

California Institute for Regenerative Medicine
Overview of Current Training Opportunities and Needs
July 10, 2006

Introduction

The following overview provides a high-level summary of training programs related to human embryonic stem cells (hESC). It includes an overview of CIRM Training Program as well as other training programs both across the country and in California, along with a discussion of future training needs and possible roles for CIRM in meeting those needs. It is designed to provide some background for our discussion and is not intended to be comprehensive or exhaustive.

I. Existing Training Programs

A. Overview of CIRM Training Grant Program (1)

1. Background

- a. CIRM is providing three year grants to California academic and non profit research institutions to foster training in stem cell research for pre-doctoral, post-doctoral, and clinical fellows. The rationale for the grant program is to train the next generation of stem cell researchers.
- b. Each institution offers a single, integrated program appropriate for the educational level of its trainees and the areas of expertise of its faculty, with a premium placed on training a diverse pool of investigators.
- c. All programs offer one or more classes in stem cell biology and a required course in the social, legal, and ethical implications of stem cell research. They also offer opportunities for laboratory work under the direction of a mentor in stem cell biology or clinical training that is closely related to stem cell research.

2. Award Details

- a. Three levels of awards accommodate trainees in programs at small and large institutions throughout California:
 - i. Type I - Comprehensive training programs: Offer training at all three educational levels (pre-doctoral, post-doctoral, and clinical) and support up to 16 CIRM Scholars at a total budget of up to \$1.25M per year.
 - ii. Type II - Intermediate training programs: Offer training at two of the three levels of education and may support up to ten CIRM Scholars at a given institution with a total budget of \$800K.
 - iii. Type III - Specialized training programs: Offer training at one or two levels of education and will fund up to six CIRM Scholars at a total budget of \$500K.

3. Award Recipients

- a. In April, 2006, the CIRM awarded its first training grants totaling \$12.1M (first year award); the program will cost roughly \$37.5M and support 169 scholars in the aggregate. Awards were made to 16 California non-profit institutions, as follows:

Institution	Approved Trainee Slots			1st Year Award
	Pre-Doctoral	Post-Doctoral	Clinical	
Burnham Institute	0	6	0	\$445,500
California Institute of Technology	0	10	0	\$690,608
Children's Hospital Los Angeles	0	7	3	\$784,006
Scripps Research Institute	3	3	0	\$347,160
Stanford University	6	5	5	\$1,221,694
The J. Gladstone Institutes	0	7	3	\$799,080
The Salk Institute for Biological Studies	0	6	0	\$481,010
University of California, Berkeley	6	4	2	\$815,990
University of California, Davis	4	4	4	\$896,082
University of California, Irvine	8	4	0	\$674,482
University of California, Los Angeles	5	5	6	\$1,231,802
University of California, San Diego	6	4	6	\$1,203,207
University of California, San Francisco	6	6	4	\$1,152,431
University of California, Santa Barbara	2	4	0	\$393,091
University of California, Santa Cruz	3	3	0	\$374,730
University of Southern California	5	2	2	\$601,379
TOTAL	54	80	35	\$12,112,252

B. Overview of Selected Training Programs

1. Selected Programs Outside California

Cold Spring Harbor Laboratory - New York (2)	
Course Topic / Title	Stem Cells
Objective	To provide participants with an opportunity to achieve an advanced understanding of the scientific and clinical importance of stem cells
Duration	Two-week lecture course
Target Audience(s)	Leading researchers in the stem cell field and a small group of international students
Synopsis	<ul style="list-style-type: none"> ▪ This lecture and discussion course is designed to cover a series of subjects including: the cells of the early embryo, the nature of germ cells, the mechanisms that control the number of stem cells, their stability, and transformation into other cell types ▪ The clinical potential and political impact of stem cell technology will also be presented in depth by invited speakers
Cost	\$2,540 (includes board and lodging)
Funding	Funds provided by the Howard Hughes Medical Institute (HHMI)

Jackson Labs - Maine (3)	
Course Topic / Title	Methods in Human Embryonic Stem Cell Research
Objective	This annual workshop provides hands-on training for investigators learning how to culture, manipulate, and differentiate hESC cells from humans in vitro
Duration	6 days
Target Audience	Attendance is limited to those with or near completion of a doctorate
Synopsis	<p>The course will include:</p> <ul style="list-style-type: none"> ▪ Preparation of media, including quality control practices ▪ Preparation and cryopreservation of mouse embryonic fibroblasts ▪ Cell passaging, cryopreservation, and transfection techniques ▪ FACS analysis of cells and derivatives ▪ Experimental differentiation of embryonic stem cells
Cost	\$1,500
Funding	NIH

Technion / Johns Hopkins University - Maryland (4)	
Course Topic / Title	Short-term Course in Human Embryonic Stem Cell Culture Techniques
Objective	To learn about human embryonic stem cell (hESC) culture techniques
Duration	5 days
Target Audience	Not specified
Synopsis	<p>The course covers the following topics :</p> <ul style="list-style-type: none"> ▪ An introduction, including a brief scientific background and a discussion of hESC markers ▪ Derivation, culture, freezing and thawing of human and mouse feeder cells ▪ hESC culturing methods, including culture and daily care, freezing and thawing, and various culture media ▪ hESC differentiation methods, including embryoid body formation
Cost	\$950
Funding	NIH

The University of Wisconsin - Wisconsin (5)	
Course Topic / Title	The Wisconsin Stem Cell Training Program (SCTP) is a new interdisciplinary postdoctoral program which aims to train a future generation of stem cell researchers.
Objective	<p>To provide postdoctoral researchers and graduate students with a comprehensive understanding of stem cell biology and ethics and:</p> <ul style="list-style-type: none"> ▪ Foster communication among stem cell researchers ▪ Provide information on stem-cell-related research breakthroughs, new publications, and funding opportunities ▪ Coordinate fundraising efforts, especially for collaborative projects involving multiple research groups
Duration	The postdoctoral traineeships are initially awarded for a one-year period, renewable for a second year upon demonstration of satisfactory progress
Target Audience(s)	<ul style="list-style-type: none"> ▪ The traineeships are open to trainees who will work with SCTP Trainers as mentors ▪ Applicants must receive their Ph.D., M.D., V.M.D., or equivalent degree before the initial date of the proposed traineeship
Synopsis	The SCTP will include a core lecture series, a journal club, a retreat, a plenary lecture series, and an ethics course
Cost	N/A (NIH specifies trainee salary levels)
Funding	A T32 Training Grant from the National Institute of Aging

WiCell Research Institute - Wisconsin (6)	
Course Topic / Title	Introduction to Human Embryonic Stem Cell Culture Methods
Objective	This "hands-on" course is intended to provide participants with an understanding of the basic concepts of human embryonic stem cell culture.
Duration	3 days
Target Audience(s)	Those who have at least six months sterile tissue culture experience in the last five years.
Synopsis	<ul style="list-style-type: none"> ▪ This is an introductory course that teaches basic hESC culture methods. ▪ The course is not intended to be an introduction to sterile technique or basic tissue culture. ▪ Methods for directed differentiation to specific lineages and derivation of new lines are NOT covered.
Cost	\$1000
Funding	This course is supported with funds from the WiCell Research Institute

University of Georgia, Biomedical and Health Sciences Institute (7)	
Course Topic / Title	Human Embryonic Stem Cell Toolbox Workshop
Objective	To enable participants to work with instructors with over two years experience in developing and propagating NIH approved hESC lines.
Duration	5 days
Target Audience	Not specified; enrollment is limited to 16 students.
Synopsis	<p>Participants will acquire skills/knowledge in:</p> <ul style="list-style-type: none"> ▪ Propagation (mechanical and enzymatic techniques), maintenance, and cryopreservation of undifferentiated hES ▪ Induced differentiation of hES cells by embryoid body cultures) ▪ Markers used to follow hES cell differentiation through immunocytochemistry, cell cytometry, biochemical markers and cell cycle, microarray and real-time PCR analysis.
Cost	\$1,500
Funding	NIH

University of Minnesota Stem Cell Institute (8)	
Course Topic / Title	Essentials of Human Embryonic Stem Cell Culture Techniques
Objective	To provide hands-on training in the culture of hESC
Duration	3 days
Target Audience	<ul style="list-style-type: none"> ▪ Eligible individuals, include, but are not limited to graduate students, post-doctoral fellows, research technicians, and faculty. ▪ A maximum of five investigators, with a minimum of 6 months mammalian cell culture experience, can be trained in each session. . ▪ Special consideration will also be given to scientists who are the first individual from their laboratory to attend.
Synopsis	<p>The course will cover:</p> <ul style="list-style-type: none"> ▪ Passaging, freezing, thawing, and banking of hESC. ▪ Methods in monitoring hESC cultures by karyotype, stem cell marker expression, and pluripotency assays. ▪ Instruction in methods to establish primary mouse embryo fibroblast (MEF) feeders and alternative methods without the use of MEFs. ▪ Methods of differentiation and genetic modification for transient and stable gene expression will also be presented.
Cost	\$1,000
Funding	NIH

The Harvard Stem Cell Institute (HSCI) (9)	
Course Topic / Title	HSCI Summer Undergraduate Research Internships 2006
Objective	The goal of the program is to provide undergraduate students with a research experience they may otherwise not have and to expose them to different options including career pathways.
Duration	The internships last for a period of 10 weeks (or longer by agreement with the faculty host) during the summer.
Target Audience(s)	Undergraduates
Synopsis	This program is intended to encourage those without access to stem cell research to consider this area of science, perhaps for a post graduate program, and help promote awareness at the students' own schools.
Cost	The 2006 stipend will be \$4,320
Funding	The Summer Undergraduate Research Internship is funded by the Howard Hughes Medical Institute

2. Selected Programs Inside California

(Note: Programs also exist at the University of California, San Francisco, and the Burnham Institute but detailed information was not readily available at this writing.)

Children's Hospital of Orange County Research Institute (10)	
Course Topic / Title	Human Embryonic Stem Cell Culture Training Course
Objective	<ul style="list-style-type: none"> ▪ To provide hands-on training for investigators to learn how to culture, manipulate, and differentiate hESC humans in vitro ▪ The overall goal is to send students back to their labs with the ability to efficiently set up and conduct human embryonic stem cell research
Duration	10 days
Target Audience(s)	The courses are available to investigators in research areas of interest and to all institutes and centers of the NIH
Synopsis	<p>Each course will cover, among other topics, the following:</p> <ul style="list-style-type: none"> ▪ Demonstration of proper growth conditions for cells and proper freeze-thaw cycling and preparation of cell passages ▪ Use of co-culture techniques and cell separation procedures ▪ Development of protocols that support the hESC characterization ▪ Application of standard protocols for directed differentiation of hESC ▪ Cross-training of techniques used in other stem cell applications
Cost	The tuition for the course has been set at \$3,750
Funding	NIH.

Pasadena City College (PCC) (11)	
Course Topic / Title	Stem Cell Culture Training Program / Biological Technology Program
Objective	Incorporation of mouse stem cell culture training into the program allows PCC to train students to work in facilities performing stem cell research
Duration	At least one year
Target Audience(s)	Not specified.
Synopsis	<ul style="list-style-type: none"> ▪ Students train to work in academic institutions or the biotech industry. ▪ On average, the Program serves 25 students per year. ▪ Incorporating mouse stem cell culture training allows training of students to work in facilities performing stem cell research
Cost	Not specified
Funding	Not specified

City College of San Francisco (11)	
Course Topic / Title	Stem Cell Technology Certificate Program
Objective	To equip participants with the advanced skills needed to find jobs in the lucrative and rapidly growing field of stem cell research
Duration	Students with proper background can complete the program in 1 year
Target Audience(s)	Undergraduates
Synopsis	Using a two-year \$779,067 grant, City College created a Stem Cell Research Technician Certificate program which will equip participants with the advanced skills needed to find jobs in the lucrative and rapidly growing field of stem cell research
Cost	Not specified
Funding	California Governor's funding category Growth Industries; High Wage, High Skill Job Training

II. Discussion of Issues Related to Training

A number of challenges face researchers, particularly junior researchers, who wish to enter the field of stem cell science, or any field of research for that matter; several of these issues are outlined below.

A. Lack of Protected Time for Physician-Scientists

1. We have heard anecdotally that a lack of "protected" time (that is, time devoted exclusively to conducting research) in the face of ever increasing clinical responsibilities is perhaps the greatest challenge to young physician-scientists entering the research arena.

B. The Need to Develop "Grantsmanship" (12)

1. Young investigators may face a lack of readily identifiable research funding dollars. This lack of funding is often exacerbated by a lack of facility and experience in "researching" funding sources. Finally, many young researchers do not properly understand the mechanics of procuring funding.

C. The "Learning Curve" (13)

1. Many postdocs and students find themselves scrambling to acquire fresh skills as research becomes ever more interdisciplinary and multidisciplinary. This is causing a change in the way scientists need to be trained and form collaboration outside their own fields. Although they must gain expertise in their speciality, they must also become conversant in techniques outside their domain and recognize when they should seek help from or collaborate with others who have the relevant expertise.

III. Potential Roles for CIRM - Topics for Discussion

A. Possible Enhancement of Existing Training Grant Program

1. Increasing the number of training grants awarded
 - a. CIRM has awarded 16 training grants to date and may consider funding other training grants in the future.
2. Fostering interactions among trainees
 - a. CIRM might host an annual meeting of current trainees so they can meet other fellows and scholars in the state and view the spectrum of stem cell research ongoing in California. This would also present a good opportunity to meet mentors or future collaborators
3. Increasing the visibility of the program
 - a. A website on the current program highlighting key elements and offerings could help increase awareness of the program among California researchers and the general public.
4. Providing opportunities for technical training
 - a. One option is for CIRM to support training programs aimed at providing the technical skills necessary to work in the field of stem cell research.
5. Expanding education to include outreach efforts
 - a. CIRM could consider providing educational opportunities to the public and those interested in learning about stem cell science, research, ethics, etc.
 - b. Another option is to establish programs for educating high school and college students about stem cell research and the career opportunities in the field.

B. Addressing the Issue Facing Researchers

A number of options exist for how CIRM might use training and training-related programs to address the challenges facing investigators, junior and senior, hoping to enter the field of stem cell research.

1. Lack of Protected Time for Physician-Scientists
 - a. The CIRM could support efforts to buy the time of younger physician-scientists (that is, CIRM could provide a portion of their salaries to free them from clinical responsibilities not associated with research or education).
2. The Need to Development "Grantsmanship"
 - a. The CIRM could use its web site to help increase accessibility of information about the existing availability of research funding (from CIRM and other sources) for junior researchers.

- b. In addition to publicizing its own funding opportunities, the CIRM could support courses to educate junior researchers on how to identify funding sources and prepare grant requests specifically targeting philanthropic organizations, the pharmaceutical industry (including foundations), the Federal government, and professional societies, among others (12).
- 3. The "Learning Curve" (13)
 - a. CIRM could support the design and implementation of courses for stem cell researchers that cut across a range of disciplines that are utilized in stem cell research (e.g., genomics, proteomics, ethics, etc). Such courses would provide researchers with a "toolbox" of broadly based skills.

References

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