
Preface

Proper development of the germ cells (i.e., germline) is essential for the propagation of mammalian species. In spite of recent advances in the biological sciences, our knowledge of the mechanisms that regulate germline development is still rather limited. This volume aims to provide a comprehensive collection of techniques that can be applied to the study of both the male and female germline.

The germline is unique in mammals as it is the only cell lineage that undergoes mitosis, meiosis, and differentiation. Furthermore, the lineage comprises an array of developmentally distinct stages from the germinal stem cell to the terminally differentiated sperm or oocyte. Fortunately, cells at unique stages of development can be isolated as relatively pure populations. This feature makes these cells amenable to in-depth genomic and mechanistic studies. Knowledge of the biology of cells of either the male or female lineage will provide us with a better appreciation of the cellular mechanisms modulating the germline developmental processes. In addition, understanding how a germinal stem cell maintains stemness versus the induction of its differentiation will provide us insight on how to direct the pathway of differentiation of stem cells in regenerative studies.

Past studies of germ cells have been largely limited to histological and cell biology aspects of these cells. Only limited information has been available on the molecular genetics and genomics of cells of the germline. With advances in technology in recent years, we are now at a stage where we can acquire a much better understanding of the genetic and genomic regulatory mechanisms of the developing germ cells. This volume aims at bringing the field of germline developmental studies together such that readers can find, in a single volume, techniques that allow the isolation of germ cells at different stages of development, the study of the genomics and epigenomics of germ cells, and an examination of the role of single genes in the development potential and function of germ cells.

Elucidation of the biology of germline development as well as germinal stem cell maintenance or differentiation would be of great impact to both the biomedical as well as agricultural communities. For example, improvements in assisted reproduction (in humans) and cloning (in animals) technologies are dependent on advancing current in vitro systems towards more efficient oocyte development. Similarly, the development of methodologies to maintain germinal stem cell systems for male or female instances of spontaneous or drug/toxin-induced infertility in humans or, in the case of agricultural animals, for alternative modes of cryopreservation to maintain germplasm or to improve transgenic technologies for the enhancement of production traits and the generation of animal models with nutraceutical worth, are all important.

The male and the female germline differ slightly in their developmental program. Consequently, the techniques used for isolating and studying male and female germ cells are slightly different. Therefore, this volume groups the different technologies under two sections, namely, male germline and female germline. It is our hope that this volume will provide a comprehensive text to individuals, in particular, researchers in reproductive and developmental biology, who are interested in studying cells of the germ lineage.

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Germline Development

Methods and Protocols

Chan, W.-Y.; Blomberg, L.A. (Eds.)

2012, XI, 256 p., Hardcover

ISBN: 978-1-61779-435-3

A product of Humana Press