly lower it back down. Perform the movement slowly and steadily, up for 2 seconds, hold for 1 second at the top without locking the knee, and lower for 3-4 seconds. Do 8-10 repetitions per side, alternate legs, and repeat for 3 sets.

Caloric Deficit: The Core Principle of Losing Fat and Building Muscle

Today, body management and healthy shaping have become widely discussed topics. Whether aiming to lose fat and slim down, get rid of excess weight, or build muscle and improve posture, many people have tried various methods such as dieting, exercise and cutting sugar, yet often find themselves stuck in the frustrating cycle of feeling hungry every day without seeing any weight loss. In fact, the root cause of most failed weight-loss attempts is the lack of a caloric deficit. Fundamentally, all changes in body composition depend on the balance of energy intake and expenditure—the most basic and essential principle in fitness.

First, let's clarify what a caloric deficit is. The human body undergoes energy metabolism every day. On one hand, it takes in calories through food to sustain all vital activities such as breathing, studying and exercising; on the other hand, it burns calories through basal metabolism, daily activities and physical exercise. **A caloric deficit** refers to the difference when the body's total caloric expenditure exceeds its intake over a day. Conversely, when caloric intake exceeds expenditure, it results in a **caloric surplus**. When intake equals expenditure, it is known as **energy balance**.

Let me explain using my own example. My daily basal metabolic rate is 1,770 kcal, and with regular physical activity, my total daily energy expenditure is about 2,000 kcal. If I consume only 1,500 kcal per day, this creates a caloric deficit of 500 kcal. When the body doesn't receive enough external energy, it starts drawing on stored fat and a small amount of glycogen to make up for the shortfall. Over time, consistent adherence to this deficit leads to a gradual reduction



in body fat, resulting in natural weight loss. Importantly, muscle loss can take place in the absence of physical activity. On the other hand, if I consume 2,200 kcal daily—200 more than my expenditure—the excess 200 kcal will be stored as fat, leading to gradual weight gain over time. Under energy balance, weight remains stable without significant fluctuations.

Many people mistakenly believe that “losing weight means starving yourself”, yet this is the most common misunderstanding of the caloric deficit concept. A truly healthy caloric deficit should be reasonable and feasible, and we should pursue a scientifically manageable dietary plan. If you aim for rapid weight loss by severely restricting or even skipping meals, creating an excessively large deficit of over a thousand calories per day, your body will lower its basal metabolic rate to conserve energy. This can lead not only to fatigue, hair loss, dull complexion and weakened immunity, but also to a “plateau” where weight stops dropping. Once you resume normal eating,

Nutrition and Metabolism

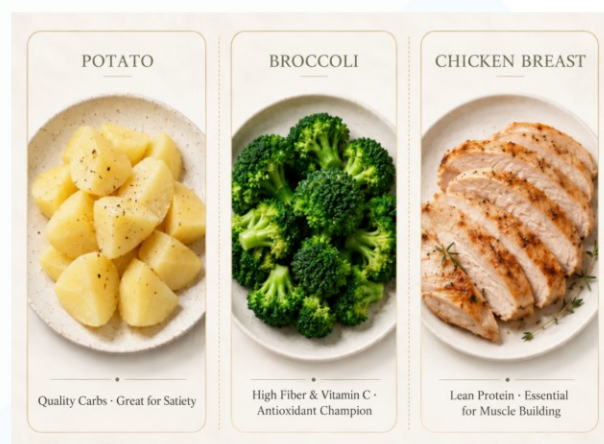
the weight quickly rebounds. The end result is that you may struggle for an entire month, only for a single hotpot or barbecue meal to set you right back to square one.

For the average person, **a daily caloric deficit of 300–500 kcal is the best choice for fat loss**, and it allows for steady fat burning without negatively affecting your metabolism. The simplest way to create a reasonable deficit is through **a combination of dietary control and moderate exercise**. On the diet front, there's no need for extreme restriction, and you should simply cut back on high-sugar and high-fat foods like milk tea, fried items and ultra-processed snacks, while ensuring adequate intake of protein, dietary fiber and vitamins to maintain satiety. On the exercise front, incorporate physical activities like jogging, jump rope and strength training, to boost daily calorie expenditure and allow the deficit to form naturally. Aerobic exercise is more effective and easier to stick with than anaerobic exercise, and combining aerobic exercise with resistance training represents the optimal strategy.

For those looking to build muscle, the logic of caloric deficit applies as well, but in reverse. Muscle gain requires a slight caloric surplus to provide energy and nutritional support for muscle growth. However, many people blindly overeat, creating too large a surplus, and end up accumulating a lot of fat rather than muscle. **It is recommended to maintain a daily**

caloric surplus of 200–300 kcal, while pairing it with resistance training and adequate protein intake, so that the excess calories are preferentially used for muscle synthesis and fat accumulation is avoided.

In addition, everyone should avoid the pitfall of “looking only at calories, not nutrition”. The same 500 kcal from fried chicken and cake versus those from whole grains, lean meat and vegetables produce completely different effects on the body. Highly processed, calorie-dense foods cause large blood sugar spikes, making you feel hungry easily and leading to overeating; whereas high-protein and high-fiber natural foods prolong satiety, stabilize metabolism and make maintaining a caloric deficit much easier and healthier. The previously popular CPB diet is a great example—chicken breast, potatoes, broccoli, and carrots are all nutrient-dense and highly satiating foods. No matter how you combine them, you can achieve a caloric deficit while still feeling full.



In the end, weight loss is not mystery. Losing weight is never about painful self-deprivation, and building muscle is never about blind overtraining. Understand the caloric deficit, abandon the extreme dieting and reckless exercise, and adopt a gentle and sustainable way to adjust your diet and physical activity. This will make body management both efficient and effortless, allowing you to achieve your ideal physique while safeguarding your overall health.



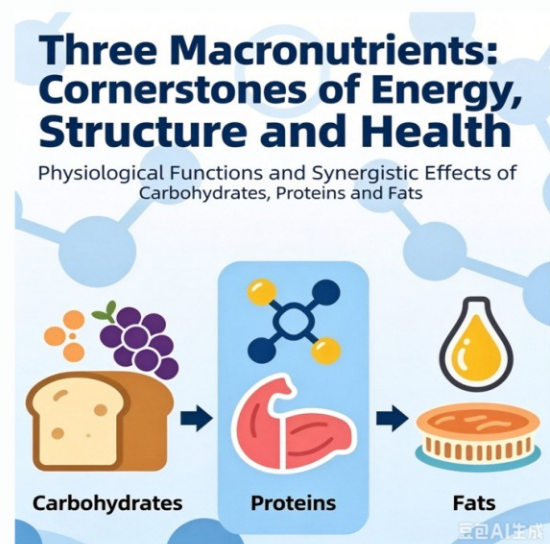
Basal Metabolism and the Three Macronutrients: Unlocking the Science Behind Diet for Fat Loss and Body Shaping

In the previous article, we learned that the caloric deficit is the fundamental principle behind weight management, a direct manifestation of energy conservation in human metabolism. However, most people run into practical challenges when implementing this principle: for instance, they may restrict food intake strictly to achieve a theoretical calorie deficit, yet still face weight loss plateaus, loss of body firmness, or weight regain. The root cause may lie in an over-reliance on “calorie numbers” which causes people to overlook basal metabolic rate—the foundation of caloric expenditure—and the three macronutrients that shape the body's metabolic profile.

Basal metabolism is the most fundamental energy consumption system in the human body, referring to the minimum amount of calories required to sustain essential life functions—while the body is awake, fasting, lying at complete rest and kept at a constant ambient temperature. It accounts for 60% to 70% of total daily energy expenditure and serves as the core source of energy consumption during rest. Unlike active energy expenditure such as physical exercise, basal metabolism is beyond voluntary control, instead it represents an inevitable product of bodily physiological processes. If a person follows extreme or unbalanced dieting, and consumes far fewer calories than the body's basic requirements, the body triggers energy-saving protective mechanisms, deliberately slows the metabolic rate and lowers energy expenditure to counteract energy deficiency. This creates a vicious cycle: “The less you eat, the slower your metabolism becomes, and the slower fat loss occurs.” Moreover, excessive hunger frequently leads to overeating, a major contributor to failed weight-loss efforts and rapid weight regain.

It is evident that the core of fat loss lies not in extreme caloric restriction, but in the optimization of basal metabolism. The key to modulating one's metabolic state and matching dietary intake to the body's energy needs lies in achieving a proper balance among the three

macronutrients: carbohydrates, proteins, and fats. As essential macronutrients, each plays a distinct role, directly influencing the metabolic rate, satiety, and body composition. This stands in contrary to the oversimplified popular notion that “carbs make you fat, fats are harmful, and protein is optional.”



Carbohydrates constitute the body's most energy source of energy and form as the foundation of metabolic stability. High-quality complex carbohydrates, including whole grains, tubers, and cereals, undergo slow digestion and absorption, delivering sustained energy to support stable basal metabolism and avert abrupt metabolic drops. By contrast, refined carbohydrates like desserts, white rice, and processed flour products trigger sharp blood-sugar fluctuations. Excess energy is quickly converted into body fat, while satiety is diminished and erratic appetite patterns are exacerbated. Scientific weight loss doesn't call for the elimination of carbohydrates, instead, it involves selecting higher-quality carbohydrate sources and moderating portion sizes to balance energy requirements against fat-loss objectives. Even nutrient-dense foods such as purple sweet potatoes and potatoes can be prepared into delicious, low-calorie meals.

Nutrition and Metabolism

Protein is a core nutrient that supports basal metabolism and plays a key role in body shaping. Sufficient protein intake effectively helps preserve muscle mass. Since muscle mass is positively correlated with the metabolic rate, a larger muscle mass contributes to higher resting energy expenditure. Additionally, protein exhibits a substantially higher thermic effect compared with carbohydrates and fats: body expends more calories during its digestion and absorption, and it promotes prolonged satiety which helps reduce excess calorie intake. Consistent intake of high-quality proteins, such as chicken breast, fish, shrimp, eggs and soy-based products, represents an optimal choice for preserving metabolism and avoiding loss of body firmness.



Fat is not a metabolic waste but an essential nutrient that helps maintain hormonal balance and supports normal metabolic function. Healthy unsaturated fats can modulate endocrine function and promote

digestion and nutrient absorption. They also guard against reduced appetite and metabolic disorders triggered by inadequate fat intake. For weight-loss purposes, avoiding fried foods and trans fats such as margarine, while moderating intake of high-quality fats like nuts, avocados, and olive oil can boost dietary adherence and facilitate long-term weight management.



It is true that evidence-based body management centers on a healthy caloric deficit and stable basal metabolism, and relies on balanced ratios among the three macronutrients to optimize metabolic function. By avoiding the pitfalls of extreme dieting and creating a caloric deficit rooted in healthy metabolism and balanced nutrition, individuals can achieve efficient, sustainable fat loss while preserving body composition and minimizing weight rebound, ultimately building a long-term healthy lifestyle.

The Hidden Realms of the Brain

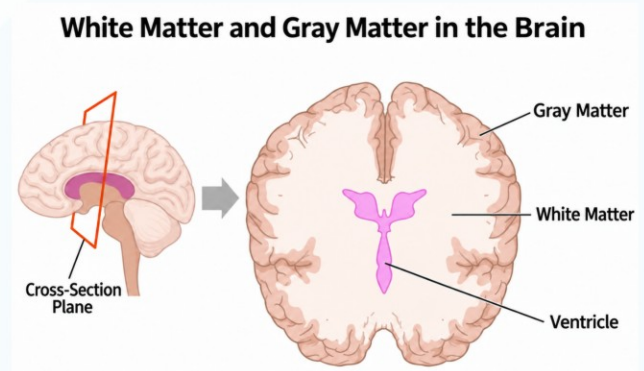
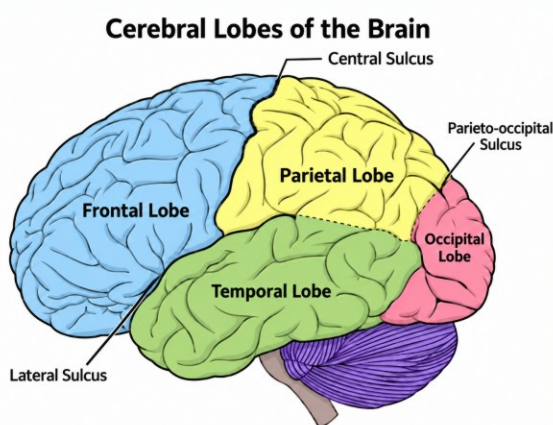
Unveiling the Wonders of the Brain: How Neurons Think and Communicate

In the vast universe within our bodies, nothing is more wondrous or complex than our nervous system. Whether you are glancing up at a brilliant sunset, playing a soothing piano melody, or recalling the events of your day in the quiet of night, none of this would be possible without the massive and intricate neural network inside the brain. Today, let us pull back the curtain on the nervous system and explore how individual cells utilize electrical and chemical signals to support our entire mental and physical world.

1. The Macroscopic Design of the Nervous System: Gray and White Matter

To understand how the brain works, we must first become familiar with structural organization of the nervous system. The human brain and spinal cord constitute **the Central Nervous System**, while the sensory and motor neurons that extend away from brain and spinal cord form **the Peripheral Nervous System**. The cerebral cortex is divided into distinct functional lobes: **the frontal lobe** handles reasoning, planning, impulse control, motor regulation and speech production; **the temporal lobe** governs hearing, memory and speech comprehension; **the parietal lobe** processes stimuli related to touch, pressure, temperature and pain; and **the occipital lobe** is dedicated to vision.

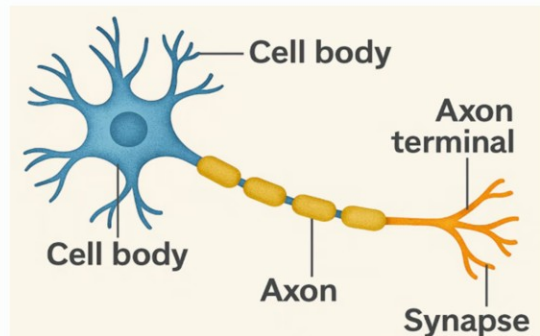
If you make a cross-section of the brain or spinal cord, you will notice a stark color contrast between gray matter and white matter. **Gray matter** consists primarily of cell bodies and dendrites, serving as the core computing centers, whereas **white matter** consists of major axon tracts wrapped in myelin. Because the primary component of myelin is fat and appears white, these lipid-rich sheaths act as high-speed communication cables connecting different brain regions.



The Hidden Realms of the Brain

2. Neurons: The Protagonists of Signaling and the Neuron Doctrine

The fundamental cell responsible for signaling in the brain is the neuron. According to the foundational “Neuron Doctrine”, **the Neuron** is the fundamental structural unit of the nervous system. Neurons feature an elegant functional architecture: **the dendrites** receive signals, **the cell body** integrates them, and **the axon** conducts the signal outward. Furthermore, there is dynamic polarization, meaning there is a predictable, one-way flow of signal (dendrites – cell body – axon). To enhance transmission efficiency, axons in many neurons are coated in a **myelin sheath** produced by glial cells. While an unmyelinated axon conducts signals at roughly 1 meter per second, a myelinated axon can reach speeds of up to 100 meters per second, allowing rapid and coordinated responses throughout the body.



3. The Cellular Battery: Resting Potential and Ionic Gradients

The capacity of neurons to generate electrical signals relies fundamentally on membrane impermeability to charged ions. When monitoring across a membrane, scientists observe both charge distribution and concentration distribution for individual ions. At rest, the electric potential caused by the inside being more negative is around -70 mV.

This resting potential is maintained by two critical mechanisms:

The Na⁺K ATPase: Transmembrane proteins that use energy (usually ATP) to push ions against their gradients, expelling 3 Na ions out while importing 2 K ions in.

“Leak” Channels: Always-open channels that allow passive ion movement, with potassium leak channels playing a dominant role.

When a stimulus reaches the threshold -55 mV, voltage-gated sodium and potassium channels open and close, causing the membrane potential to rise rapidly and trigger an action potential. Action potentials are “all or none”: a neuron's signal is binary, and it either fires an action potential or it doesn't. A strong electrical signal is communicated based on frequency, not the size of the action potential.

4. Bridging the Gap: Synaptic Communication

Once an action potential propagates all the way down the axon, it reaches the axon terminal and must cross a physical barrier known as a synapse. Because electrical currents cannot easily bridge this gap, neurons rely on chemical signaling at synapses.

When an action potential reaches the end of the axon, it opens voltage-gated calcium channels at the synapse. Entering Ca binds to synaptotagmin and triggers synaptic vesicle fusion with the presynaptic membrane. As a result, neurotransmitters are released from vesicles, binding to receptors on the postsynaptic cell to affect the target cell for a brief amount of time. Finally, neurotransmitters undergo rapid clearing and recycling from the synapse via glial transporters and degradation enzymes to ensure precise signal control.

The Hidden Realms of the Brain

Sculpting Our Brains: From Neural Development to the Secrets of Learning and Memory

How does our brain evolve from a simple embryonic cell into a complex universe containing roughly 8.5 billion neurons with exquisite connections? After birth, the brain does not present itself as a “finished product”. Instead, it undergoes a long and fascinating journey of development, refinement and lifelong learning-induced shaping. Today, let us step into the world of neurobiology to explore the developmental mechanisms of the brain and the biological codes underlying learning and memory.



1. The Initial Construction of the Nervous System and the First “Pruning”

During the embryonic stages of life, our nervous system produces a large number of neurons and supporting glial cells. However, having an initial “rough draft” does not equal perfection. Initial growth and development still require a good deal of modification at two levels: the number of neurons and the placement of synaptic connections.

Regarding neuron numbers, scientists have discovered through classic experiments (such as those involving developing limb buds) that many neurons undergo programmed cell death (apoptosis) during development. Only those neurons that successfully secure sufficient survival signals (such as neurotrophins like BDNF or NGF secreted by target cells) survive, while those failing to receive adequate support perish. This mechanism ensures a precise match between the number of neurons and their target organs.

2. Experience, Critical Periods, and Neuronal Co-firing

Beyond changes in cell numbers, the core of proper brain wiring lies in the precise placement of synaptic connections. Different brain regions mature at different rates. For example, the prefrontal cortex, which governs impulse control and planning, continues its synaptic pruning and development well into a person's twenties.

During early development, environmental inputs (such as visual experience) play a decisive role in refining neural circuits. Taking the development of “ocular dominance columns” in the visual cortex as an example, if visual input to one eye is restricted (such as by suturing it shut) during specific “critical (sensitive) periods” early in life, it results in dramatic alterations in axonal branching patterns in the visual cortex. This process exemplifies a classic neuroscience principle: neurons that fire together, wire together. When the timing of presynaptic action potentials matches the activity of postsynaptic cells, synapses get strengthened and expand; conversely, asynchronous or infrequently active synapses are weakened and pruned away, transforming broad and approximate initial wiring into remarkable precision.

The Hidden Realms of the Brain

3. The Biological Basis of Memory: Dynamic Synaptic Remodeling from the Hippocampus to Synapses

When we discuss learning and memory, what are we actually changing? Famous neurological case studies (such as the legendary patient Henry Molaison, who underwent bilateral hippocampal removal to control seizures) revealed the critical role of the hippocampus in consolidating new long-term explicit memories. Although H.M. lost the ability to form new long-term memories, his working memory and his capacity to improve in complex motor tasks (such as the star-tracing task) through repeated practice remained intact, demonstrating the structural division of labor for different memory types within the brain.

At the microscopic and molecular levels, mammals and simpler model systems (like the marine slug *Aplysia*) share strikingly similar mechanisms of synaptic plasticity. Long-lasting memories and learning are correlated with enduring changes in cell structure and synaptic strength, and strong excitatory synapses typically feature more receptors (such as glutamate receptors) and persistent engagement of neurotrophic factors like brain-derived neurotrophic factor (BDNF). Through synapse-specific changes, connections between neurons are consolidated, providing the physical foundation for acquiring new knowledge and long-term habits.

4. Public Health Implications: How Sleep and Aerobic Exercise Nourish the Brain

Understanding brain plasticity is not only of academic value but also carries profound practical guidance for our daily lives. Scientific research offers two powerful, evidence-based recommendations:

Sleep is good for learning and memory: Sleep is not a “shutdown” state for the brain, but rather the golden period for memory consolidation. During sleep, the brain reactivates and organizes daytime neural activity, promoting the reorganization and stabilization of synapses.

Aerobic exercise is good for learning and memory: A wealth of animal and human studies indicate that sustained aerobic exercise correlates positively with improved performance across a variety of cognitive tasks, enhanced academic performance in children, and increased hippocampal volume in older adults. One underlying biological reason is that exercise increases BDNF levels across a number of brain areas, supplying continuous momentum for neuronal health and synaptic plasticity.

Conclusion

The brain is the most complex precision instrument we possess in the universe, continually evolving under the joint shaping of environment, experience, sleep and exercise. Grasping these scientific principles not only inspires awe for the mysteries of life, but also provides a solid guide for living and learning scientifically.

Rethinking Life's Final Chapter: Choice, Dignity, and the Ethics of Assisted Dying

Introduction: A Renowned Thinker's Final Decision

When facing the terminal stage of life, does an individual hold the moral right to decide how their personal narrative concludes? In March 2024, Daniel Kahneman, Nobel laureate in Economics and Princeton psychologist, chose to end his life via assisted dying in Switzerland at age 90. Prior to his journey, Kahneman spent cherished days in Paris with his family, savoring art and cuisine.

In a farewell email to close friends, Kahneman articulated his decision with characteristic clarity: "This is a goodbye letter I am sending friends to tell them that I am on my way to Switzerland, where my life will end on March 27. ...

I discovered after making the decision that I am not afraid of not existing, and that I think of death as going to sleep and not waking up. The last period has truly not been hard, except for witnessing the pain I caused others. So if you were inclined to be sorry for me, don't be."

Kahneman's choice directly reflects his groundbreaking Peak-End Rule, which posits that human evaluations of an experience are heavily dictated by its peak emotional intensity and its final moment, rather than its cumulative duration. Facing severe kidney decline and memory impairment, Kahneman made a conscious trade-off between enduring prolonged physical deterioration and concluding his life with autonomy and dignity.



1. Longevity vs. Quality of Life: Ezekiel Emanuel's Perspective

Modern bioethics increasingly challenges the uncritical idealization of maximum life extension. In "Why I Hope to Die at 75", oncologist and bioethicist Ezekiel J. Emanuel argues: "Seventy-five. That's how long I want to live: 75 years." ... "But here is a simple truth that many of us seem to resist: living too long is also a loss. It renders many of us, if not disabled, then faltering and declining, a state that may not be worse than death but is nonetheless deprived."

Emanuel points out that advanced age frequently brings severe morbidity, cognitive impairment, and a marked decline in creative output. "It robs us of our creativity and ability to contribute to work, society, the world. It transforms how people experience us, relate to us, and, most important, remember us. We are no longer remembered as vibrant and engaged but as feeble, ineffectual, even pathetic."

From Emanuel's viewpoint, setting a boundary regarding medical interventions late in life prioritizes a complete, vibrant life over an elongated dying process.

Ethical Myths

2. Theoretical Debates: Autonomy & Mercy vs. Intrinsic Value

The ethical framework surrounding assisted dying divides bioethicists along fundamental normative lines:

A. Defense of Voluntary Active Euthanasia

Philosopher Michael Tooley defines euthanasia as: "... any action where a person is intentionally killed or allowed to die because it is believed that the individual would be better off dead than alive or else, as when one is in an irreversible coma, at least no worse off." Tooley asserts two core claims: "... given appropriate circumstances, neither voluntary active euthanasia nor assisting someone to commit suicide is in any way morally wrong. ... there should be no laws prohibiting such actions, in the relevant cases."

Tooley's framework balances patient autonomy (the competent individual's informed choice) and mercy (the alleviation of unbearable suffering).

B. Deontological Opposition

Conversely, bioethicist Patrick Lee argues in "Physician-Assisted Suicide Is Not Ethical" that assisted dying violates fundamental moral duties regarding human life: "Every human life, including the life of someone in extreme pain and suffering, is intrinsically worthwhile. Life is not merely instrumentally valuable, nor does one's life cease to have intrinsic value with pain and suffering. ... Loved ones and healthcare professionals should act to mitigate pain and suffering, not destroy persons as a means of removing pain and suffering."

3. Empirical Evidence vs. Theoretical Concerns

Opponents, such as philosopher Kathleen Stock, express concerns regarding potential societal pressures and the devaluation of vulnerable populations. However, in "It's My Party and I'll Die If I Want To", Rosalind Arden analyzes over two decades of data encompassing nearly 200,000 cases across twenty jurisdictions (including Oregon, Canada, Belgium, and the Netherlands). "The slippery slope has not materialised. Palliative care has not deteriorated. The vulnerable have not been systematically coerced.... The conditions driving requests for assisted dying remain, with remarkable consistency across jurisdictions and legal cultures, the conditions one would expect: serious, incurable illness, unbearable suffering, and the desire to retain dignity and control at the end of a life."

Empirical evidence shows that approximately 80% of applicants suffer from terminal conditions such as advanced cancer or Amyotrophic Lateral Sclerosis (ALS). Where robust safeguards exist, assisted dying functions not as an uncontrolled slope, but as a regulated, compassionate option at life's end.

Conclusion: Toward an Informed Consensus

Public discussion surrounding end-of-life options requires balancing rigorous philosophical arguments with empirical data. Recognizing both the intrinsic value of human dignity and the reality of unbearable suffering enables societies to establish compassionate frameworks that protect vulnerable individuals while honoring personal autonomy.

Ethical Myths

Quick Facts: Assisted Dying and Euthanasia



Assisted dying: A third-party (typically a physician) provides the means or medication to end life, while the patient independently performs the final lethal act. It is legal in jurisdictions including Switzerland, Austria, and some U.S. states.

Active euthanasia: At the voluntary request of a mentally competent patient, a third-party (typically a physician) directly administers lethal measures to end the patient's life. It is legal in jurisdictions such as the Netherlands, Belgium, Luxembourg, and Spain.

Passive euthanasia: Withholding or withdrawing life-sustaining treatments (e.g., ventilators and tube feeding), no lethal intervention is administered, and death results from the natural progression of disease. This is commonly known as "forgoing life-sustaining treatment".

Within the territory of the People's Republic of China, assisted suicide and active euthanasia are both criminal offences.

Reframe the Abortion Debate: Rigorous Philosophical Inquiry

The abortion debate remains one of the most intense and emotionally charged ethical controversies in contemporary society. Public discourse often descends into reductive slogans. In academic philosophy, however, the inquiry is addressed through structured analysis of bodily rights, personhood, the wrongness of killing, and moral responsibility. To popularize and understand the foundational arguments surrounding abortion, we must examine four central frameworks established by key contemporary philosophers.



1. Bodily Autonomy and the Limits of Rights: Judith Jarvis Thomson & Ben Bayer

A dominant presumption in anti-abortion arguments is that if the fetus is granted a full moral right to life from conception, abortion is automatically impermissible. In her seminal 1971 essay, “A Defense of Abortion”, Judith Jarvis Thomson challenges this inference directly. Thomson invites us to grant, for the sake of argument, that the fetus is a person from conception, yet demonstrates that abortion can remain morally permissible.

To illustrate her thesis, Thomson constructs the famous Violinist Thought Experiment: You wake up in a hospital connected to an unconscious, world-famous violinist suffering from a fatal kidney ailment. The Society of Music Lovers canvassed all medical records and discovered that you alone possess the compatible blood type. They kidnapped you and plugged his circulatory system into yours so that your kidneys can filter his blood. The hospital director informs you that disconnecting him will cause his death, but after nine months, he will recover.

Thomson argues that while remaining connected would be generous, you are under no moral obligation to do so. The core philosophical principle is formulated as follows: “Nobody has any right to use your kidneys unless you give him such a right, and nobody has the right against you that you shall give him this right ... the right to life does not guarantee having either the right to be given use of or the right to be allowed continued use of another person's body—even if one needs it for life itself.” Thus, having a right to life does not entail the right to forcibly use another person's body as life support.

Expanding on this rights framework, Objectivist philosopher Ben Bayer grounds reproductive freedom in Enlightenment political philosophy and individual rights. Bayer emphasizes that: “Rights belong only to entities capable of independent rational action paradigmatically, adult human beings.” Bayer argues that compelling a woman to undergo nine months of forced pregnancy deprives her of irreplaceable time, self-determination, and personal value, violating her sacred right to live her own life.

2. Personhood and the Genetic Fallacy: Mary Anne Warren

Philosopher Mary Anne Warren argues that Thomson's violinist analogy provides a definitive defense primarily in cases of rape, where pregnancy is forced. In ordinary unintended pregnancies, where women bear some behavioral involvement, Warren argues that we must directly answer the fundamental question: Is the fetus a person with a moral right to life?

In "On the Moral and Legal Status of Abortion" (1973), Warren exposes a logical equivocation in standard anti-abortion syllogisms: It is wrong to kill an innocent human being, and a fetus is an innocent human being, therefore it is wrong to kill a fetus. Warren points out that "human being" in Premise 1 means a moral person (a full member of the moral community possessing full rights), whereas "human being" in Premise 2 means merely a biological human entity (genetically human tissue).

To clarify what constitutes a moral person, Warren establishes Five Criteria of Personhood: Consciousness, Reasoning, Self-motivated activity, Capacity to communicate and Self-awareness. Warren demonstrates that fetuses satisfy none of these five criteria. Consequently, fetuses are not moral persons and lack a full moral right to life. The actual rights of an existing adult woman invariably override the potential status of a fetus.

3. The Future-Like-Ours Account: Don Marquis

In contrast to Warren's personhood criteria, Don Marquis presents a secular anti-abortion argument in "Why Abortion Is Immoral" (1989) that bypasses debates over fetal personhood or biological definition.

Marquis asks a foundational question: What primarily makes killing an adult human being wrong? Marquis rejects accounts centered on the killer's brutalization or the grief of survivors. Instead, he identifies the primary wrongness of killing in its effect on the victim: "What primarily makes killing wrong is neither its effect on the murderer nor its effect on the victim's friends and relatives, but its effect on the victim. The loss of one's life is one of the greatest losses one can suffer. The loss of one's life deprives one of all the experiences, activities, projects, and enjoyments which would otherwise have constituted one's future."

Marquis labels this the "Future-Like-Ours" (FLO) account. Because a standard fetus possesses a Future-Like-Ours—a valuable future containing experiences, activities, and enjoyments—abortion deprives the fetus of that valuable future. Therefore, Marquis concludes: "Since a fetus possesses a property, the possession of which in adult human beings is sufficient to make killing an adult human being wrong, abortion is wrong and falls in the same moral category as killing an innocent adult human being."

4. Moral Responsibility and Special Obligations: C'Zar Bernstein & Paul Manata

Rebutting Thomson's bodily autonomy defense, philosophers C'Zar Bernstein and Paul Manata formulate the Responsibility Objection (RO) in "Moral Responsibility and the Wrongness of Abortion" (2019). Bernstein and Manata argue that Thomson's violinist analogy fails in typical non-rape pregnancies because of the crucial factor of voluntariness. In the violinist scenario, the victim is kidnapped without consent. In non-rape pregnancies, however, the pregnant woman voluntarily engages in conduct knowing the foreseeable risk of creating a dependent biological entity. They argue that voluntary behavior that results in a dependent state generates a special obligation to assist. Their complete thesis states: "If a mother is morally responsible to a sufficient degree, she acquires an obligation to assist. If she is not, the force of her right to bodily integrity may be reduced." Thus, moral responsibility alters the balance of rights, creating an obligation not to abort even if bodily autonomy is invoked.

Conclusion

The philosophical exploration of abortion transcends emotional ideology by grounding the debate in rigorous concepts: Bodily Autonomy & Rights (Thomson, Bayer), Personhood & Moral Status (Warren), the Deprivation of Future Value (Marquis), Voluntariness & Moral Responsibility (Bernstein & Manata). By examining these distinct theoretical frameworks, we gain a nuanced, rational comprehension of the moral complexities surrounding human life, autonomy, and ethical duty.

Instructions for Authors

About Quadrants of Life

Quadrants of Life welcomes original articles exploring four dimensions of life—sports injuries rehabilitation, nutrition and metabolism, neuroscience, and bioethics.

My magazine aims to make scientific knowledge accessible to high-school students and general readers, connects scientific ideas to everyday experiences, and encourages thoughtful discussion about health and human life.

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Quadrants of Life welcomes submissions including science explainers, research overviews, and reflective essays related to the four sections:

- **Sports Injuries and Rehabilitation:** Exploring how the body moves, why common sports injuries occur, and the science behind prevention and recovery.
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- **Ethical Myths:** Examining questions about life, dignity, autonomy, and care through philosophical perspectives and reasoned discussion.

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