HANDBOOK OF STEM CELLS

VOLUME 2

Adult and Fetal

干细胞手册

第二卷：成体和胎儿干细胞

EDITORS

Robert Lanza

John Gearhart　Brigid Hogan

Douglas Melton　Roger Pedersen

James Thomson　Michael West

ELSEVIER

英文原版名作
中文导读系列

科学出版社
www.sciencep.com

Handbook of Stem Cells

Volume 2

Adult and Fetal

干细胞手册

第二卷：成体和胎儿干细胞

EDITORS

Robert Lanza
John Gearhart
Brigid Hogan
Douglas Melton
Roger Pedersen
James Thomson
Michael West

科学出版社
北京

图字:01-2006-0538 号

This is an annotated version of
Handbook of Stem Cells
Robert Lanza et al. eds.

ISBN 0-12-436643-0

Published by arrangement with **Elsevier Pte Ltd.**

AUTHORIZED EDITION FOR SALE IN P. R. CHINA ONLY
本版本只限于在中华人民共和国境内销售

图书在版编目(CIP)数据

干细胞手册=Handbook of Stem Cells/(美)兰扎(Lanza, R.)等编. —北京:科学出版社,2006
(Elsevier 英文原版名作中文导读系列)
ISBN 7-03-016709-0
Ⅰ. 干… Ⅱ. 兰… Ⅲ. 干细胞-手册-英文 Ⅳ. Q24-62
中国版本图书馆 CIP 数据核字(2005)第 155558 号

责任编辑:马学海 盖 宇
责任印制:钱玉芬/封面设计:耕者设计工作室

科学出版社 出版
北京东黄城根北街16号
邮政编码:100717
http://www.sciencep.com
中国科学院印刷厂 印刷
科学出版社发行 各地新华书店经销
*
2006 年 1 月第 一 版 开本:889×1194 1/16
2006 年 1 月第一次印刷 印张:116 1/2 插页:4
印数:1—2 500 字数:2 749 000
定价:320.00 元(全二卷)
(如有印装质量问题,我社负责调换〈科印〉)

导读编译者

裴雪涛　教授　（军事医学科学院）

（以下按汉语拼音排序）

管利东　刘大庆　刘庆斌　李艳华　王韫芳

习佳飞　闫　舫　姚海雷　赵敬湘　张　鹏

EDITORIAL BOARD

Contributors

Numbers in parentheses indicate the chapter to which the author contributed.

Alaa Adassi, MD (27)
Stem Cell Institute and Division of Hematology, Oncology and Transplantation, Department of Medicine, University of Minnesota Medical School, Minneapolis, MN

Iva Afrikanova, PhD (36)
Department of Pathology and Immunology, Washington University School of Medicine, St. Louis, MO

Koichi Akashi, MD, PhD (34)
Associate Professor, Cancer Immunology and AIDS, Dana-Farber Cancer Institute, Harvard Medical School, Boston, MA

Piero Anversa, MD (64)
Director, Cardiovascular Research Institute, Professor and Vice Chairman, Department of Medicine, New York Medical College, Valhalla, NY

Anthony Atala, MD (16, 50)
The William Boyce Professor and Director, Wake Forest Institute for Regenerative Medicine, Wake Forest University, Winston-Salem, NC

Scott T. Avecilla, BS (35)
Research Associate, Department of Genetic Medicine, Cornell University Medical College, New York, NY

Dolores Baksh, PhD (59)
NIAMS, National Institutes of Health, Bethesda, MD

Yann Barrandon, MD, PhD (69)
Laboratory of Stem Cell Dynamics, Swiss Institute of Technology (EPFL), Lausanne University Hospital (CHUV), 1015 Lausanne, Switzerland

Stephen H. Bartelmez (10)
The Basic Research Laboratory, Center for Cancer Research, National Cancer Institute-Frederick, Frederick, MD

Steven R. Bauer, PhD (73)
Chief, Laboratory of Stem Cell Biology, Division of Cellular and Gene Therapies, Office of Cellular, Tissue, and Gene Therapies, Center for Biologics Evaluation and Research, Food and Drug Administration, Bethesda, MD

Prosper Benhaim, MD (40)
Associate Professor, Orthopedic Surgery, UCLA, Los Angeles, CA

Paolo Bianco, MD (39, 71)
Professor of Pathology, Department of Experimental Medicine and Pathology, La Sapienza University, Rome, Italy

Helen M. Blau, PhD (37)
Professor and Director, Baxter Laboratory in Genetic Pharmacology, Department of Microbiology and Immunology, Stanford University School of Medicine, Stanford, CA

Hans Bode (4)
Department of Developmental and Cell Biology, University of California, Irvine, CA

Susan Bonner-Weir, PhD (66)
Associate Professor/Senior Investigator, Harvard Medical School, Boston, MA

Corinne A. Boulanger, MS (25)
Mammary Biology and Tumorigenesis Laboratory, Center for Cancer Research, Bethesda, MD

Mairi Brittan, BSc (47)
Histopathology Unit, London Research Institute, Cancer Research UK, London, United Kingdom

Marianne Bronner-Fraser, PhD (19)
California Institute of Technology, Division of Biology, Beckman Institute, Pasadena, CA

Hal E. Broxmeyer, PhD (17)
Chairman and Mary Margaret Walther Professor, Microbiology/Immunology, Professor of Medicine, Scientific Director of the Walther Oncology Center, Indiana University School of Medicine, Indianapolis, IN

Richard K. Burt, MD (68)
Associate Professor, Division of Immunotherapy, Department of Medicine, Northwestern University Feinberg School of Medicine, Chicago, IL

Maeve A. Caldwell, PhD (52)
Centre for Brain Repair, University Forvie Site, Cambridge, United Kingdom

Fernando D. Camargo (31)
Baylor College of Medicine, Houston, TX

Arnold I. Caplan, PhD (28)
Professor of Biology, Director of Skeletal Research Center, Department of Biology, Case Western Reserve University, Cleveland, OH

Peter Carmeliet, MD, PhD (42)
Professor of Medicine, Adjunct Director Center for Transgene Technology and Gene Therapy, Flanders Interuniversity Institute for Biotechnology (VIB), University of Leuven, Campus Gasthuisberg, Leuven, Belgium

Elena Cattaneo, PhD (62)
Department of Pharmacological Sciences and Center of Excellence on Neurodegenerative Diseases, University of Milano, Milan Italy

Siddharthan Chandran MD, PhD (52)
Department of Clinical Neurosciences, University of Cambridge, Forvie Site, Cambridge, United Kingdom

Howard Y. Chang, MD, PhD (57)
Department of Dermatology and Biochemistry, Stanford University, Stanford, CA

Xin Chen, PhD (57)
Department of Biopharmaceutical Sciences, University of California, San Francisco, San Francisco, CA

Tao Cheng, MD (6)
Director of Stem Cell Biology, University of Pittsburgh Cancer Institute, Pittsburgh, PA

Richard W. Childs, MD (67)
Senior Investigator, National Heart, Lung, and Blood Institute, National Institutes of Health, Bethesda, MD

Kyunghee Choi, PhD (36)
Associate Professor, Department of Pathology and Immunology, Washington University School of Medicine, St. Louis, MO

Dipanjan Chowdhury (8)
Rosenstiel Basic Medical Sciences Research Center, Department of Biology, Brandeis University, Waltham, MA

Yun Shin Chung, PhD (36)
Department of Pathology and Immunology, Washington University School of Medicine, St. Louis, MO

Philippe Collas, PhD (13)
Professor, Department of Biochemistry, Institute of Basic Medical Sciences, University of Oslo, Oslo, Norway

Gay M. Crooks, MD (33)
Associate Professor of Pediatrics, Department of Pediatrics, USC Keck School of Medicine, Division of Research Immunology/BMT, The Saban Research Institute of Childrens Hospital Los Angeles, Los Angeles, CA

Giulio Cossu, MD (65)
Professor of Histology and Embryology, Stem Cell Research Institute, Dibit, H. San Raffaele, Milan, Italy, Institute of Cell Biology and Tissue Engineering, San Raffaele Biomedical Science Park of Rome, University of Rome "La Sapienza", Rome, Italy

Brian R. Davis, PhD (72)
Senior Scientist, Institute for Inherited Disease Research, Newtown, PA

Gabriella Cusella De Angelis, MD, PhD (65)
Stem Cell Research Institute, Dept. of Exptl. Med., Human Anatomy, University of Pavia, Pavia, Italy

Sharon Y.R. Dent (formerly Sharon Y. Roth) (9)
Associate Professor, Department of Biochemistry and Molecular Biology, University of Texas M.D. Anderson Cancer Center, Houston, TX

John E. Dick, PhD (58)
Canada Research Chair in Stem Cell Biology, Toronto General Research Institute, Princess Margaret Hospital, University Health Network, Professor, Department of Medical Genetics and Microbiology, University of Toronto, Toronto, Ontario, Canada

Natalie Direkze, MB, BS, MRCP (47)
Histopathology Unit, London Research Institute, Cancer Research UK, London, United Kingdom

Yuval Dor, PhD (46)
Harvard University, Cambridge, MA

Ryan R. Driskell (48)
Department of Anatomy and Cell Biology, University of Iowa, Iowa City, IA

Catherine Dulac, PhD (22)
Professor of Molecular and Cellular Biology, Investigator, Howard Hughes Medical Institute, Department of Molecular and Cellular Biology, Harvard University, Cambridge, MA

Cynthia E. Dunbar, MD (53)
Head of Molecular Hematopoiesis, Section Hematology Branch, National Institutes of Health, Bethesda, MD

Hideo Ema, MD, PhD (30)
Associate Professor, Laboratory of Stem Cell Therapy, Center for Experimental Medicine, Institute of Medical Science University of Tokyo, Tokyo, Japan

John F. Engelhardt, PhD (48)
Professor, Director, Center for Gene Therapy, Department of Anatomy and Cell Biology, University of Iowa, Iowa City, IA

Tariq Enver, PhD (7)
Professor of Stem Cell Biology, MRC Molecular Haematology Unit, Weatherall Institute of Molecular Medicine, John Radcliffe Hospital, Headington, Oxford, England

Yvonne A. Evrard, PhD (9)
Department of Biochemistry and Molecular Biology, University of Texas M.D. Anderson Cancer Center, Houston, TX

Valentina M. Factor (45)
Laboratory of Experimental Carcinogenesis, Center for Cancer Research, National Cancer Institute, National Institutes of Health, Bethesda, MD

K. Rose Finley (60)
Division of Hematology/Oncology, Children's Hospital, Dana-Farber Cancer Institute, and Harvard Medical School, Boston, MA

Jennifer C. Fletcher, PhD (56)
Plant Gene Expression Center, USDA/UC Berkeley, Albany, CA

Elaine Fuchs, PhD (24)
Rebecca C. Lancefield Professor, Investigator of the Howard Hughes Medical Institute, Laboratory of Mammalian Cell Biology and Development, The Rockefeller University, New York, NY

Margaret T. Fuller, PhD (5)
Professor, Departments of Developmental Biology and Genetics, Stanford University School of Medicine, Stanford, CA

Amiela Globerson, PhD (32)
Department of Immunology, Weizmann Institute of Science, Rehovot, Israel, Director, Center for Multidisciplinary Research in Aging, Ben Gurain University of the Negev, Beer Sheva, Israel

Victor M. Goldberg, MD (70)
Case Western Reserve University, University Hospitals of Cleveland, Cleveland, OH,

Margaret A. Goodell, PhD (31, 38)
Associate Professor, Center for Cell and Gene Therapy, Baylor College of Medicine, Houston, TX

Berthold Göttgens, DPhil (29)
Leukaemia Research Fund Lecturer, Department of Haematology, Cambridge Institute for Medical Research, University of Cambridge, Cambridge, United Kingdom

Elizabeth Gould, PhD (20)
Professor, Department of Psychology, Program in Neuroscience, Princeton University, Princeton, NJ

Anthony Richard Green, PhD, FRCP, FRCPath, FMedSci (29)
Professor of Haemato-Oncology, Head of Department of Haematology, Department of Haematology, University of Cambridge, Cambridge Institute for Medical Research, Cambridge, United Kingdom

Joe W. Grisham (45)
Laboratory of Experimental Carcinogenesis, Center for Cancer Research, National Cancer Institute, National Institutes of Health, Bethesda, MD

Markus Grompe, MD (44)
Director, Oregon Stem Cell Center, Professor, Department of Medical and Molecular Genetics, Department of Pediatrics, Oregon Health and Science University, Portland, OR

David N. Haylock, PhD (55)
Stem Cell Research Laboratory, Peter MacCallum Cancer Centre, Melbourne,Victoria, Australia

Anne L. Hazlehurst (74)
Center for Biochemical Engineering, Brown University, Providence, RI

Marc H. Hedrick, MD (40)
Adjunct Associate Professor, Department Surgery and Pediatrics, University of California, Los Angeles, Los Angeles, CA

Marko E. Horb, PhD (12)
Laboratory of Molecular Organogenesis, Institut de Recherches Cliniques de Montreal (IRCM), Montreal, Quebec, Canada

Jerry I. Huang, MD (70)
Case Western Reserve University, University Hospitals of Cleveland, Cleveland, OH

H. David Humes, MD (43)
Professor, Division of Nephrology, Department of Internal Medicine, University of Michigan School of Medicine, Ann Arbor, Michigan

Haruhiko Ishii (8)
Rosenstiel Basic Medical Sciences Research Center, Department of Biology, Brandeis University, Waltham, MA

David K. Jin, MD, PhD (35)
Department of Genetic Medicine, Cornell University Medical College, New York, NY

D. Leanne Jones, PhD (5)
Department of Developmental Biology, Stanford University School of Medicine, Stanford, CA

Jan Kajstura, PhD (64)
Cardiovascular Research Institute, New York Medical College, Valhalla, NY

Anne Kessinger, MD (61)
Professor, Department of Internal Medicine, University of Nebraska Medical Center, Omaha, NE

Chris Kintner, PhD (18)
Professor, Molecular Neurobiology Laboratory, The Salk Institute for Biological Studies, La Jolla, CA

Naoko Koyano-Nakagawa, PhD (18)
Department of Neuroscience, University of Minnesota, Minneapolis, MN

Robb Krumlauf, PhD (19)
Scientific Director, Stowers Institute for Medical Research, Kansas City, MO

Thomas Küntziger, PhD (13)
Professor, Institute of Basic Medical Sciences, Department of Biochemistry, University of Oslo, Oslo, Norway

Mark A. LaBarge, PhD (37)
Department of Life Sciences, Lawrence Berkeley National Laboratory, Berkeley, CA

Peter M. Lansdorp, MD, PhD (11)
Professor of Medicine, University of British Columbia, Senior Scientist, Terry Fox Laboratory, BC Cancer Research Center, Vancouver, British Columbia, Canada

Robert Lanza, MD (Preface)
Vice President, Medical and Scientific Development, Advanced Cell Technology, Adjunct Professor of Surgical Sciences, Institute of Regenerative Medicine, Wake Forest University School of Medicine, Winston-Salem, NC

Ihor Lemischka, PhD (3)
Professor, Department of Molecular Biology, Princeton University, Princeton, NJ

Annarosa Leri (64)
Associate Professor, New York Medical College, Valhalla, NY

Joseph J. Lucas, PhD (14)
Department of Pediatrics, National Jewish Medical and Research Center, Denver, CO

Aernout Luttun, PhD (42)
Center for Transgene Technology and Gene Therapy, Flanders Interuniversity Institute for Biotechnology, Department of Medicine, University of Leuven, Leuven, Belgium

Michael J. Lysaght, PhD (74)
Professor and Director, Center for Biomedical Engineering, Brown University, Providence, RI

Gerard J. Madlambayan, PhD (59)
University of Toronto, Institute of Biomaterials and Biomedical Engineering, Toronto, Ontorio, Canada

Gillian May, PhD (7)
MRC Molecular Haematology Unit, Weatherall Institute of Molecular Medicine, John Radcliffe Hospital, Headington, Oxford, United Kingdom

Joby L. McKenzie, BSc (58)
Molecular and Medical Genetics, University of Toronto/University Health Network, Toronto, Ontario, Canada

Shannon McKinney-Freeman, PhD (38)
Children's Hospital Boston, Boston, MA

Douglas A. Melton, PhD (Foreword, 46)
Thomas Dudley Cabot Professor in the Natural Sciences, Department of Molecular and Cellular Biology, Harvard University, Investigator, Howard Hughes Medical Institute, Cambridge, MA

Christian Mirescu, PhD (20)
Department of Psychology, Princeton University, Princeton, NJ

Malcolm A.S. Moore, PhD (15)
Enid A. Haupt Professor of Cell Biology, Head, James Ewing Laboratory of Developmental Hematopoiesis, Memorial Sloan-Kettering Cancer Center, New York, NY

Yo-hei Morita, BA (30)
Laboratory of Stem Cell Therapy, Center for Experimental Medicine, Institute of Medical Science, University of Tokyo, Tokyo, Japan

Bernardo Nadal-Ginard, MD, PhD (64)
Cardiovascular Research Institute, New York Medical College, Valhalla, NY

Hiromitsu Nakauchi, MD, PhD (30)
Professor, Laboratory of Stem Cell Therapy, Center for Experimental Medicine, Institute of Medical Science, University of Tokyo, Tokyo, Japan

Donald Orlic, PhD (53)
Associate Investigator, Genetics and Molecular Biology Branch, National Human Genome Research Institute, NIH, Bethesda, Maryland

Christopher S. Potten, PhD, DSc (1)
Professor, EpiStem Limited, Manchester, United Kingdom

Sean Preston, MB, BS, MRCP (47)
Histopathology Unit, London Research Institute, Cancer Research UK, London, United Kingdom

Darwin J. Prockop, MD, PhD (Foreword)
Director, Center for Gene Therapy, Professor of Biochemistry, Tulane University Health Sciences Center, New Orleans, LA

Nicole L. Prokopishyn, PhD (72)
Fund for Inherited Disease Research, Newtown, PA

Shahin Rafii, MD (35)
Professor of Genetic Medicine, Hematology-Oncology and Genetic Medicine, Cornell University Medical College, New York, NY

Carlos Almeida Ramos, MD (31)
Oncology/Hematology Fellow, Memorial Sloan-Kettering Cancer Center, New York, NY

Pamela A. Raymond, PhD (63)
Professor, Cell and Developmental Biology, University of Michigan Medical School, Ann Arbor, MI

Pamela Gehron Robey, PhD (39)
Chief, Craniofacial and Skeletal Diseases Branch, National Institute of Dental and Craniofacial Research, National Institutes of Health, Bethesda, MD

Ariane Rochat, PhD (69)
Project Leader, Laboratory of Stem Cell Dynamics, Swiss Institute of Technology (EPFL) and Lausanne, University Hospital (CHUV), Lausanne, Switzerland

Hans-Reimer Rodewald, PhD (49)
Professor, Head of Department, Department of Immunology, University Clinics Ulm, Ulm, Germany

Nadia Rosenthal, PhD (41)
Head, EMBL Mouse Biology Programme, European Molecular Biology Laboratory, Monterotondo Scalo (Rome), Italy

Ferdinando Rossi, MD, PhD (62)
Professor of Neuroscience, Rita Levi Montalcini Centre for Brain Repair, Department of Neuroscience, University of Turin, Turin, Italy

Francis W. Ruscetti, PhD (10)
Head, Leukocyte Biology Section, Center for Cancer Research, National Cancer Institute-Frederick, Frederick, MD

Maurilio Sampaolesi, PhD (65)
Stem Cell Research Institute, Dept. of Exptl. Med., Human Anatomy, University of Pavia, Pavia, Italy

Maria Paola Santini, Laurea (41)
EMBL Mouse Biology Programme, European Molecular Biology Laboratory, Monterotondo Scalo (Rome), Italy

David T. Scadden, MD (6)
Professor of Medicine, Harvard University, Massachusetts General Hospital, Boston, MA

Ruth Seggewiss, MD (53)
Section Hematology Branch, National Institutes of Health, Bethesda, MD

Ranjan Sen (8)
Rosenstiel Basic Medical Sciences Research Center, Department of Biology, Brandeis University, Waltham, MA

J. Graham Sharp (61)
University of Nebraska Medical Center, Omaha, Nebraska

Sergey V. Shmelkov, MD (35)
Department of Genetic Medicine, Cornell University Medical College, New York, NY

Mohummad Minhaj Siddiqui, BS (16)
Wake Forest Institute for Regenerative Medicine, Wake Forest University School of Medicine, Winston-Salem, NC

Paul J. Simmons, PhD (55)
Program Head in Stem Cell Biology, Stem Cell Biology Laboratory, Peter MacCallum Cancer Centre, East Melbourne, Australia

William B. Slayton, MD (54)
Assistant Professor, Pediatric Hematology/Oncology, University of Florida College of Medicine, Gainesville, FL

Gilbert H. Smith, PhD (25)
Mammary Biology and Tumorigenesis Laboratory, Center for Cancer Research, Bethesda, MD

Lukas Sommer, PhD (21)
Assistant Professor in Cell and Developmental Biology, Institute of Cell Biology, Swiss Federal Institute of Technology, Zurich, Switzerland

Gerald Spangrude, PhD (54)
Professor of Medicine, Division of Hematology, University of Utah, Salt Lake City, UT

Ramaprasad Srinivasan, MD, PhD (67)
Staff Physician, Urologic Oncology Branch, National Cancer Institute, Bethesda, MD

Mark S. Szczypka, PhD (43)
Director of Research, Research Division, Nephros Therapeutics Inc., Ann Arbor, MI

Yoshiyuki Takahashi, MD, PhD (67)
Hematology Branch, National Heart Lung and Blood Institute/NIH, Bethesda, MD

Rafael Tejada, (35)
Research Associate, Department of Genetic Medicine, Cornell University Medical College, New York, NY

Naohiro Terada, MD, PhD (14)
Associate Professor, Department of Pathology, University of Florida, Gainesville, FL

E. Donnall Thomas, (Hon) (Foreword)
Member, Fred Hutchinson Cancer Research Center, Professor of Medicine, Emeritus, University of Washington, Seattle, WA

James A. Thomson, VMD, PhD, Dipl ACVP (57)
John D. MacArthur Professor, Department of Anatomy, University of Wisconsin-Madison Medical School, The Wisconsin National Primate Research Center, Madison, WI

Snorri S. Thorgeirsson (45)
Laboratory of Experimental Carcinogenisis, Center for Cancer Research, National Cancer Institute, National Institutes of Health, Bethesda, MD

Marc Tjwa, MD (42)
Center for Transgene Technology and Gene Therapy, Flanders Interuniversity Institute for Biotechnology (VIB), University of Leuven, Campus Gasthuisberg, Leuven, Belgium

David Tosh, PhD (12)
Biology and Biochemistry, University of Bath, Bath, United Kingdom

Paul A. Trainor, PhD (19)
Stowers Institute for Medical Research, Kansas City, MO

David Traver, PhD (34)
Department of Cell and Developmental Biology, University of California, San Diego, La Jolla, CA

Tudorita Tumbar, PhD (24)
Laboratory of Mamalian and Cell Biology, The Rockefeller University, New York, NY

Joseph P. Vacanti, MD (26)
Chief, Pediatric Surgery, Massachusetts General Hospital, Director, Laboratory for the Tissue Engineering and Organ Fabrication, Massachusetts General Hospital, Boston, MA

Larissa Verda, MD, PhD (68)
Research Associate, Division of Immunotherapy, Department of Medicine, Northwestern University Feinberg School of Medicine, Chicago, IL

Catherine M. Verfaillie, MD (2, 27)
Director, Stem Cell Institute, Professor, Department of Medicine, University of Minnesota, Minneapolis, MN

Fiona M. Watt, DPhil (23)
Head, Keratinocyte Laboratory, Cancer Research UK London Research Institute, London, United Kingdom

Gordon C. Weir, MD (66)
Professor of Medicine, Harvard Medical School, Head, Section on Islet Transplantation and Cell Biology, Diabetes Research and Wellness Foundation Chair, Joslin Diabetes Center, Boston, MA

James W. Wilson, PhD (1)
Research Centre for Gastroenterology, Institute for Cell and Molecular Science, Barts and The London Queen Mary's School of Medicine and Dentistry, London, United Kingdom

Nicholas A. Wright MA, DSc, MD, PhD, FRCPath, FRCS, FRCP, FmedSci (47)
Histopathology Unit, London Research Institute, Cancer Research UK, London, United Kingdom

Zipora Yablonka-Reuveni, PhD (51)
Research Professor, Department of Biological Structure, University of Washington, Seattle, WA

Pamela C. Yelick, PhD (26)
Staff Member, Department of Cytokine Biology, The Forsyth Institute, Department of Oral and Developmental Biology, Harvard School of Dental Medicine, Boston, MA

Jung U. Yoo, MD (70)
Case Western Reserve University, University Hospitals of Cleveland, Cleveland, OH

Peter W. Zandstra, PhD (59)
Associate Professor, Institute of Biomaterials and Biomedical Engineering, University of Toronto, Toronto, Ontario, Canada

Lisa Zakhary (22)
Department of Molecular and Cellular Biology, Harvard University, Cambridge, MA

Wen Jie Zhang, PhD (36)
Department of Pathology and Immunology, Washington University School of Medicine, St. Louis, MO

Leonard I. Zon, MD (60)
Grousbeck Professor of Pediatrics, HMS, Investigator, HHMI, Children's Hospital Boston, Boston, MA

Patricia A. Zuk PhD (40)
Research Director, Regenerative Bioengineering and Repair Laboratory, David Geffen School of Medicine at UCLA, Los Angeles, CA

Preface

New discoveries in the field of stem cells increasingly dominate the news and scientific literature. Wave upon wave of papers has led to an avalanche of new knowledge and research tools that may soon lead to new therapies for cancer, heart disease, diabetes, and a wide variety of other diseases that afflict humanity. The *Handbook of Stem Cells* integrates this exciting area of biology, combining in two volumes the prerequisites for a general understanding of adult and embryonic stem cells; the tools, methods, and experimental protocols needed to study and characterize stem cells and progenitor populations; as well as a presentation by the world's experts of what is currently known about each specific organ system. No topic in the field of stem cells is left uncovered, including basic biology/mechanisms, early development, ectoderm, mesoderm, endoderm, methods (such as detailed descriptions of how to derive and maintain animal and human embryonic stem cells), application of stem cells to specific human diseases, regulation and ethics, and patient perspectives from Mary Tyler Moore (diabetes) and Christopher Reeve (spinal cord injury). The result is a comprehensive two-volume reference that will be useful for students and experts alike. It represents the combined effort of 12 editors and more than 300 scholars and scientists whose pioneering work has defined our understanding of stem cells.

Robert Lanza, M.D.
Boston, Massachusetts

序　言

干细胞领域的新发现越来越影响着新闻和科学文献。大量文章的出现引发的新知识和研究手段的涌现，最终将产生针对肿瘤、心脏病、糖尿病，以及影响人类健康的许多其他疾病的新的治疗手段。《干细胞手册》这部书分为上下两册，整合了该领域有关成体干细胞和胚胎干细胞必备的生物学知识、手段、方法、研究和描述干/祖细胞的特征所用的实验方案，以及国际专家对于每一个特定的器官系统相关知识发展现状的介绍。干细胞领域的所有主题无一例外地收录其中，包括基础生物学/机制、早期发育、外胚层、中胚层、内胚层、方法（例如如何分离和培养动物和人胚胎干细胞的具体描述）、针对特定人类疾病的干细胞的应用、法规与伦理，以及分别来自 Mary Tyler Moore（糖尿病患者）和 Christopher Reeve（脊髓损伤患者）的观点。这两册书将成为学生和科研人员必备的全面的参考书目，它们凝集了 12 位编辑和超过 300 位学者和科学家的共同努力，正是他们开拓性的工作使得我们对干细胞有了精确的理解。

Robert Lanza，MD
波士顿，马萨诸塞州

前　言

众所周知，关于细胞移植的事件都源自于二战结束之后。最初发现小鼠经过注射脾或骨髓细胞之后能够抵御致命的辐射损伤。起初假设这些是由于脾脏或者骨髓内体液因子的保护作用，可是这些保护作用可能源自于活细胞的假设被一些实验结论所推翻。细胞遗传学和皮肤移植的研究证实保护辐射损伤的原因是细胞假说而不是体液假说。

早期的研究者意识到在脾脏和骨髓内一定存在着某种类型的种子细胞，它们能够形成再生的骨髓组织。这些细胞被称为干细胞，但是找到干细胞存在的证据是一个长期的艰巨过程；之后在近交系小鼠内进行了数以千计的实验以阐明成功的细胞移植所需的条件，并且描述了其中涉及的免疫学现象。狗成为了一个补充近交系和杂交系动物品系之间空缺的实验模型，因为大多数情况下，医生总是试图通过从动物实验结果中获取的知识用于解决人类疾病，然而应用这些通过动物实验结果获取的知识解决骨髓移植问题时却导致患者出现了严重的并发症，包括免疫缺陷疾病、白血病和再生障碍性贫血等；到了 20 世纪末，骨髓、外周血以及脐带血来源的造血细胞移植已经成为治疗许多类型疾病的主要手段。

随着研究工作的深入，干细胞被成功地分离和鉴定。尽管进行了很多实验，人类干细胞的体外扩增培养依旧非常困难。人类干细胞的基因治疗研究充满了吸引力但是困难重重。长期以来一直假定造血干细胞只能产生造血细胞，但是最近令人振奋的实验数据提示骨髓干细胞能够产生其他组织类型的细胞包括肝、心脏甚至是中枢神经系统细胞。实验结果表明骨髓、肝、心脏等组织器官有它们自己的干细胞，而且这些干细胞不是组织特异性的。干细胞的可塑性、或者说横向分化研究已经成为干细胞领域的一个主要的研究课题。从胚胎组织中获取干细胞的技术不断进步并且提供了更广阔的应用前景。应用这些干细胞治疗那些难以治愈疾病成为可能。

因此，在 21 世纪之初，我们开始着手完成这项工作——编写《干细胞手册》。这本分上下两卷的手册汇集了干细胞研究不同领域的很多研究者辛勤的工作积累。很明显地，干细胞研究是飞速发展的学科，需要更多的工作去验证目前的假说，这本手册为那些致力于这项工作的人们提供了最基本的信息。

E. Donnall Thomas，(Hon)

Foreword

Almost everything we know about cell transplantation dates to the end of World War II. It was found that mice could be protected against otherwise lethal irradiation by an injection of spleen or marrow cells. At first it was hypothesized that the protection was caused by a humerol factor in the spleen or marrow preparations. That the protection might be caused by living cells seemed to be ruled out by several experiments. However, cytogenetic and skin transplant studies made it clear that the cellular hypothesis rather than the humoral hypothesis was the explanation for the irradiation protection phenomenon.

The early investigators recognised that there must be some kind of seed cell or cells in the spleen or marrow preparations that generated the repopulated marrow. These cells came to be called stem cells, but the search for the elusive stem cell became a long and complicated one. There followed thousands of experiments in inbred mice that clarified the requirements for successful cell transplants and described the immunological phenomena involved. The dog became a model for bridging the gap of knowledge between inbred mice and outbred species. As is often the case, physicians were driven to attempt to alleviate human disease by the application of knowledge gained from studies of animal systems. Application of this knowledge to human marrow transplantation began to produce results in patients with fatal disorders such as immunodeficiency disease, leukemia, and aplastic anemia. By the end of the twentieth century, transplantation of hematopoietic cells from marrow, blood, or cord blood had taken its place in the therapeutic armamentarium against an ever-increasing number of diseases.

As work continued, stem cells were isolated and characterized. Despite many studies, the expansion of human stem cells by *in vitro* culture proved to be difficult. Gene therapy of human stem cells remained an attractive but elusive goal. It had long been assumed that hematopoietic stem cells would produce only hematopoietic cells, but intriguing data began to suggest that marrow stem cells might generate other tissues such as a liver, a heart, or even a central nervous system. These and other tissues and organs seemed to have their own stem cells, and these stem cells might not be lineage specific. The plasticity of stem cells, or transdifferentiation, became a major subject of study. Techniques for obtaining stem cells form embryonic tissues were developed and seemed to offer even greater utility. Application of these stem cells to a variety of otherwise incurable human diseases became a possibility.

Thus, at the beginning of the twenty-first century, the stage was set for this work, *Handbook of Stem Cells*. This two-volume book is a much-needed attempt to bring together the cumulative work of many investigators in widely diverse aspects of stem cell studies. Clearly, this field is a work in progress. Much more work will be needed to fulfill the exciting promise of stem cell research. This handbook provides essential information for those who undertake this challenge.

E. Donnall Thomas, (Hon)