

Application to Master of Science in Biomedical Data Science programme 2023

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Test question 1: exactly 700 word count including in-text citation

The human body is a complex biological system that has evolved over time to assist humans in overcoming harsh environmental changes or resisting genetic mutation; this ability to defend against unforeseen changes in the environment that may be harmful to humans is known as biological robustness [1]. In other words, the human biological system's robustness is the most important factor in the survival of any living organism. Physiological homeostasis, such as maintaining circadian rhythm, body temperature in hot or cold environments, a healthy ionic composition in blood, and tissue integrity even under rapid cellular turnover, are all examples of biological robustness [2], [3]. Other examples of biological robustness that can be seen in animals' behaviors, includes bird migration patterns as a result of climate change [4], or the ability to seek shelter, food, and reproduce, which are all essential survival skills that ensure the species' survival [5], [6]. We can see from these examples that biological robustness is not only important for survival, but also for species evolution, because biological robustness allows them to successfully adapt to changing environmental conditions, and these traits that allow the species to survive in the new environment can be passed down to the next generation [1], [7].

Biological fragility, on the other hand, is the inverse of biological robustness, and it is the failure to overcome the challenges of harsh environmental changes due to an inability to adapt successfully [8]. Cancer is an example of biological fragility, in which the rate of cell growth has exceeded the rate of cell death [8], [9]. As a result, uncontrollable cell growth which are now cancerous, proceed to develop malignant tumors and destroy healthy cells [9], [10]. Biological fragility is also the cause of the extinction of Baiji dolphin, which lives in the freshwater in China's Yangtze River. They were forced into extinction due to overfishing and a poor habitation environment caused by pollution from fishing nets and hooks [11]. As Baiji dolphins were unable to migrate like birds or defend themselves against overfishing by local fishers, they were unable to maintain biological robustness and succumbed to fragility. Therefore, these examples shows that biological fragility has the consequences of organ system dysfunction, death, or extinction of species [1], [12].

Fortunately, biological fragility can be avoided if we comprehend the components of a robust system and recognize its weaknesses so we can plan countermeasures against it [1]. A very clear illustration of how humans have managed to avoid biological fragility is vaccination. The earliest vaccines developed was for smallpox vaccines in the 18th century and were thought to be a form of bioterrorism that killed over 400,000 people annually [13]. Edward Jenner, the father of vaccination, became interested in cowpox after a dairymaid said she would never get smallpox because she had cowpox. He successfully eradicated smallpox after conducting extensive research and developed the first vaccines against smallpox based on the protective effect of cowpox [13]. Similarly, Pfizer and Moderna created messenger RNA (mRNA) vaccines with the same goal in mind: to strengthen the human immune system to fend against the recent Covid-19 pandemic [14]. Aside from vaccinations, biological fragility can also be avoided with timely checkups to check for the possibility of cancer or

other health defects, maintaining a healthy lifestyle, avoiding junk food consumption, and refrain from smoking cigars.

In conclusion, biological robustness and fragility can be viewed as trade-offs; the ability to withstand or adapt to fluctuating external stressors results in biological robustness, while failure to do so results in biological fragility [1]. Humans has been referred to as the 'super predator' due to their ability to alter their eating pattern to devour a large diversity of food to the point that it has led to tropic cascades, which are the indirect interactions to control the ecosystem [15]. Humans are also extremely intelligent; since ancient times, we have developed medical technologies and medicine that have significantly increased human lifespan by decades [16]. Even Tardigrades, the most robust organism on earth that can survive extreme environmental conditions, only have a lifespan of a few months [17]. This demonstrates that humans can effectively combat biological fragility in order to increase their biological robustness, resulting in greater survivability.

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