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Single Cell Biology

Perspective

Accumulation of Single Cell Aging: Biological Approach

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DESCRIPTION

Aging is a leading cause of human morbidity and mortality, but efforts to slow or reverse its effects are hampered by an incomplete understanding of its multifaceted origins. Systems biology, the use of quantitative and computational methods to understand complex biological systems, offers a toolkit well suited to elucidating the root cause of aging. We describe the known components of the aging network and outline innovative techniques that open new avenues of investigation to the aging research community. We propose integration of the systems biology and aging fields, identifying areas of complementarity based on existing and impending technological capabilities. Aging, the time dependent deterioration of function and physiology, is a major cause of human death and disability. Overcoming aging is an old-fashioned, but elusive goal that dates back to the earliest human writings. Our incomplete understanding of the aging process and its underlying complexity has limited even modern efforts to widespread interventions that have limited potential to delay the aging process. However, the on-going renaissance in the field of aging research opens up the possibility of intelligent designed targeted therapies that delay or reverse the effects of aging. Aging is usually seen at the biological level, but signs of aging result from a complex interaction of changes in multiple organ systems and their components. Indeed, the rate and properties of aging are driven by both the intracellular and extracellular environment and differ between tissue and organ systems. To fully understand the causes of aging of an organism, it is necessary to understand the contributions of its many components. The approach of understanding each contributor individually and then integrating it into the whole simplifies this conceptual framework.

Basic elements of single-cell aging

Bottom-up surveys start at the basic element level and work upwards. In the case of single-cell aging, bottom-up investigation begins by looking for specific molecular damage that causes aging. Many age-related changes have been described withvarying degrees of evidence of a causal relationship to functional decline. The detected age-related changes can be broadly categorized at the subsystem level or the basic element level. The basic element is the low-level components of the system. In this study, they are the basic units that suffer molecular damage with age.

Systems biology for aging professionals

Systems biology is an interdisciplinary field dedicated to the development and application of quantitative analysis and computational modelling approaches aimed at gaining mechanical insights from experimental data. This is in contrast to the traditional reductionist approach of examining each part of the system individually, thus ignoring the complex behavior that results from the interaction of these individual parts. Given the extraordinary complexity of the phenotype of aging and the wide variety of cellular systems it affects, it is almost certain that a comprehensive study of aging will require the application of systems biology approaches.

CONCLUSION

The advent of these powerful techniques is changing the field of cell aging. Systems biology is an interdisciplinary field dedicated to the development and application of quantitative analysis and computational modelling approaches aimed at gaining mechanical insights from experimental data. Since the beginning of the new millennium, systems biology approaches have been successfully used to gain insights into various cellular processes. However, aging is one of the few areas of research where systems biology tools and methods have not been widely applied. For example, applying a method of building quantitative networks based on the scalability of lifespan distribution sheds light on the modularity of global genetic networks that control aging and lifespan of living organisms. Over the last few decades, many proteins have been identified that affect the longevity of various

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model organisms. It is known that changing the expression level of these proteins at once affects the lifespan of cells, but for example, how these proteins interact through the feedback loop of the genetic network is complete. Systems biology approaches are essential for mapping the structure of aging networks.