

## What Are Stem Cells?-Review Paper

Claire Marie Agius and Renald Blundell

Department of Physiology and Biochemistry, University of Malta, Msida MSD06, Malta

**Abstract:** Modern medicine has moved by leaps and bounds throughout recent years to literally make science fiction part of our day-to-day reality. Undoubtedly one of the biggest breakthroughs was the discovery of stem cells, which was followed up in a breathtaking fashion by report after report of their promise, so much so that an almost miraculous scenario seems to be unfolding in front of the world's eyes. Stem cells are classified mainly by their source into three basic types: Embryonic, umbilical and adult stem cells. Each differ in their plasticity and could thus potentially be used for different medical purposes. However, for this to be possible, lab techniques for collecting, culturing and perhaps even transdifferentiating different stem cells need to be studied and outlined, ideally while having a good background of the mechanisms underlying the processes of differentiation and transdifferentiation, with all the various combinations of growth factor cocktails needed for the cell culture to be viable commercially and the individual and additive effect of each ingredient on the resultant culture.

**Key words:** Stem cells, classification, differentiation, embryonic stem cells, umbilical cord blood

### INTRODUCTION

Stem cell research was launched into the limelight recently by James Thomson, a scientist at the University of Wisconsin in Madison, who successfully removed cells from spare embryos at fertility clinics and grew them in the laboratory, establishing the world's first human Embryonic Stem cell (ES cell) line. In the same year, Dr. Gearhart isolated cells from 2-4-month-old fetuses (obtained from elective abortions with informed consent from donors who had independently decided to terminate their pregnancy). Gearhart's team established a different line of cell cultures, by collecting cells from the gonadal ridge from 9-week-old fetuses. Embryonic Germ (EG) cells from each fetus were used to establish a separate culture line.

These discoveries can be considered to be the starting point of what eventually became a plethora of evidence that has emerged since then, suggesting that these ES cells are capable of becoming almost any of the specialised cells in the body and therefore have the potential to generate replacement cells for a broad array of tissues and organs such as the heart, liver, pancreas and nervous system. Furthermore, other kinds of stem cells have been identified and it was found that the variety of cells that can be produced from each kind of stem cells differs under different laboratory conditions.

When taking in account all available evidence, the possibilities for stem research seem truly endless and yet unpredictable. The emerging field of stem cell research crosses many disciplinary boundaries, including reproductive biology, embryology, cell biology, molecular biology, endocrinology, immunology, foetal medicine, transplantation medicine and surgery.

### MATERIALS AND METHODS

**Classification of stem cells in terms of their plasticity. Methods of culturing each type of stem cells in the lab:** Stem cells are defined as clonogenic, self-renewing progenitor cells that have the ability to divide for an indefinite period and can give rise to one or more differentiated cell types (Vejajiva, 2002), which ability is known as developmental plasticity.

Stem cells are classified into different types and the different types exhibit a different degree of plasticity. A fertilized egg (zygote) is able to give rise to all cells of the body and has the highest degree of developmental plasticity. It is thus said to be totipotent. Blastomeres are initially totipotent but their level of plasticity decreases quickly. In fact, blastomeres from a five-day human embryo (consisting of about 200 cells) are said to be pluripotent because they can only give rise to a limited range of cell types. As the embryo continues to develop,

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*Stem Cell Research* Great Britain. Parliament. House of Lords. Select Committee on Stem Cell Research, Great Britain. Parliament. House of Lords, 2002 The Committee was appointed in March 2001 to examine the issues arising from the Human Fertilisation and Embryology Research Purposes Regulations 2001 These regulations extended the legal grounds for research on human embryos to include the increase of knowledge about the development of embryos or serious disease or to enable such knowledge to help in the development of treatments for serious diseases The Committee's report analyses the potential of stem cell research to generate new therapies and assesses the relative scientific advantages and disadvantages of research on embryonic and adult stem cells It considers the ethical concerns about the use of early human embryos for research purposes and the implications of developments in cell nuclear replacement and reproductive cloning The report discusses the current regulatory regime and the scope for future legislation including the issue of informed consent and the creation of stem cell banks Overall the Committee finds that there is a strong scientific and medical case for continued research on human embryonic stem cells in order to realise the full therapeutic potential of stem cell research Adult stem cell research holds the promise of future therapies which might make further research on embryonic cells unnecessary although this is unlikely in the foreseeable future In the meantime to ensure maximum medical benefit it is necessary to keep both routes to therapy open since neither alone is likely to meet all therapeutic needs The role of the Human Fertilisation and Embryology Authority is crucial to the effective regulation of research and maintenance of public confidence *The SAGE Encyclopedia of Stem Cell Research* Eric E. Bouhassira, 2015-06-15 The SAGE Encyclopedia of Stem Cell Research Second Edition is filled with new procedures and exciting medical breakthroughs including executive orders from the Obama administration reversing barriers to research imposed under the Bush administration court rulings impacting NIH funding of research based on human embryonic stem cells edicts by the Papacy and other religious leaders and the first success in cloning human stem cells Stem cell biology is clearly fueling excitement and potential in traditional areas of developmental biology and in the field of regenerative medicine where they are believed to hold much promise in addressing any number of intractable medical conditions This updated second edition encyclopedia will expand on information that was given in the first edition and present more than 270 new and updated articles that explore major topics in ways accessible to nonscientists thus bringing readers up to date with where stem cell biology stands today including new and evolving ethical religious legal social and political perspectives This second edition reference work will serve as a universal resource for all public and academic libraries It is an excellent foundation for anyone who is interested in the subject area of stem cell biology Key Features Reader's Guide Further Readings Cross References Chronology Resource Guide Index A Glossary will elucidate stem cell terminology for the nonscientist Statistics and selected reprints of major journal articles that pertain to milestones achieved in stem cell research Documents from Congressional Hearings on stem cells and cloning Reports to the

President's Council on Bioethics and more      *Stem Cell Research* Great Britain. Parliament. House of Lords. Select Committee on Stem Cell Research, Great Britain. Parliament. House of Lords, 2002 Stem Cell Research Report from the Select Committee      **Embryonic Stem Cells and the Law** Joshua Weiser, 2024-06-05 This book deals with the research and use of embryonic stem cells to combat a number of diseases and the legal limitations arising mostly from bioethical concerns regarding human life Using the New Haven problem and policy oriented method of jurisprudence the author thoroughly explains the scientific and technological parameters and promise of this medical innovation and its alternatives as well as the conflicting claims and past decisions regarding its legal and moral acceptability in international and comparative perspective International law EU and regional human rights law as well as individual countries laws across the globe are covered ending with American law on the federal and state levels The book concludes with a recommendation of humane regulation and a draft federal statute as a model form of regulation that would allow the beneficial research and use of this technology

**Fundamentals of the Stem Cell Debate** Kristen Renwick Monroe, Ronald Miller, Jerome Tobis, 2008 What the editors have managed to accomplish with *Fundamentals of the Stem Cell Debate* is very significant The book is well informed sophisticated and attends to the moral and scientific complexities of stem cell research rather than sweeping them under the rug This book encompasses the complexities without sacrificing the other main virtue of the collection to definitively illuminate the debate for all Jason Scott Robert author of *Embryology Epigenesis Evolution Taking Development Seriously*

**Stem Cells, Human Embryos and Ethics** Lars Østnor, 2008-04-03 Is it acceptable from an ethical point of view to use stem cells from human embryos for scientific research and clinical therapy And what are the weaknesses and strengths of various opinions and positions when they are critically evaluated These are the main problems dealt with in this book The various chapters as a whole give a comprehensive many sided and balanced discussion of the subject The book contains contributions from biological medical social political philosophical and theological perspectives The authors have been chosen because of their professional competence many of them being respected scholars on a top international level They give an updated contribution from their own discipline in order to enlighten the different aspects of the common theme The authors cover various positions and evaluations with regard to the question of the use of embryonic stem cells for research and therapy The book is written for several audiences a scholars and professionals working with stem cell research or with the ethical questions arising from this field people from biology medicine law philosophy theology etc b advanced and graduate students within the same professional disciplines and c politicians and the general public interested in the burning ethical problems which are intensively debated in many countries      Biotechnology Fundamentals Firdos Alam Khan, 2018-09-03 A single source reference covering every aspect of biotechnology *Biotechnology Fundamentals* Second Edition breaks down the basic fundamentals of this discipline and highlights both conventional and modern approaches unique to the industry In addition to recent advances and updates relevant to the first edition the revised work also covers

ethics in biotechnology and discusses career possibilities in this growing field The book begins with a basic introduction of biotechnology moves on to more complex topics and provides relevant examples along the way Each chapter begins with a brief summary is illustrated by simple line diagrams pictures and tables and ends with a question session an assignment and field trip information The author also discusses the connection between plant breeding cheese making in vitro fertilization alcohol fermentation and biotechnology Comprised of 15 chapters this seminal work offers in depth coverage of topics that include Genes and Genomics Proteins and Proteomics Recombinant DNA Technology Microbial Biotechnology Agricultural Biotechnology Animal Biotechnology Environmental Biotechnology Medical Biotechnology Nanobiotechnology Product Development in Biotechnology Industrial Biotechnology Ethics in Biotechnology Careers in Biotechnology Laboratory Tutorials Biotechnology Fundamentals Second Edition provides a complete introduction of biotechnology to students taking biotechnology or life science courses and offers a detailed overview of the fundamentals to anyone in need of comprehensive information on the subject

*Ethics, Law and Society* Jennifer Gunning, 2017-07-28 This key collection brings together a selection of papers commissioned and published by the Cardiff Centre for Ethics Law Society It incorporates contributions from a group of international experts along with a selection of short opinion pieces written in response to specific ethical issues The collection addresses issues arising in biomedical and medical ethics ranging from assisted reproductive technologies to the role of clinical ethics committees It examines broader societal issues with particular emphasis on sustainability and the environment and also focuses on issues of human rights in current global contexts The contributors collect responses to issues arising from high profile cases such as the legitimacy of war in Iraq to physician related suicide The volume will provide a valuable resource for practitioners and academics with an interest in ethics across a range of disciplines

*Stem Cells—Advances in Research and Application: 2013 Edition*, 2013-06-16 Stem Cells Advances in Research and Application 2013 Edition is a ScholarlyEditions book that delivers timely authoritative and comprehensive information about Adult Stem Cells The editors have built Stem Cells Advances in Research and Application 2013 Edition on the vast information databases of ScholarlyNews You can expect the information about Adult Stem Cells in this book to be deeper than what you can access anywhere else as well as consistently reliable authoritative informed and relevant The content of Stem Cells Advances in Research and Application 2013 Edition has been produced by the world's leading scientists engineers analysts research institutions and companies All of the content is from peer reviewed sources and all of it is written assembled and edited by the editors at ScholarlyEditions and available exclusively from us You now have a source you can cite with authority confidence and credibility More information is available at <http://www.ScholarlyEditions.com>

*Biotechnology Fundamentals Third Edition* Firdos Alam Khan, 2020-03-04 After successful launching of first and second editions of Biotechnology Fundamentals we thought let us find out the feedbacks from our esteemed readers faculty members and students about their experiences and after receiving their suggestions and recommendation we thought it

would be great idea to write 3rd edition of the book Being a teacher of biotechnology I always wanted a book which covers all aspects of biotechnology right from basics to applied and industrial levels In our previous editions we have included all topics of biotechnology which are important and fundamentals for students learning One of the important highlights of the book that it has dedicated chapter for the career aspects of biotechnology and you may agree that many students eager to know what are career prospects they have in biotechnology There are a great number of textbooks available that deal with molecular biotechnology microbial biotechnology industrial biotechnology agricultural biotechnology medical biotechnology or animal biotechnology independently however there is not a single book available that deals with all aspects of biotechnology in one book Today the field of biotechnology is moving with lightening speed It becomes very important to keep track of all those new information which affect the biotechnology field directly or indirectly In this book I have tried to include all the topics which are directly or indirectly related to fields of biotechnology The book discusses both conventional and modern aspects of biotechnology with suitable examples and gives the impression that the field of biotechnology is there for ages with different names you may call them plant breeding cheese making in vitro fertilization alcohol fermentation is all the fruits of biotechnology The primary aim of this book is to help the students to learn biotechnology with classical and modern approaches and take them from basic information to complex topics There is a total of 21 chapters in this textbook covering topics ranging from an introduction to biotechnology genes to genomics protein to proteomics recombinant DNA technology microbial biotechnology agricultural biotechnology animal biotechnology environmental biotechnology medical biotechnology nanobiotechnology product development in biotechnology industrial biotechnology forensic science regenerative medicine biosimilars synthetic biology biomedical engineering computational biology ethics in biotechnology careers in biotechnology and laboratory tutorials All chapters begin with a brief summary followed by text with suitable examples Each chapter illustrated by simple line diagrams pictures and tables Each chapter concludes with a question session assignment and field trip information I have included laboratory tutorials as a separate chapter to expose the students to various laboratory techniques and laboratory protocols This practical information would be an added advantage to the students while they learn the theoretical aspects of biotechnology

Human Embryonic Stem Cells Arlene Chiu, Mahendra S. Rao, 2003-08-01 A discussion of all the key issues in the use of human pluripotent stem cells for treating degenerative diseases or for replacing tissues lost from trauma On the practical side the topics range from the problems of deriving human embryonic stem cells and driving their differentiation along specific lineages regulating their development into mature cells and bringing stem cell therapy to clinical trials Regulatory issues are addressed in discussions of the ethical debate surrounding the derivation of human embryonic stem cells and the current policies governing their use in the United States and abroad including the rules and conditions regulating federal funding and questions of intellectual property

**Advances in Blood Transfusion Research and Application: 2012 Edition** ,2012-12-26 Advances in Blood

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*Human Stem Cell Manual* Suzanne Peterson, Jeanne F. Loring, 2012-08-27 This reader friendly manual provides a practical hands on guide to the culture of human embryonic and somatic stem cells By presenting methods for embryonic and adult lines side by side the authors lay out an elegant and unique path to understanding the science of stem cell practice

*Toxic Mix?* Herbert N. Foerstel, 2009-12-09 This book presents a comprehensive analysis of the contentious relationship between the White House and the scientific community from the FDR administration to the Obama administration Toxic Mix A Handbook of Science and Politics takes a topic very much in the center of public debate in the last decade and places it in a revealing historical context It follows the often contentious relationship of science and politics from the FDR era to the current Obama administration highlighting the many highly charged moments when the two were in conflict Toxic Mix ranges across the major areas of scientific inquiry with public policy implications including atomic energy space science public health stem cells sexual reproduction environmental science global warming and evolution to examine important events where political imperatives and scientific research were at odds In addition the book looks at another important area where politics and science are at cross purposes immigration as many of our most accomplished degree earners are foreign born and are unable to stay and work in the United States A final chapter analyzes the attempts by the early Obama administration to build public policy that embraces science rather than manipulates it

The Global Politics of Human Embryonic Stem Cell Science H. Gottweis, B. Salter, C. Waldby, 2009-01-15 Drawing on a wide range of interviews and primary and secondary sources this book investigates the dynamic interactions between national regulatory formation and the global biopolitics of regenerative medicine and human embryonic stem cell science

**The Embryo** Shraga Blazer, Etan Z. Zimmer, 2005 Sophisticated imaging devices and new biological technologies have greatly enhanced our ability to detect an ever increasing number of fetal malformations during pregnancy Elucidation of the human genetic code and exact molecular definition of various diseases together with enhanced capabilities for repairing genetic defects have opened possibilities for diagnosis and treatment which less than a decade ago could only have been dreamed of However many clinical topics related to the embryo and human genetics as well as the issues of cloning and

the use of human embryonic stem cells have outpaced our ability to keep up appropriate public discourse of ethical religious and legal issues This book is designed to bridge the gap between scientific innovation treating clinicians and parents in whose unborn child a malformation was detected and who face a difficult and confusing decision making process All chapters were written by leading authorities and reflect the state of the art as well as the authors personal experiences unique perspectives and predictions for developments in their fields in the near future Specialists in obstetrics gynecology and reproductive medicine pediatrics and neonatology genetics molecular biology philosophy ethics and law will benefit from this book written by international experts in their fields *The National Bioethics Advisory Commission* Elisa Eiseman, 2003 The National Bioethics Advisory Commission NBAC was established in 1995 to advise various government entities on issues arising from research on human biology and behavior During its five year tenure NBAC submitted six reports to the White House containing 120 recommendations on several complex bioethical issues including the cloning of human beings and embryonic stem cell research This study assesses NBAC s contribution to policymaking by tracking the response to NBAC s recommendations from the president Congress government societies and foundations other countries and international groups

**Practical Decision Making in Health Care Ethics** Raymond J. Devettere, 2016-05-20 For more than twenty years Practical Decision Making in Health Care Ethics has offered scholars and students a highly accessible and teachable alternative to the dominant principle based theories in the field Raymond J Devettere s approach is not based on an ethics of abstract obligations and duties but following Aristotle on how to live a fulfilled and happy life in short an ethics of personal well being grounded in prudence the virtue of ethical decision making New sections added in this revised fourth edition include sequencing whole genomes even those of newborns the new developments in genetic testing now provided by online commercial companies such as 23andMe the genetic testing of fetuses by capturing their DNA circulating in the pregnant woman s blood the Stanford Prison experiment and its relevance to the abuses at the Abu Graib prison recent breakthroughs in the diagnosis of consciousness disorders such as PVS the ongoing controversy generated by the NIH study of premature babies at many NICUs throughout the country a study known as SUPPORT that the OHRP Office of Human Research Protections an office within the department of HHS deemed unethical Devettere updates most chapters New cases include Marlise Munoz dead pregnant woman s body kept on life support by a Texas hospital Jahi McMath teenager pronounced dead in California but treated as alive in New Jersey Margot Bentley nursing home feeding a woman dying of end stage Alzheimer s despite her advance directive that said no nourishment or liquids if she was dying with dementia Brittany Maynard dying 29 year old California woman who moved to Oregon to commit suicide with a physician s help and Samantha Burton woman with two children who suffered rupture of membranes at 25 weeks and whose physician obtained a court order to keep her at the hospital to make sure she stayed on bed rest Thoughtfully updated and renewed for a new generation of readers this classic textbook will be required reading for students and scholars of philosophy and medical ethics *Stem Cell Genetics for*



*Biomedical Research* Raul Delgado-Morales, 2018-06-27 This book looks at where stem cell technology is presently and how it is instrumental in advancing the field of disease modeling and cell transplantation. By focusing on major human disorders such as Alzheimer's disease, cancer, and heart disorders, the book summarizes the major findings in the field of human stem cells and dissects the current limitations on our understanding of stem cell biology. The chapters focus on the genetics, genomics, epigenetics, and physiology of stem cells, models together with technological advances on molecular biology such as CRISPR-Cas9 or epigenetic editing that will be instrumental in the future of human disease modeling and treatment. In the face of the limitations of current disease models and in the face of the unmet necessity of finding therapeutic interventions for human disorders, the availability of stem cell technology has opened new doors for several fields. The unlimited self-renewal capacity and more extensive differentiation potential of stem cells offers a theoretically inexhaustible and replenishable source of any cell subtype. Since Professor Shinya Yamanaka described it 10 years ago in his seminal paper that somatic cells could be reprogrammed to induce stem cells (iPSC) just by expressing four transcription factors, the field has exploded, especially its applications in biomedical research.

*The Legal, Medical and Cultural Regulation of the Body* Stephen W. Smith, 2016-03-03 The regulation of the body provides an important concern in law, medical practice, and culture. This volume contributes to existing research in the area by encouraging experts from a range of related disciplines to consider the legal, cultural, and medical ways in which we regulate the body, further exploring how conceptions of self, liberalism, property, and harm inform and influence contentious legal and ethical questions about what we can and cannot do to or with our own bodies.

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