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The challenge of sustainability and the promise of mathematics

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The continual increase in the human population, magnified by increasing per capita demands on Earth's limited resources, raises the urgent mandate of understanding the degree to which these patterns are sustainable. The scientific challenges posed by this simply stated goal are enormous; mathematics provides a common language and a way to cross disciplines and cross scales. What measures of human welfare should be at the core of definitions of sustainability, and how do we discount the future and deal with problems of intragenerational and inter-generational equity? How do environmental and socioeconomic systems become organized as complex adaptive systems, and what are the implications for dealing with public goods at scales from the local to the global? How does the increasing interconnectedness of natural and human systems affect us, and what are the implications for management? What is the role of social norms, and how do we achieve cooperation at the global level? Mathematical tools help in understanding the collective dynamics of systems from bacterial biofilms to bird flocks and fish schools to ecosystems and the biosphere, and the emergent features that support life on the planet. They also provide ways to resolve the game-theoretic challenges of achieving cooperation among individuals and among nations in providing for our common future.

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