

Preface

Interest in regeneration has waxed and waned since Lazzaro Spallanzani first described salamander limb regeneration in the eighteenth century. Currently, regeneration is a highly researched area with potential applications derived from biomedical and engineering research that will impact future medical therapies. The availability of genomic and transcriptomic data from regenerative species, combined with new approaches to identify and culture stem cells, has led to an explosive growth in our understanding of the molecular mechanisms of regeneration. In this book, we bring together the latest insights into these mechanisms.

In the first chapter, Debuque and Godwin describe the history of molecular research in salamanders and discuss the latest findings on unique proteins that mediate regeneration. These authors also provide insight into the regeneration of multiple structures and tissues and the transgenic tracing of stem cells that contribute to newly made tissues. While amphibians demonstrate spectacular regenerative ability, the more limited tail regeneration in anole lizards is captivating because these reptiles are evolutionarily more closely related to humans than salamanders, yet retain a significant ability to regenerate nerves, skin, muscle, and cartilage. In the second chapter, Hutchins et al. update the most recent findings in this model species.

The immune response is important for wound healing and initiation of regeneration. In the third chapter, Lynch and coauthors focus on the integration of the inflammatory response and the regulation of stem cells in regeneration of skeletal muscle in mammals. The role of the immune response is also discussed in amphibians and reptiles in the abovementioned chapters. Further, the immune response and signaling pathways during wound healing versus regeneration of amputated mouse digit tips is discussed by Dawson et al. This fourth chapter reviews important differences that account for regeneration following loss of the digit tip, but not more proximal amputations, as seen in very young children.

The next chapters focus on regeneration of cartilage, the heart, and the central nervous system. In the fifth chapter, Lozito et al. discuss cartilage regeneration in amphibians and reptiles and the application of findings from these species to human cartilage repair. Tissue engineering efforts focus on the repair of cartilage defects and of damage due to degeneration, such as in osteoarthritis. In the sixth chapter,

Judd and Huang provide a comprehensive discussion of cardiomyocyte regeneration in multiple model systems, including neonatal mice, with a focus on tissue engineering using stem cells. In the final chapter, Roussas et al. review traumatic brain injury and tissue engineering approaches to healing damage to the central nervous system.

In summary, this volume will appeal to readers interested in the broad overview of regenerative research, both in terms of species and tissues. Each chapter has a focus on molecular signals, the role of stem cells, and tissue engineering, making it a unique collection.

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