



# Balancing potential energy and entropy: the foundations of lifestylopathy and homeostasis

Jawad Alzeer

College of Medicine and Health Sciences, Palestine Polytechnic University, Hebron, Palestine

Correspondence to: Jawad Alzeer, PhD. College of Medicine and Health Sciences, Palestine Polytechnic University, P.O. BOX 198, Wadi Al-haria, Hebron, Palestine. Email: zeer@ppu.edu.

**Abstract:** The manuscript explores the complex interplay of homeostasis and emphasizes the influential relationship between potential energy and entropy in the areas of prevention and treatment. It offers insights into the profound effects of entropy on physiological systems and unravels the intricate mechanisms that maintain homeostatic balance. The investigation extends to innovative strategies for harnessing these forces for optimal health and resilience. The manuscript emphasizes the vital role of maintaining the delicate balance between potential energy and entropy and highlights its fundamental importance in shaping health and resilience. It addresses the intricate relationship between genetic changes, the build-up of disorder and the entropic environment and emphasizes the need to reduce entropy and enrich potential energy for disease management in line with the principles of lifestylopathy. The delicate balance between potential energy and entropy, coupled with excitatory and inhibitory neurotransmitters, plays a crucial role in mental stability and overall homeostasis. Disturbances in this balance can lead to imbalances, emphasizing the importance of maintaining balance for optimal well-being. Maintaining a delicate balance between excitatory and inhibitory neurotransmitters is essential for overall well-being. Focusing on the delicate balance between anabolism and catabolism in the body's metabolic processes is important for physical stability and homeostasis. Anabolism builds vital molecules and cells that are rich in potential and information. In contrast, catabolism breaks down molecules from ingested food and releases energy in the process. Catabolic conversion leads to a decrease in potential energy, increased entropy and further disorganization, which contributes to aging and susceptibility to disease. Balancing anabolism and catabolism is essential for optimizing energy utilization. Homeostasis is sustained through the continual interplay of potential energy and entropy, wherein living organisms employ intricate mechanisms to restore energy and minimize entropy. This dynamic equilibrium is more than a physical phenomenon; it represents the essence of life, controlling biological processes and enabling adaptation to the environment. Those who understand these concepts can make informed decisions to promote overall well-being and resilience.

**Keywords:** Homeostasis; potential energy; entropy; neurotransmitters; metabolism

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## Introduction

In the dynamic field of healthcare, a captivating interplay of biological principles evolves to guide human behavior and influence both prevention and cure. At its core, this complex interplay revolves around the delicate balance of neurotransmitters, the functionality of proteins, and the

regulatory balance of metabolic processes (1). At the core of all biological processes is the fundamental need for energy to maintain the vital functions that are the essence of life (2). This vital existence is made possible by the seamless exchange of vital information within biological systems, which is a key element in maintaining equilibrium. Genetic and epigenetic codes represent invaluable repositories in

which the intricate instructions of life are meticulously stored (3). Any disruption of these codes can have profound consequences, affecting the scaffolding of biological processes and the integrity of biostructures.

Proteins, the driving force behind nearly all biological processes, are essential for maintaining vital functions (4). Their proper function hinges on the preservation of structural information. However, the accumulation of heat can perturb this delicate structure, resulting in denaturation and a loss of function (5). Depending on their specific roles, proteins can impact processes like energy production and distribution within the body. In certain health conditions, such as neurodegenerative disorders, a significant deviation from the norm occurs. These diseases are characterized by the buildup of misfolded and dysfunctional proteins. This abnormal protein folding and aggregation play a central role in the development of these conditions, contributing to impaired cellular function and, in severe cases, cell damage (6-8).

At the heart of discussions within the realm of public health lies the fundamental concept of homeostasis (9). It functions as nature's inherent regulator, responsible for upholding internal stability and balance within living organisms. Nevertheless, this fragile equilibrium remains under continuous scrutiny and testing, primarily due to the persistent influence of different energy forms (10). Entropy serves as a form of energy, persistently pushing systems towards disorder and, consequently generating heat. The concept of entropy is closely tied to the intricate and sometimes spontaneous interactions among molecules, metabolic processes, and the transmission of genetic information within biological systems (11). In contrast, potential energy, another form of energy, symbolizes the accumulation of order through non-spontaneous processes. The ongoing interplay between these contrasting forces exerts influence over a range of physiological systems, encompassing the nervous system, cellular metabolism, and immune function. Disruptions in this finely calibrated equilibrium have consequences on homeostasis, giving rise to a spectrum of health disorders that public health endeavors diligently strive to comprehend, manage, and alleviate (12).

This manuscript delves deep into the intricate interplay of homeostasis, exploring how the harmonious coexistence of potential energy and entropy can wield substantial influence within the realms of prevention and treatment. It sheds light on entropy's profound effects on diverse physiological systems and offers profound insights into the

complex mechanisms that meticulously uphold the delicate equilibrium of homeostasis. Moreover, we extend our inquiry to innovative strategies that harness the dynamic synergy of these forces to promote optimal health and well-being in the face of tremendous challenges. In essence, this manuscript offers a broad insight into the biological forces that not only influence but also strengthen our health and resilience in the ever-evolving process of organizing life.

### **Potential energy, entropy, and their role in health**

In order to fully appreciate the importance of different energy forms in the context of our health, which pertains to both prevention and treatment, it becomes crucial to delve deeper into understanding the origins and behavior of these energy manifestations. Energy, in general, represents the capacity of an object to perform work, cause a change in a process, exert a function, or provide heat. Potential energy refers to the stored energy possessed by an object or system due to its position or constitution. In biological systems, potential energy plays a crucial role in various processes such as metabolism, muscle contraction, and cellular signalling, as it is stored in the constitution, configuration, and conformation of molecules and can be used to perform work when energy is released (13). Entropy, representing the tendency towards disorder and increased randomness, presents a significant challenge to the regulatory mechanisms governing biological systems. Changes in potential energy can have a direct impact on the entropy of a system. When the potential energy decreases, the entropy of the system increases, and vice versa (14).

Molecules that possess a substantial reservoir of potential energy are characterized by their remarkable functional capabilities and their ability to store valuable information. This increased functionality is a direct result of the complicated properties embedded in their constitution, configuration, and conformation. Conversely molecules with an increased entropy profile experience a significant decrease in their functional capabilities and information content. This decrease leads to a structural flexibility that manifests itself in increased vibrational, rotational, and translational motions. It is as if these molecules are transformed from complicated and specialized system to adaptable entities with greater freedom of movement but less capacity to perform complicated functions. The human body must maintain a delicate equilibrium between the two energy forces: potential energy and entropy. Potential energy plays a critical role in providing the energy needed

for anabolic processes and supporting various biochemical reactions, enabling the body to function optimally. On the other hand, entropy generates heat, which is essential for driving biological processes and maintaining biochemical reactions at 37 °C. This balance between potential energy and entropy is of utmost importance, as it governs the intricate and dynamic molecular interactions and processes that underlie life within biological systems. It is a fundamental factor that significantly influences the operation of our biological machinery, making it a crucial consideration for overall well-being and health (15).

Ensuring a careful equilibrium between potential energy and entropy is vital for sustaining optimal health. Potential energy, the stored energy within molecules, fuels various biological processes, while entropy, the tendency towards disorder, drives heat generation. By promoting activities that enhance potential energy production and regulating processes that contribute to entropy, we can support the body's natural mechanisms for maintaining a healthy equilibrium between these two energy forces.

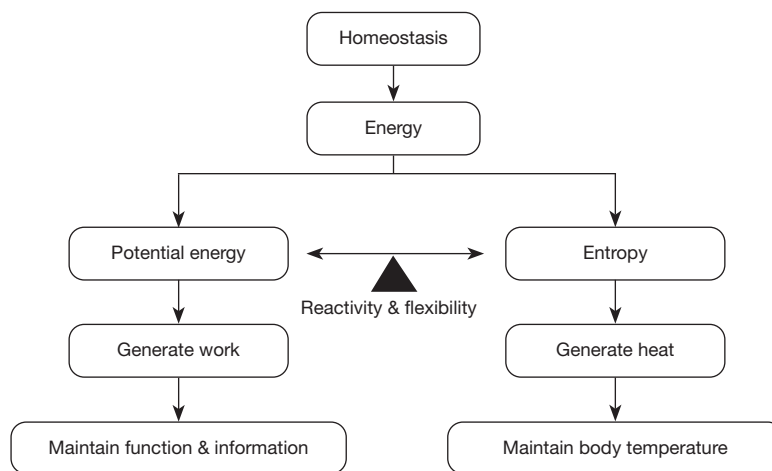
### **Homeostasis and the roles of potential energy and entropy**

Homeostasis is a crucial biological concept that refers to the ability of living organisms to maintain a stable and balanced internal environment despite external fluctuations or changes. Homeostasis plays a crucial role in boosting the immune system, enabling prevention, and actively participating in the fight against diseases. Within the context of homeostasis, potential energy and entropy assume pivotal roles in regulating the dynamic equilibrium, thereby ensuring optimal biological function and information flow (16). Living organisms obtain potential energy from different sources, each contributing to specific physiological functions. One significant source of potential energy is chemical potential energy, which is derived from the breakdown of nutrients during metabolic processes (17). Another form of potential energy is elastic potential energy, which arises from the mechanical properties of tissues and structures within the body. During activities like exercise or movement, muscles and tissues stretch or compress, storing elastic potential energy (18). This stored energy facilitates movement and provides the necessary force for physical activities. Additionally, living organisms utilize action potential energy, particularly in the nervous system (19). Neurons generate electrical signals known as action potentials, involving changes in the electrical potential

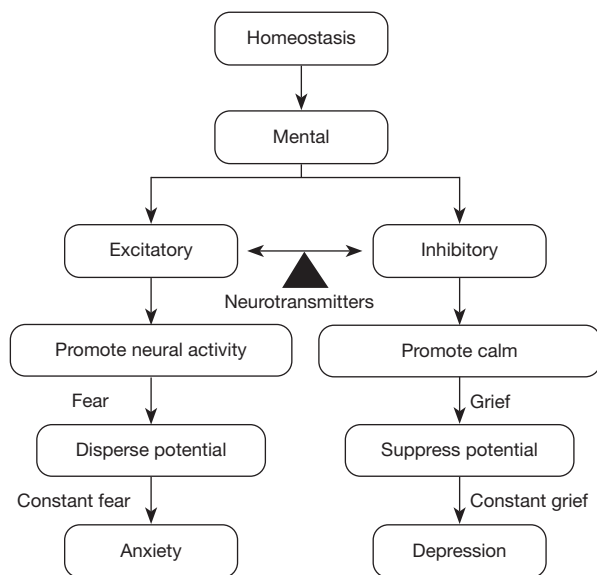
across the cell membrane. These impulses transmit information throughout the nervous system, enabling communication between different parts of the body and facilitating physiological processes like muscle contraction and sensory perception.

Entropy, on the other hand, is primarily generated as a by-product of catabolic reactions during metabolism (20). These catabolic reactions break down complex molecules into simpler ones, releasing energy in form of adenosine triphosphate (ATP) and producing heat in form of entropy. As catabolic process is spontaneous therefore entropy tends to increase over time, leading to a gradual loss of organization and potential energy within the system. As biological processes proceed, there is a natural tendency for systems to become more disordered and randomized over time, as described in the Second Law of Thermodynamics. This increase in entropy can potentially disrupt the delicate balance maintained by homeostatic mechanisms. However, living organisms have evolved intricate mechanisms to counteract the effects of entropy and maintain balance. These mechanisms work together to maintain a relatively stable and consistent internal environment, despite the constant fluctuations and changes in the external environment (*Figure 1*). Homeostasis can be seen as a dynamic equilibrium between the opposing forces of entropy and potential energy. As time progresses, entropy naturally increases; however, homeostatic mechanisms employ potential energy to constantly counteract this entropy increase and maintain the stability of the system.

The preservation of homeostasis, a state of equilibrium within living organisms, hinges on a constant interplay between potential energy, the stored energy within molecules, and entropy, the tendency towards disorder. As time progresses, entropy naturally increases, threatening to disrupt the delicate balance. However, living organisms possess intricate mechanisms to replenish potential energy and minimize entropy production, ensuring the stability of their internal environment and promoting optimal health and resistance to disease. This dynamic balance between opposing forces is not merely a physical phenomenon; it represents the essence of life, the intricate interplay of molecular interactions that drive biological processes and enable adaptation to a changing environment. By understanding these fundamental concepts, we gain a deeper appreciation for the intricate mechanisms that govern life within biological systems, empowering us to make informed choices that promote overall well-being and resilience.



**Figure 1** Energetic equilibrium and functional stability in biological systems.



**Figure 2** Neurochemical balance and psychological well-being: navigating homeostasis.

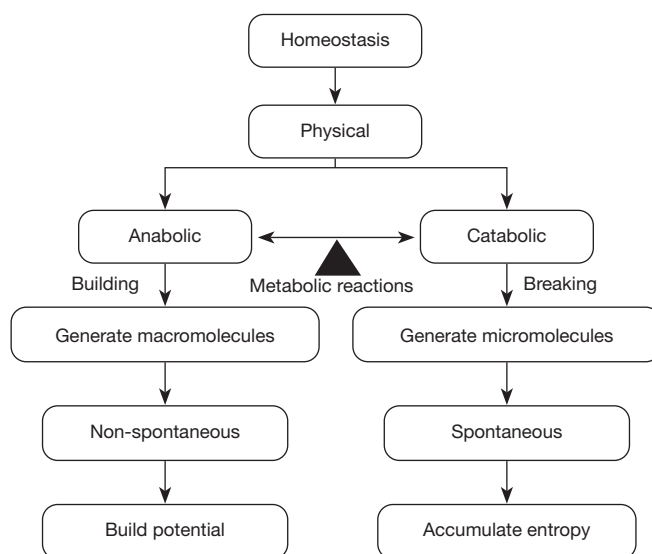
**Homeostasis in mental stability**

Understanding the critical role of potential energy and entropy is essential in the context of homeostasis. These factors intricately balance one another, paving the way for advanced biological functions and ensuring the smooth flow of information within the system. In the context of mental stability, the brain relies on a balance between excitatory and inhibitory neurotransmitters. These neurotransmitters convey information between nerve cells and play a vital role

in shaping the brain’s activity. Excitatory neurotransmitters promote neural activity and, when dominant, can lead to heightened arousal and anxiety. In contrast, inhibitory neurotransmitters help regulate and calm the brain, potentially resulting in a more subdued state and even depression when dominant (21-23).

The concept of potential energy and its excitation and inhibition also play a role in the interplay between neurotransmitters and mental stability. When the body is constantly exposed to excitatory neurotransmitters, potential energy can be activated, leading to an acceleration of biochemical reactions (24,25). Continuous activation may result in the dispersion of potential energy and an increase in heat release, consequently enhancing entropy. As a consequence, even though there is an excess of energy, it is in an uncoordinated and disordered form, resulting in prevalent anxiety and symptoms such as hyperactivity, sleep disturbances, inability to concentrate, worry, high tension, and fear (Figure 2). Continuous excitation over the threshold can accelerate biological processes such as heart rate, respiratory rate, and blood pressure, increasing the risk of heart attack and other cardiovascular diseases (26,27).

On the other hand, prolonged exposure to inhibitory neurotransmitters can reduce the rate of biological reactions and may lead to the suppression of potential energy. In this state, potential energy is suppressed, causing depression to prevail and allowing symptoms such as despair, regret, and grief to dominate. The suppression of energy leads to repression and degradation, ultimately increasing entropy. Continuous inhibition below the threshold slows electrical activity in the brain, causing cells and biological processes to



**Figure 3** Physical balance and dynamic metabolism: building up potential, balancing entropy.

become less productive and less effective, thereby increasing the risk of heart attack and the subsequent development of coronary artery disease (28).

The delicate equilibrium between potential energy and entropy, coupled with the interplay of excitatory and inhibitory neurotransmitters, stands as a critical factor in buffering the system and upholding both mental stability and overall homeostasis. Disruptions in this balance can lead to a range of emotional and physiological imbalances, emphasizing the importance of preserving the dynamic equilibrium between these dual forces for optimal well-being. The concept of potential energy and its excitation and inhibition plays a role in the interplay between neurotransmitters and mental stability (29). Continuous excitation or inhibition of potential energy can have significant effects on the brain's activity and overall mental state.

A delicate balance between excitatory and inhibitory neurotransmitters in the brain that is crucial for shaping neuronal activity. Disruptions to this balance can lead to emotional and physiological imbalances, highlighting the importance of maintaining balance for optimal well-being. Continuous exposure to excitatory neurotransmitters can lead to anxiety, while prolonged exposure to inhibitory neurotransmitters can lead to depression. Maintaining this delicate balance is essential for maintaining mental stability and overall homeostasis.

### Homeostasis in physical stability

In the context of homeostasis, the body's intricate metabolic processes involve a delicate balance between anabolism and catabolism, with each playing a crucial role in maintaining physiological functions and overall balance (9). Anabolism is responsible for building new molecules and cells, supporting growth, repair, and essential physiological functions. These newly formed macromolecules have defined constitution, configuration, and conformation, making them rich in potential, information and capable of functioning as integral parts of the biological system. On the other hand, catabolism breaks down complex molecules from ingested food into their building blocks, releasing a significant amount of energy in the form of potential energy (ATP) and entropy (heat). ATP is crucial for providing the necessary resources for various physiological functions, whereas heat is essential to maintain body temperature. Catabolic reactions occur spontaneously and are driven by the increase in entropy as macromolecules break down into less ordered and more flexible micromolecules (*Figure 3*). During the catabolic process, molecules undergo a transformative phase where their structure, arrangement, and distinct conformations gradually dissipate. This transformation results in a decrease in potential energy, leading to an eventual rise in entropy. As this change continues, a sense

of disorder becomes more pronounced, and along with it, information gradually fades away. This progression leads the system toward a state of heightened entropy, where the delicate balance between order and disorder becomes increasingly evident, ultimately contributing to aging with increased susceptibility to diseases (30,31).

Maintaining a balance between anabolism and catabolism is vital to efficiently utilize energy resources for growth, repair, and maintenance of bodily functions. If anabolism dominates, excessive accumulation of new molecules and cells can lead to issues like weight gain and the formation of unnecessary cells, such as cancer cells. Conversely, if catabolism prevails, excessive breakdown of complex molecules and cells can result in weight loss, weakness, and compromised health outcomes (32-35). The body's biochemical reactions play a significant role in maintaining this delicate balance. Anabolic reactions require ATP, obtained from catabolic reactions, as an energy source to proceed. These reactions are not spontaneous and depend on the availability of potential energy. Micromolecules involved in anabolic reactions are naturally higher in entropy and less in potential, compared to macromolecules, and characterized by simpler structures and greater mobility. However, in cases they are not used to build macromolecules via anabolic pathways, they are eliminated from the body. Anabolic processes counteract entropy by building macromolecules with defined structures and potential to maintain their activity, especially in older individuals (36). Since this process is non-spontaneous, it requires careful effort and regulation to initiate and control, allowing the body to adapt to various physiological demands and environmental changes while maintaining overall stability and optimal functioning. Through comprehension and the preservation of the delicate equilibrium between anabolism and catabolism, which in turn represents a balance between potential energy and entropy, the body can attain optimal functioning and adaptability, effectively responding to diverse physiological demands and environmental fluctuations (2).

In homeostasis, the body's metabolic processes maintain a balance between anabolism and catabolism, which is crucial for physiological functions. Anabolism builds vital molecules with rich potential and information, while catabolism breaks down complex molecules, releasing energy and increasing entropy. An imbalance that favors anabolism can lead to problems such as weight gain and unnecessary cell formation, while a dominance of catabolism leads to weight loss and adverse health effects. A delicate balance between anabolism and catabolism is essential for the body's growth,

repair and overall function.

### Lifestylopathy

Duality, a fundamental concept in science, mirrors the interplay of opposing yet complementary elements within a system. In the realm of medicine, the ancient principles of yin and yang in traditional Chinese medicine serve as a striking example of this concept (37,38). These principles acknowledge the existence of opposing forces or energies that harmonize and uphold equilibrium within the body. Lifestylopathy places a strong emphasis on effectively managing entropy and harnessing potential energy to redefine disease prevention and treatment. Within the framework of lifestylopathy, we can draw a parallel between the principles of yin and yang and the fundamental concepts of entropy and potential energy. Potential energy, in this context, can be viewed as the "yang" force, catalyzing the activation of the immune system and promoting growth. Conversely, entropy represents the "yin" force, characterized as the state of disorder, and plays a pivotal role in maintaining health by eliminating this disorder (27). In the delicate balance of potential energy and entropy, akin to the harmony of yin and yang, lifestylopathy finds its innovative approach to comprehending and addressing diseases, ultimately revolutionizing the way we approach healthcare. Central to lifestylopathy is the concept of homeostasis, which involves the regulation and coordination of various factors within the body (39). Homeostasis governs critical aspects such as chemical concentrations, biochemical reaction rates, body temperature, and pressure. The brain serves as the central regulator, requiring a diverse and balanced energy supply while maintaining balance between anabolic and catabolic processes.

Lifestylopathy acknowledges the pivotal role of the immune system in disease prevention and recovery. A delicate balance between anabolic and catabolic activities is paramount, with anabolic processes prevailing during growth and catabolic processes becoming predominant in later stages of life. Activation of the immune system in the fight mode optimizes biochemical reactions, reduces stress, and enhances communication between the brain and body (25). Conversely, modes like fright and flight heighten stress levels, disperse or suppress potential energy, and accumulate entropy, resulting in less efficient immune responses.

Understanding entropy and potential energy is of utmost significance, as these principles are fundamental to grasping the physical properties and natural processes of all objects.

Entropy symbolizes spontaneous energy with adverse effects, leading to heat accumulation, while potential energy embodies the highest form of positive energy, manifesting as work. These two concepts are intertwined, shaping overall health and well-being. Factors such as knowledge, moral and spiritual values, and a supportive environment enriches potential energy, fostering resilience and well-being. Conversely, a preoccupation with materialism and exposure to distracting information can contribute to entropy, leading to a state of disorder and diminished overall health and vitality.

Lifestylopathy, a novel approach to healthcare, emphasizes the delicate interplay of potential energy and entropy, analogous to the harmony of yin and yang. By optimizing this balance, lifestylopathy promotes optimal health and resilience by activating the immune system and maintaining a balanced anabolic/catabolic state. In essence, lifestylopathy represents a shift from treating symptoms to cultivating the inherent balance within the body.

## Discussion

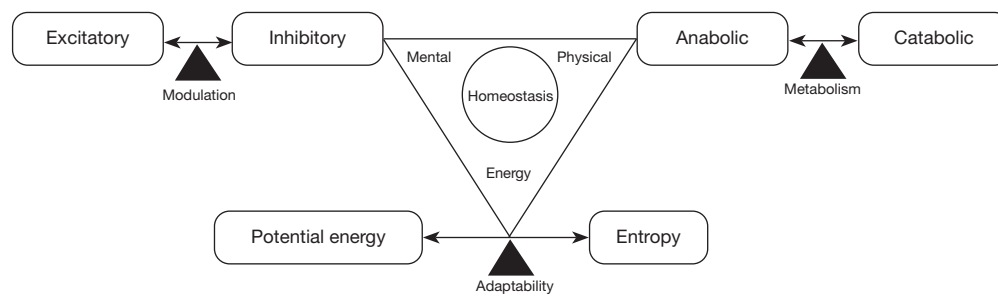
The human body has an inherent capacity to process genetic information, which materializes in the form of intricate functional proteins. Additionally, external factors, ranging from supportive to distractive or neutral information, play a role in shaping the body's epigenetic profile over time (3). Preserving the integrity of the body's wild-type genetics is crucial in ensuring physical health, as it contributes to the body's structural stability. In contrast, the accumulation of mutations can lead to structural alterations that disrupt normal functioning, ultimately resulting in various disorders and diseases. The complex relationship between genetic modifications and illness is intricately tied to the gradual buildup of disorder within the body. This process results in the creation of an entropic environment, which, as described by lifestylopathy and many other, can be seen as a state of disease. To effectively address and manage diseases, whether through prevention or cure, the primary goal is to reduce this entropic phase and simultaneously enrich the body's potential energy. This alignment with lifestylopathy principles emphasizes the significance of restoring balance and homeostasis within the body to promote overall health and well-being (40-42).

The impact of external input on the body extends far beyond genetics, encompassing a profound influence on the delicate balance of neurotransmitters within the body's systems (29). In particular, distracting information wields

the power to disrupt the equilibrium between excitatory and inhibitory neurotransmitters, potentially giving rise to conditions such as anxiety or depression. The fluctuations in the balance of neurotransmitters directly influence the distribution of potential energy within the system, leading to either its widespread dispersion or suppression. Consequently, this leads to the accumulation of entropy and disorder within the body. Conversely, supportive information plays a crucial role in fostering a harmonious balance of neurotransmitters, which is of significant importance for upholding the principles of homeostasis in accordance with lifestylopathy. In this context, maintaining an environment enriched with supportive information is crucial for the overall well-being and health of an individual.

Within the domain of macromolecules, their significance lies in serving as reservoirs of both functionality and information. However, as these macromolecules undergo catabolic processes, a natural degradation occurs, giving rise to various micromolecules. This degradation process amplifies collisions among these micromolecules, leading to the release of heat. This heightened heat possesses the potential to exert an influence on the structure and operational efficiency of proteins, consequently impacting their function and the informational content they carry. Anabolic processes, in contrast, assume a fundamental role in the preservation of the body's functional capacity while replenishing its potential. These processes revolve around the recycling of building blocks derived from breakdown, such as amino acids and nucleosides. Indeed, the fundamental purpose of anabolic processes is to construct operational proteins and DNA that carry a wealth of information. This intricate balance between catabolic (the breakdown) and anabolic (the build-up) processes is essential for aligning harmoniously with the principles of homeostasis (*Figure 4*).

Absolutely, the spontaneous nature of catabolic processes and the subsequent accumulation of entropy make them inevitable in natural systems. However, their rate and impact can be influenced by establishing favorable conditions that support and maintain the continuous momentum of anabolic processes. Anabolic processes, being non-spontaneous, necessitate deliberate human intervention to facilitate and ensure their effectiveness. Indeed, maintaining balance and homeostasis within the lifestylopathic framework is contingent on the creation of an environment characterized by several key elements: positivity, anabolic thinking, a health-conscious lifestyle, and a supportive ecosystem (43). This dynamic equilibrium



**Figure 4** Embracing homeostasis: achieving harmony between potential energy, entropy, and optimal well-being.

not only serves as the cornerstone for holistic well-being but also exerts a profound influence on numerous aspects of human physiology. These principles align perfectly with the core tenets of lifestylopathy, emphasizing the interconnectedness of physical, mental, and spiritual well-being to promote a state of optimal health and harmony (39).

## Conclusions

Lifestylopathy embodies the concept of duality, akin to the principles of yin and yang in traditional Chinese medicine, focusing on the harmonious interplay of opposing elements within the body. Within this innovative healthcare approach, entropy and potential energy are key principles in understanding and addressing diseases. Potential energy serves as a catalyst for activating the immune system and promoting growth. Conversely, entropy is crucial for maintaining health by reducing disorder. Central to lifestylopathy is the concept of homeostasis, which balances various factors in the body. The immune system plays a pivotal role in disease prevention and recovery, with an emphasis on achieving a balance between anabolic and catabolic activities. Entropy and potential energy significantly impact overall health. Factors like knowledge, values, and a supportive environment enrich potential energy and promote resilience. Maintaining an environment rich in supportive information is crucial for overall well-being. The balance of neurotransmitters also plays a vital role in homeostasis. The interaction of catabolic and anabolic processes in the body is crucial. While catabolic processes are inevitable, fostering favorable conditions for anabolic processes is essential for holistic well-being. In this framework, promoting positivity, anabolic thinking, a health-conscious lifestyle, and a supportive ecosystem is crucial. These elements underpin the interconnectedness of physical, mental, and spiritual well-being, promoting optimal health and harmony.

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