

Editorial

The uncertain future

“I hope you’re doing well in these uncertain times” is a sentence many of us encountered in one form or another in the last 12 months. It still rings true; these are uncertain times. As a global community, we are entering the second year of a pandemic, but beyond that, we are facing facts about how human progress is changing the planet that nurtures us, and we are confronting the limits of our understanding of our own physiology as well as of the organisms we share this world with. We do not know what the future holds, but as the saying goes “the only constant is change,” and change is inevitable in the face of uncertainty. With that comes the hope and possibility that what comes next may be better than what came before.

This past year has shown us how science, and in particular our understanding of biology, can chart a path through uncertainty. Building on decades of biological research in virology, immunology, and RNA biology, we went from having zero knowledge of a novel virus to effective vaccines in less than a year. This momentous achievement is emblematic of what the scientific community can achieve through building a deep understanding of the natural world and harnessing global expertise to focus on an urgent goal. It is a microcosm of what we bring to the many uncertainties that lie ahead.

In this Special Issue, we are privileged to feature pieces that explore the changing world, uncertainty, and an unknown future. Within this context, the pieces discuss how biological systems deal with changing, stressful, and uncertain environments; the changing landscape of human disease; how biology is being harnessed to prepare for future uncertainties; and unknowns concerning the scientific community and its interaction with the broader world. Facing change and uncertainty with boldness, curiosity, a little excitement, and a core desire to make tomorrow better than yesterday is at the heart of what we do at *Cell*. We are committed to being home to research that identifies new questions and moves us through the unknown, and we are excited by the broad scope of this Special Issue. It reflects the growing breadth of biological research and the correspondingly expanding scope of the research *Cell* publishes. When considering the articles in this issue, a few field-spanning themes emerge.

Resilience in context

One of the wonders of life is its ability to adapt to changing and stressful environments. We have a deep appreciation of adaptation at the species level, and molecular and cell biology has given us a foundational understanding of the universal and conserved cellular mechanisms of stress resilience and adaptation. More recently, we have gained understanding of how tissues and organs themselves adapt to diverse and challenging conditions. From these advances, we have begun to appreciate the roles of specific cell types within the broader tissue context and how different cells interact together to achieve resilience. A better un-

derstanding of how tissues adapt to stresses such as aging, metabolic imbalance, and environmental insults is driving strategies to therapeutically support homeostasis.

An immune undercurrent

Throughout this issue, the selections that touch on growing human health issues in many cases discuss an immune or inflammatory component. In some cases, the topics relate to emerging external health threats, such as viral infections, and so they naturally cover the role of the body’s defense system. In other cases, immune functions are being uncovered in settings where they were previously underappreciated, such as aging and metabolic syndrome. Finally, in some parts of the world we are seeing diseases of immune dysfunction growing in incidence for reasons we still do not understand. The immune system composition and function is complex and context dependent, expressing variability between individuals and within the same individual across time. Given this complexity, there are many mysteries about the immune system and its various roles in disease that have yet to be uncovered.

Quantifying diversity

The future of humanity is intertwined with the future of other species on Earth. In this issue, several pieces discuss distinct threats, opportunities, and challenges to preserving biodiversity. These articles point out that a significant roadblock to understanding the impacts of climate change on Earth’s many species has been a lack of technologies to precisely, efficiently, and accurately measure changes in species diversity and abundance. Advances in genomics, metagenomics, sensor technologies, and deep learning algorithms show promise for addressing these challenges. With better tools, we can begin to tease apart how specific variables, such as rainfall, temperature, and environmental pH, are affecting individual species. Moreover, those same tools will help scientists assess whether mitigation strategies are working. However, the need for better assessment and monitoring tools is only part of the problem. To create a brighter future for the other species on Earth, scientists from the social, natural, and physical sciences need to work together to develop complex strategies for monitoring and mitigating biodiversity loss.

Creating an equitable, ethical, and fair future

The speed of development of SARS-CoV-2 vaccines has emphasized the power and capacity of biological research to address the uncertainties of the future. However, the uneven global distribution of these vaccines to date has also highlighted the challenges of ensuring equitable distribution of the benefits of science. In tackling the challenges of our uncertain future, the articles in this Special Issue highlight the dire need for research into areas that will benefit the most vulnerable



populations around the world, not just the richest countries. They also challenge us to consider the ethical implications of our research. In a time when biotechnology is becoming capable of achieving the stuff of fiction, it is important to pause and consider the ethics of our direction. Finally, to create a fair future, scientists must broker relationships beyond their usual sphere, establishing dialog with ethicists and policymakers. Biological research is becoming an increasingly useful tool for building a brighter future, but its application can be guided

and balanced by the concerns and needs of the communities it serves.

The *Cell* editorial team is pleased to bring you this Special Issue, which captures the scale of the uncertainties and challenges facing the world today, and our boundless optimism that research can take us forward to meet these challenges. We hope that it helps you see how research in every dimension—yours and your colleagues’—is helping to make the future a little more certain and little bit brighter.

The *Cell* editorial team

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