Question 1

Pengshan Li

Robustness is often used to describe a system's ability to resist external interference. For example, in computers, robustness refers to the ability of a computer system to remain stable in the face of internal and external disturbances such as disk failure or network overload. Then, in terms of biology, biological robustness is the ability of biological system to maintain its normal development and functional stability despite external interference or internal influence. In my opinion, the best manifestation of biological robustness is the impact of environmental changes on biological systems. We live in a changing environment, with many factors such as temperature, climate and food changing all the time. The ability to adapt to different environmental conditions and maintain the stability of biological systems is the embodiment of biological robustness. Biological robustness can be reflected not only by environmental changes, but also by mutations and recombination of genes in organisms. The biggest difference between biological robustness and homeostasis is that homeostasis responds to transient stimuli, while biological robustness is the ability to respond to internal and external changes over a long period of time. Biological fragility, in contrast to biological robustness, is a biological system that does not have enough capacity to maintain stability in the face of disturbance, resulting in degradation or disease.

Biological robustness is considered to be an essential feature of evolutionary systems. Biological systems must be robust to environmental and genetic changes in order to evolve. Escherichia coli has been observed to chemotaxis across a wide range of chemoattractant concentrations because of the complete intracellular feedback that allows it to adapt to different environments. Conversely, some organisms are unable to adapt effectively to changes in their environment due to their biological fragility, making it difficult for them to survive. The Australian government declared Bramble Cay Melomys extinct in February 2019, making it the first species globally to go extinct due to climate change.

Biological robustness is an indispensable part of biological system. Multiple mechanisms in organisms work together to ensure robustness, enhanced to perturbations through system control, Modularity, substitution mechanisms, and decoupling(Kitano, 2004). However, some unexpected perturbations are very

damaging to the robustness. Once the robustness is damaged, the fragility of the biological system will be shown, which will have a bad effect on the organism. For example, we are thought to be robust to hunger and high energy requirements, when it was disturbed by low energy requirements and excess nutrition, can lead to the development of diabetes(Kitano *et al.*, 2004). Therefore, we should understand the formation mechanism of biological robustness and the principle of action. Avoiding perturbations that may damage the robustness of organisms is of great significance for the survival and development of organisms, disease treatment and environmental adaptation.

Reference

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