

Preface for Synthetic Immunology

Immunology has developed rapidly over the last 50 years through the incorporation of new technologies and concepts in cell and molecular biology, genetics, genomics, and proteomics. This progress is the result of works by many scientists all over the world. Currently, immunological research has accumulated detailed knowledge on various mechanisms of immunity and is in the process to change medical practices. Yet, due to the enormous complexity of the immune system, many aspects on the regulation and function of the immune system remain unknown. Synthetic biology is an emerging research field that uses gain-of-function rather than loss-of-function approaches. The goals of synthetic biology can be described in a simple phrase “rebuild, alter, and understand,” namely, to rebuild minimal functional systems using well-defined parts from nature and then to perturb the system to understand its working principles. Given the richness of accumulated knowledge in molecular and cellular mechanisms of the immune system, we may now begin adapting the concepts of synthetic biology to immunology. With this in mind, we have experimentally started Synthetic Immunology Workshop in 2010 and have organized four meetings, including three international meetings, by now. An immune response is a spatiotemporal phenomenon occurring at a given time and at a specialized place in the body. Thus, one goal of synthetic immunology is to reconstruct artificial microenvironments for better understanding of an immune response in four dimensions. For this reason, one central theme of synthetic immunology is “the synthesis of lymphoid niches and organs for lymphocyte development and function,” which is the viewpoint of this book. We hope this yet-to-be-experimental approach of synthetic immunology and the compilation of this book will aid our further understanding of the immune system and future devising the tools to manipulate the immune system for therapy and prevention of the diseases. This book consists of the development and regeneration of immune

cells (Chaps. 1 and 2), the immune organ development and artificial regeneration (Chaps. 3, 4, 5, and 6), and the synthetic approach towards understanding human immune system (Chaps. 7, 8, and 9).

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