

The Skin and Its Diseases

A subject collection from *Cold Spring Harbor Perspectives in Medicine*

**OTHER SUBJECT COLLECTIONS FROM COLD SPRING HARBOR
PERSPECTIVES IN MEDICINE**

MYC and the Pathway to Cancer

Bacterial Pathogenesis

Transplantation

Cystic Fibrosis: A Trilogy of Biochemistry, Physiology, and Therapy

Hemoglobin and Its Diseases

Addiction

Parkinson's Disease

Type 1 Diabetes

Angiogenesis: Biology and Pathology

HIV: From Biology to Prevention and Treatment

The Biology of Alzheimer Disease

**SUBJECT COLLECTIONS FROM COLD SPRING HARBOR
PERSPECTIVES IN BIOLOGY**

The Origin and Evolution of Eukaryotes

Endocytosis

Mitochondria

Signaling by Receptor Tyrosine Kinases

DNA Repair, Mutagenesis, and Other Responses to DNA Damage

Cell Survival and Cell Death

Immune Tolerance

DNA Replication

Endoplasmic Reticulum

Wnt Signaling

Protein Synthesis and Translational Control

The Synapse

Extracellular Matrix Biology

Protein Homeostasis

Calcium Signaling

The Golgi

Germ Cells

The Mammary Gland as an Experimental Model

The Biology of Lipids: Trafficking, Regulation, and Function

Auxin Signaling: From Synthesis to Systems Biology

The Nucleus

Neuronal Guidance: The Biology of Brain Wiring

The Skin and Its Diseases

A subject collection from *Cold Spring Harbor Perspectives in Medicine*

EDITED BY

Anthony E. Oro

Stanford University School of Medicine

Fiona M. Watt

Kings College London



COLD SPRING HARBOR LABORATORY PRESS
Cold Spring Harbor, New York • www.cshlpress.org

The Skin and Its Diseases

A Subject Collection from *Cold Spring Harbor Perspectives in Medicine*

Articles online at www.perspectivesinmedicine.org

All rights reserved

© 2014 by Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York

Printed in the United States of America

Executive Editor	Richard Sever
Managing Editor	Maria Smit
Senior Project Manager	Barbara Acosta
Permissions Administrator	Carol Brown
Production Editor	Diane Schubach
Cover Design	Denise Weiss
Publisher	John Inglis

Front cover artwork: Mouse tail epidermal whole-mount labeled with antibodies to keratin 14 (red) and the androgen receptor (green). (Image kindly provided by Kai Kretzschmar and Fiona Watt, King's College London.)

Library of Congress Cataloging-in-Publication Data

Skin and its diseases : a subject from the Cold Spring Harbor perspectives in medicine / edited by Anthony E. Oro, Stanford University School of Medicine and Fiona M. Watt, Kings College London.

page cm

Summary: "The skin is a continually renewing organ that acts as a protective barrier isolating us from the external environment. This book examines the cells that make up the skin and their functions, as well as diseases such as psoriasis that affect the skin and new molecular strategies for treating these"— Provided by publisher.

Includes bibliographical references and index.

ISBN 978-1-62182-023-9 (hardback)

1. Skin--Diseases. 2. Skin--Molecular aspects. 3. Dermatology. I. Watt, Fiona M., editor of compilation. II. Oro, Anthony E., 1958- editor of compilation.

RL96.S58 2014

616.5--dc23

2014001351

10 9 8 7 6 5 4 3 2 1

All World Wide Web addresses are accurate to the best of our knowledge at the time of printing.

Authorization to photocopy items for internal or personal use, or the internal or personal use of specific clients, is granted by Cold Spring Harbor Laboratory Press, provided that the appropriate fee is paid directly to the Copyright Clearance Center (CCC). Write or call CCC at 222 Rosewood Drive, Danvers, MA 01923 (978-750-8400) for information about fees and regulations. Prior to photocopying items for educational classroom use, contact CCC at the above address. Additional information on CCC can be obtained at CCC Online at www.copyright.com.

For a complete catalog of all Cold Spring Harbor Laboratory Press publications, visit our website at www.cshlpress.org.

Contents

Preface, vii

Markers of Epidermal Stem Cell Subpopulations in Adult Mammalian Skin, 1
Kai Kretzschmar and Fiona M. Watt

Lineage Analysis of Epidermal Stem Cells, 15
Maria P. Alcolea and Philip H. Jones

The Genetics of Human Skin Disease, 31
Gina M. DeStefano and Angela M. Christiano

Epidermal Polarity Genes in Health and Disease, 57
Frederik Tellkamp, Susanne Vorhagen, and Carien M. Niessen

Epidermal Barriers, 73
Ken Natsuga

Desmosomes: Regulators of Cellular Signaling and Adhesion in Epidermal Health and Disease, 91
Jodi L. Johnson, Nicole A. Najor, and Kathleen J. Green

Sweat Gland Progenitors in Development, Homeostasis, and Wound Repair, 115
Catherine Lu and Elaine Fuchs

Diversification and Specialization of Touch Receptors in Skin, 133
David M. Owens and Ellen A. Lumpkin

Adipocytes in Skin Health and Disease, 145
Guillermo Rivera-Gonzalez, Brett Shook, and Valerie Horsley

Melanocytes and Their Diseases, 163
Yuji Yamaguchi and Vincent J. Hearing

Wound Healing and Skin Regeneration, 181
Makoto Takeo, Wendy Lee, and Mayumi Ito

Immunology and Skin in Health and Disease, 193
Jillian M. Richmond and John E. Harris

The Dermal Papilla: An Instructive Niche for Epithelial Stem and Progenitor Cells in Development and Regeneration of the Hair Follicle, 213
Bruce A. Morgan

Contents

Macroenvironmental Regulation of Hair Cycling and Collective Regenerative Behavior, 227

Maksim V. Plikus and Cheng-Ming Chuong

Microbial Ecology of the Skin in the Era of Metagenomics and Molecular Microbiology, 241

Geoffrey D. Hannigan and Elizabeth A. Grice

Natural and Sun-Induced Aging of Human Skin, 257

Laure Rittié and Gary J. Fisher

Long Noncoding RNA: Significance and Potential in Skin Biology, 271

Derrick C. Wan and Kevin C. Wang

Epigenetic Regulation of Epidermal Differentiation, 281

Carolina N. Perdigoto, Victor J. Valdes, Evan S. Bardot, and Elena Ezhkova

p53/p63/p73 in the Epidermis in Health and Disease, 301

Vladimir A. Botchkarev and Elsa R. Flores

Cutaneous Notch Signaling in Health and Disease, 313

Craig Nowell and Freddy Radtke

Psoriasis, 329

Paola Di Meglio, Federica Villanova, and Frank O. Nestle

An Overview of Alopecias, 359

Ji Qi and Luis A. Garza

Advanced Treatment for Basal Cell Carcinomas, 373

Scott X. Atwood, Ramon J. Whitson, and Anthony E. Oro

Modeling Cutaneous Squamous Carcinoma Development in the Mouse, 385

Phillips Y. Huang and Allan Balmain

Melanoma: Clinical Features and Genomic Insights, 409

Elena B. Hawryluk and Hensin Tsao

Gene Therapy for Skin Diseases, 427

Emily Gorell, Ngon Nguyen, Alfred Lane, and Zurab Siplashvili

Cell Therapy in Dermatology, 443

Gabriela Petrof, Alya Abdul-Wahab, and John A. McGrath

Induced Pluripotent Stem Cells in Dermatology: Potentials, Advances, and Limitations, 473

Ganna Bilousova and Dennis R. Roop

Index, 489

Preface

THE ITALIAN PHILOLOGIST AND PHYSICIAN Geronimo Mercuriali published the first textbook on skin and its diseases in 1572. Today, however, we are at a nexus in modern biology where we possess unparalleled understanding of the molecular and genetic basis of skin homeostasis and worldwide access to patients and animal models with which to correlate our knowledge and develop therapies for human diseases. This nexus means that laboratory experiments are having a greater direct impact on clinical practice than ever before. Our motivation for publishing *The Skin and Its Diseases* is our belief that the skin is the quintessential model vertebrate tissue. We feel that this compendium of current knowledge is useful for both further studies of the skin itself and insights into related changes in other tissues. Our hope is that this book will catalyze such interactions and stimulate further research in basic science and clinical/translational medicine.

We are well aware that this research topic is enormous and have endeavored to assemble a representative slice of our current knowledge. Although it does not do justice to some emerging and well-developed areas and lacks contributions from certain leaders in the field, the diversity of knowledge in this compendium will whet your appetite for exploring deeper.

The chapters in the book are organized around the major cell types in the skin and the diseases that affect them, including epidermis, dermis, and cutaneous epithelial specializations such as the touch receptor. The topics range from traditional dermatologic strongholds, such as psoriasis and cutaneous oncology, to newer approaches, such as the use of embryonic-stem-cell-based therapies. The content in each chapter may not completely align with that in other chapters. We have purposely given freedom to each author to review the field as they see fit. We feel that the apparent areas of conflict provide motivation for additional experimentation.

We thank Barbara Acosta and her colleagues at Cold Spring Harbor Laboratory Press for their support. Barbara's expertise in helping us put the book together and her patience with the inevitable delays are greatly appreciated. We thank our families for putting up with us as we assembled this reference. We would like to especially thank past and current members of the cutaneous biology community for their conversations, critiques, and insights that have spurred us to investigation. We feel fortunate to have such wonderful colleagues and hope that this book will motivate readers to contribute to new understanding of the skin and its diseases.

ANTHONY E. ORO
FIONA M. WATT

This is a free sample of content from The Skin and Its Diseases. [Click here](#) for more information on how to buy the book.