

Institutional Profile

Stem cell training at Pasadena City College: providing pathways to careers in stem cell research

The Biological Technology Program at Pasadena City College (PCC) offers specialized stem cell training that provides pathways for students to careers in stem cell research. Training in stem cell culture techniques was added to the biotechnology curriculum at PCC in 2005 in response to the anticipated need for skilled stem cell technicians after the passage of a statewide ballot measure funding stem cell research efforts in California. Students who receive stem cell training at PCC reflect California's diverse workforce, including first-generation college students, high school students, individuals pursuing a second career, women re-entering the workforce, displaced workers and veterans. More than 50% of the students who join the Biotechnology Program for stem cell training have already earned their Bachelor's degrees and are acquiring additional skills to secure employment or improve their applications for graduate and professional schools. The mission of the PCC Stem Cell Training Program includes: preparing students for careers in stem cell research, both in academia and in industry; working to ensure that students are competitive in applications for postgraduate programs; facilitating internships and advanced training opportunities in the stem cell field; and providing a well-trained workforce at various educational and technical levels to the local stem cell research community.

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Program overview

The Biological Technology Program: Stem Cell Training at Pasadena City College (PCC) offers educational opportunities and training at the community college level that has a significant and positive effect on the local community and its economy. Students who join the Biotechnology Program for stem cell training are representative of California's diverse workforce, including first-generation college students, talented high school students, individuals pursuing a second career, women re-entering the workforce, displaced workers and veterans. More than 50% of the students who participate in the Stem Cell Training Program at PCC have already earned their bachelor's degrees and are acquiring additional skills to obtain employment or enter graduate and professional schools. The PCC Stem Cell Training Program prepares this diverse student population for research

and career opportunities in the fields of stem cell biology and regenerative medicine. PCC has formed partnerships with local research institutes and biotechnology companies in order to secure job and internship opportunities for the students, and has also encouraged local companies to donate equipment and supplies for training activities. As a result, the PCC Stem Cell Training Program is able to provide a diverse and well-trained workforce to the local stem cell research community at various educational and technical levels (FIGURE 1 & SUPPLEMENTARY FIGURE 1) (see online www.futuremedicine.com/doi/suppl/10.2217/rme.12.4/suppl_file/suppl_figure_1.doc).

Development of the program

- November 2004: Proposition 71 (California Stem Cell Research and Cures Initiative) passed.



- Spring 2005: received PCC Foundation Award to facilitate transfer of mouse stem cell culture technology from California Institute of Technology (Caltech; CA, USA) to PCC Biotechnology Program.
- Summer 2005: dedicated cell culture facility established on PCC campus, faculty participation in a 6-week training program in stem cell culture techniques at Caltech and curriculum development.
- Fall 2005: delivered first Stem Cell Culture Course at a community college in California.
- January 2006: presented the Stem Cell Culture Training Program at the 18th Annual Symposium, California State University Program for Education and Research in Biotechnology.
- Summer 2006: first Certificates of Achievement in Stem Cell Culture

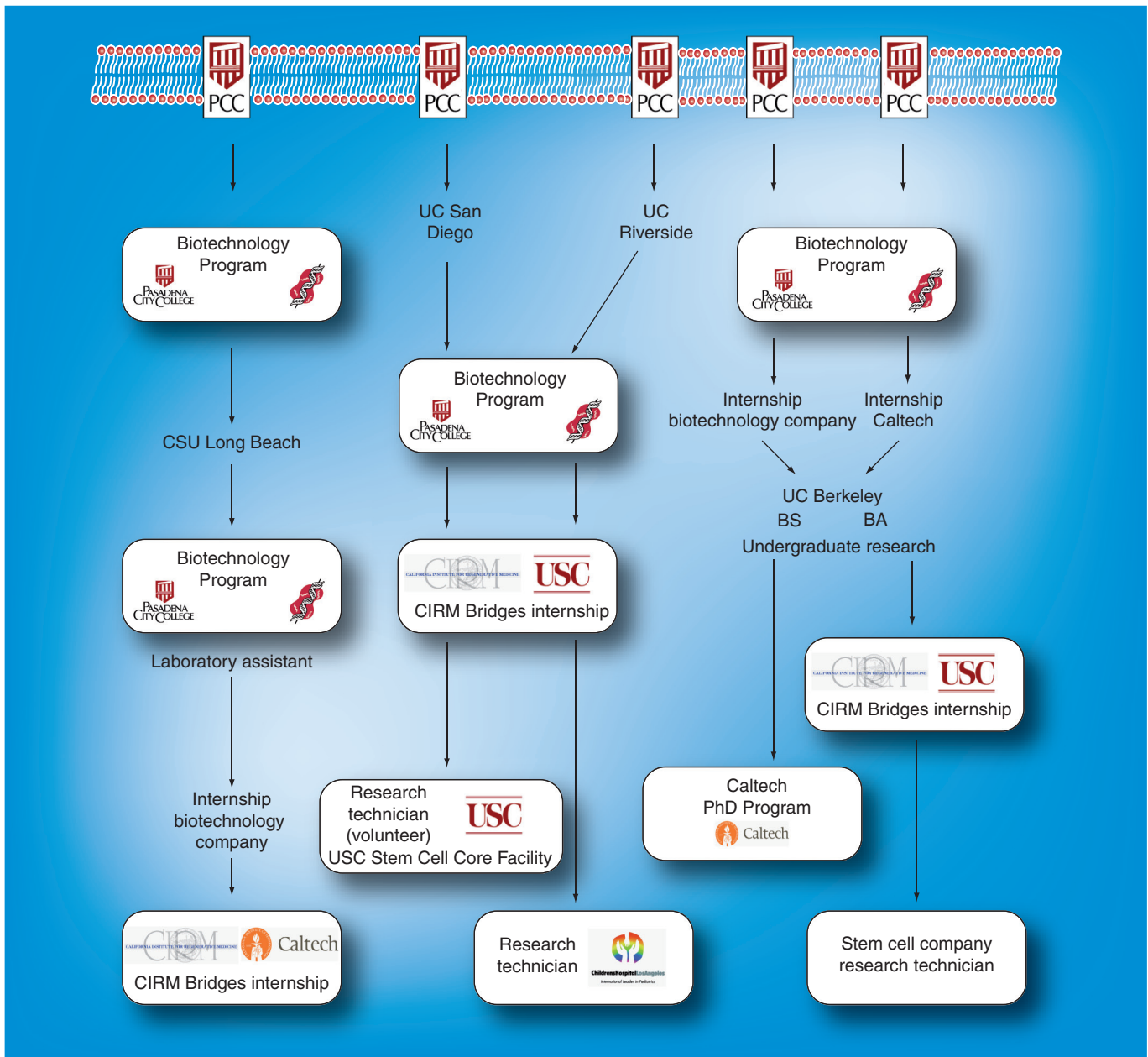
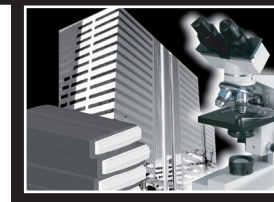


Figure 1. Stem cell training pathways to careers in stem cell research.

BA: Bachelor of arts; BS: Bachelor of science; Caltech: California Institute of Technology; CIRM: California Institute for Regenerative Medicine; CSU: California State University; PCC: Pasadena City College; UC: University of California; USC: University of Southern California.



- awarded to students successfully completing the required courses.
- Fall 2006: completed major renovation of biology stockroom to new cell culture facility.
- February 2007: submitted letter of support for the University of Southern California (USC) California Institute for Regenerative Medicine (CIRM) application to allow PCC students to participate in the proposed course: ‘Current Protocols in Human Embryonic Stem Cell Research.’
- July 2008: internship agreement with USC Center for Stem Cell and Regenerative Medicine.
- Spring 2009: received a CIRM Bridges to Stem Cell Research Award.
- Prepares students to further their education at 4-year universities;
- Provides needed training for students who have earned a bachelor’s degree and who intend to apply to postgraduate programs;
- Facilitates internships and provides assistance with job placements.

Students have been placed as interns or employees at over 50 sites, including public and private institutions, academic and research facilities and biotechnology companies.

Biological technology curriculum

The biotechnology courses are taught in a working laboratory setting. This setting allows the students to learn more than just core competencies, as it trains them to work in a research laboratory environment. The students are also mentored and evaluated as if they were employed by a biotechnology company or research institute. As a result, students learn employment

Benefits of the program

The program:

- Gives students a competitive advantage in the biotechnology workforce;

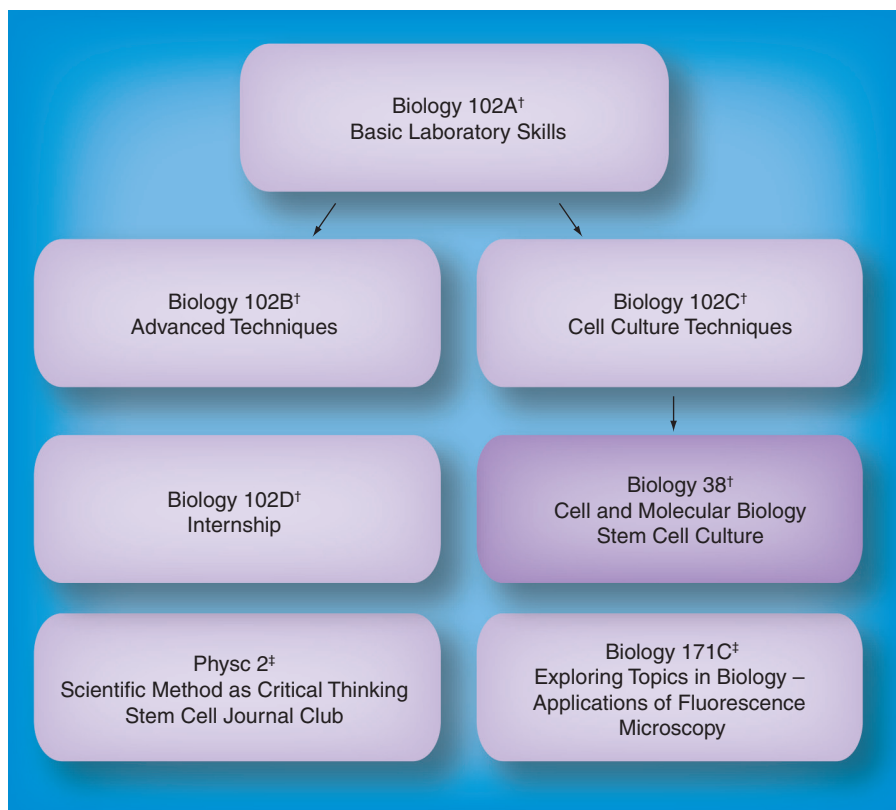


Figure 2. Biological technology core curriculum at Pasadena City College.

[†]Biotechnology coursework required to earn a Certificate of Achievement in Stem Cell Culture.

[‡]Biotechnology coursework developed for the California Institute for Regenerative Medicine-funded program: Bridges to Stem Cell Research at Pasadena City College.

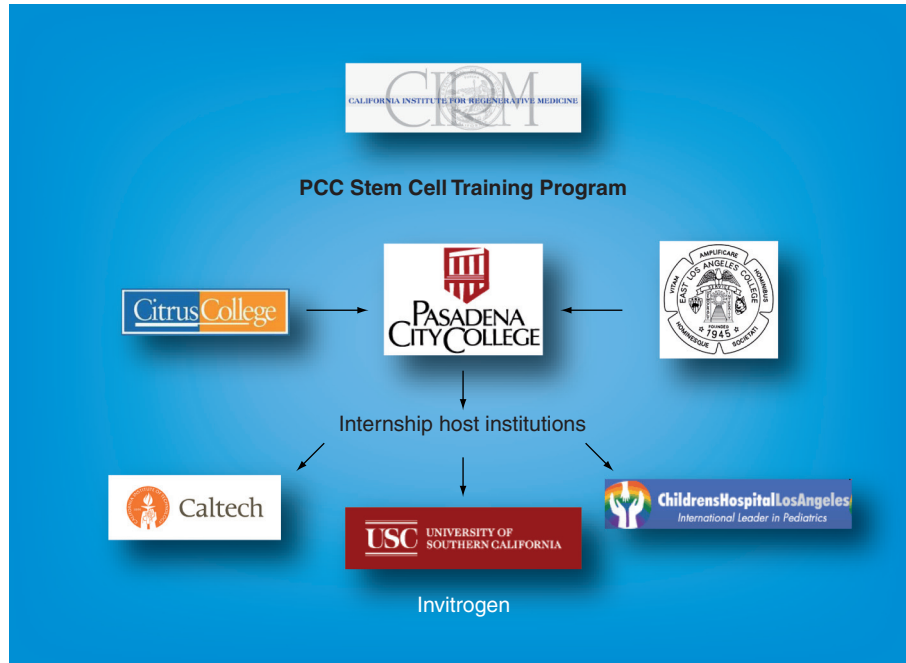


Figure 3. Program affiliations for the California Institute for Regenerative Medicine Bridges to Stem Cell Research at Pasadena City College.

Caltech: California Institute of Technology; PCC: Pasadena City College.

skills such as confidentiality, time and resource management and the ability to work as part of a team. Notebook-keeping skills and proper documentation of data are emphasized in all biotechnology laboratory classes at PCC. FIGURE 2 gives an overview of the curriculum.

- BIOL 102A: Introduction to fundamental laboratory skills. Skills include basic

laboratory techniques, solution preparation, sterile technique, cloning procedures, plasmid DNA purification and use of laboratory equipment.

- BIOL 102B: Advanced skills in applied biological technology. Skills include electrophoretic techniques (polyacrylamide gel electrophoresis), column chromatography, PCR, ELISA, DNA

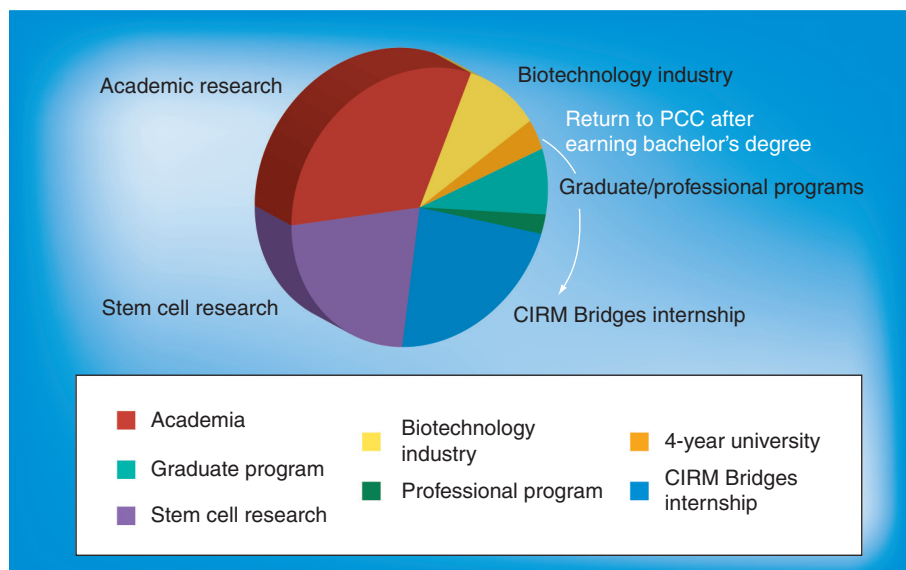
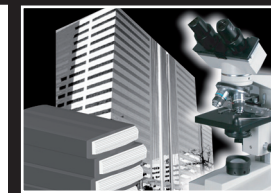


Figure 4. Student outcomes after participating in stem cell training at Pasadena City College.

CIRM: California Institute for Regenerative Medicine; PCC: Pasadena City College.



and protein purification and Southern and western blot analyses.

- BIOL 102C: Advanced skills in applied biological technology. Skills include basic and advanced mammalian cell culture techniques. Projects demonstrate an application of cell culture. Requires a poster presentation of the project at a poster session.
- BIOL 102D: Advanced skills in applied biological technology. Internship requires a student to complete a minimum of 234 h of training to satisfy course requirements.
- BIOL 38: Cell and molecular biology. Theory of cell structure, types, chemistry and function of stem cells. Methods used in biomedical and academic stem cell research programs including laboratory procedures for the growth and maintenance of mouse embryonic stem cells in culture, nondirected and directed differentiation of stem cells, and genetic modification of stem cells. Includes characterization of undifferentiated and differentiated stem cells by a variety of techniques. Projects require the performance of directed differentiation of mouse embryonic stem cells and evaluation of differentiated cell types.
- BIOL 28: Introduction to bioinformatics. Structure and function of proteins and nucleic acids, molecular modeling, sequence alignment and biological database management.
- BIOL 71C: Exploring topics in biology – RNA interference (RNAi). Biological mechanism and applications of RNAi.
- BIOL 171C: Exploring topics in biology – applications of fluorescence microscopy. Basic principles and practical biological applications of fluorescence microscopy.
- PHYSC 2: Scientific method as critical thinking – stem cell journal club. Techniques for critically reading, understanding and evaluating a scientific research article. Students present current stem cell research articles in a

traditional and an online journal club format.

Major accomplishments

- In fall 2005, PCC became the first community college in California to offer stem cell culture training to its students and introduced a Certificate of Achievement in Stem Cell Culture.
- In spring 2009, PCC was the first community college to receive a CIRM Bridges to Stem Cell Research Award to further develop the Stem Cell Training Program at PCC and to provide paid internships and training for selected students.
- In fall 2009, the new CIRM-funded Stem Cell Training Program, CIRM Bridges to Stem Cell Research at Pasadena City College began.

CIRM Bridges Internship Program

CIRM Bridges to Stem Cell Research at PCC is a stem cell training program that offers exciting new research, educational and training opportunities to biotechnology students at PCC. Students selected to participate in the CIRM Bridges Internship Program have an opportunity to participate in a 1 year paid internship in a world-class laboratory performing stem cell research at one of three local renowned research institutes: Caltech, USC and the Children's Hospital Los Angeles. In addition, selected students are eligible for additional coursework and educational enhancement activities related to stem cell biology offered by PCC and the host research institutions. Educational enhancement activities include: seminars and symposia (intellectual property and confidentiality issues, stem cell and regenerative medicine, bioethics and stem cell career opportunities); stem cell seminar series at PCC hosted by Bridges interns; and specialized workshops (data management, bioinformatics, scientific writing and presentations and graduate school applications). CIRM Bridges interns also participate in community and high school outreach activities. An overview of the program is given in **FIGURE 3**.



PCC stem cell training pathways to careers in stem cell research

The Biological Technology Program: Stem Cell Training at PCC provides numerous pathways to careers in stem cell research. Students who have participated in the Stem Cell Training Program at PCC have followed many paths, including research positions in academia and the biotechnology industry, transfers to 4-year universities, graduate or professional programs and the CIRM Bridges to Stem Cell Research Internship Program. Some students have followed multiple paths (see FIGURE 1 for details and FIGURE 4 for student outcomes).

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The author has no relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript. This includes employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, or royalties.

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