Biological robustness is one of the overall properties of biological systems, which refers to a property of a biological system that maintains its structural and functional stability when disturbed by uncertainties such as external perturbations or internal parameter uptake [1] Biology interprets robustness as the ability of a biological system to resist resistance caused by external perturbations or internal parameter uptake of the system. Robustness mechanisms are central to the maintenance of normal functioning of an organism and are involved in processes such as regulation of survival, development and evolution of the organism. Disease is a disruption of the robustness of a biological system, and if the mechanisms that maintain robustness are not repaired, disease will persist.

Robustness is a fundamental property that allows biological systems to evolve, and this evolution in turn allows biological robustness to be enhanced. This leads to the possibility that biological robustness can be continuously enhanced by adding regulatory systems, such as RNA regulation, one at a time. However, the intervention of many feedback loops may lead to an unstable system with increased vulnerability. [2] An organism is always in a changing environment, but it can maintain a relatively stable internal environment that allows it to survive in a variety of environments; therefore, biological robustness is best reflected in the adaptation of an organism to its environment. , organisms need to face selection pressure all the time, and if the system is not robust, a single gene mutation can easily lead to the loss of normal function of the individual and be eliminated. For example, the fate of the phage life cycle dictates that small perturbations to its promoter region are robust. [3]

A property that is the opposite of robustness is vulnerability, which is derived from glass physics and is used to describe the rate of temperature change of structural transitions in glass materials. Biological systems can be either sensitive, i.e., vulnerable, or insensitive, i.e., robust, to external perturbations, so here my understanding of vulnerability is just the opposite of robustness, i.e., a property of biological systems that prevents the system from continuing to maintain its structural and functional stability when disturbed by uncertainties such as external perturbations or internal parameter uptake.

Organisms are often vulnerable to unexpected mutations. For example, our body's energy control system ensures robust resistance to common perturbations such as erratic food supply or infection, but the system is vulnerable to abnormal mutations such as high-energy foods or low-energy use lifestyles [4]. The immune system provides robustness against pathogenic threats, but it shows vulnerability to unexpected failures, and the segmental polarity gene network in Drosophila shows robustness to perturbations under its initial conditions, but shows vulnerability to large temporal changes [5]. It was shown that the number of feedback loops is an indicator of vulnerability,and biological networks with a large number of positive feedback loops and a smaller number of negative feedback loops may be more resistant to perturbations, with positive feedback loops inducing multismoothness and negative feedback loops producing oscillatory behavior. The biological network gains robustness because it involves a smaller number of nodes with feedback loops that are perturbed and a larger number of nodes with feedback loops that are not perturbed. However, the robustness of the network becomes fragile when unexpected abrupt changes occur in the unperturbed nodes [6], so adjusting the number of feedback loops and the proportion of positive feedback loops may improve the robustness of the biological network to some extent and reduce its fragility

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