Model Stem Cell Curriculum Overview

The first outreach to students developed by CIRM was an introductory PowerPoint stem cell lesson. This lesson has been presented to teachers and students in California to stimulate interest and disseminate stem cell science information in this area of study for which there is little textbook material available. The introductory lesson is included as part of this curriculum along with detailed lessons (modules) in five units. The introductory lesson is intended for use by teachers who wish to teach a short lesson in one class period. The curriculum was developed by CIRM staff or CIRM-sponsored outreach programs, in collaboration with high school teachers in the Bay Area and San Diego.

These materials are suitable for use in 9th through 12th grade biology, advanced biology, AP biology, chemistry, advanced chemistry, AP chemistry, community college classes, biotechnology, physiology, anatomy, and government courses. Unit one is most appropriate for beginning biology classes. Units two through five are appropriate for more advanced classes but can be adapted for beginning students. The curriculum is comprehensive, and is intended for use by teachers and students as a study of stem cell biology and its uses in medicine and treatment therapies.

Skip to the unit descriptions and links

Model Curriculum

A team of California high school teachers, CIRM staff, and experienced student members of the UC Berkeley Stem Cell Education Outreach Program crafted five units in four to seven-day modules on stem cell science that are available online, free of charge, to high school teachers. Together with the introductory stem cell lesson, the units provide you with a central source for unbiased, accurate scientific information you can use to engage students in stem cell science while conveying underlying biological concepts and considering underlying ethical dilemmas. The team made every effort to verify the scientific accuracy of each unit. Although the units also introduce ethical issues regarding stem cell research, they strive to take a balanced position on these issues, describing both the benefits of embryonic stem cell research and the importance of discussing societal questions regarding technologies such as in vitro fertilization, preimplantation genetic diagnosis, and human embryonic stem cell research. See topics covered in the units below.

Usage

Each unit, which consists of multiple lessons, follows California's standards-based approach to introducing fundamental biological concepts. The applicable standards covered in each unit can be found on the first page of each "Lesson Outline" document. Some units encourage student insights into the impact of emerging stem-cell-related hypotheses on the world. All lessons draw upon current scientific literature, provide easy-to-understand summaries of journal articles and when possible, links to the papers and their abstracts. All units include teacher and student glossaries which define scientific terms. Units are updated to keep content current.

Teachers are encouraged to use the Introductory PowerPoint Stem Cell Lesson and the Unit Summary PowerPoint Lessons for self-education, or may use it in any way that helps present the material to students.

Important, are the Glossary, Background Information and Bibliography. There is a great deal of information in the Background Information sections intended for teacher use, not necessarily for student reading. This information may be helpful to teachers who aren't familiar with particular areas of study and can be used for enrichment for big-picture topics. The teacher glossary addresses bold terms within the teacher background information section.

Appendices contain lesson components that are important to the structure of the lessons. They contain graphic organizers, examples of student work, interactive tools, handouts, diagrams, etc. Use them as noted within the lesson text.

Modifications for Inquiry Teaching

Go to Inquiry Materials

Levels of Difficulty

In several units, you can choose among, “easy,” “mid-level,” or “challenging” lessons and web readings that complement the fundamental concepts. Sections labeled “AP extension topics” provide sets of questions, readings, and activities suitable for more-advanced students. Each unit covers multiple topics and links to a downloadable, summary PowerPoint presentation, animations, lab investigations, and graphic organizers. Teachers are encouraged to view all resource materials thoroughly TO DETERMINE WHAT WORKS BEST!

For Your Curriculum

Stem Cell Units Are Fully Modular

Although we designed each unit and its supplementary material to cover a maximum of seven days, we would like you to use the material in the way that works best for your classroom. The materials are fully modular at the unit, topic, and subtopic level, so you can select the topics you find most appropriate for your students, rearrange the information as you see fit, and present one or more units over whatever number of class days works best for you and your class.

State Funding

These detailed lessons comprise the “CIRM model curriculum on stem cell science” as discussed in Senate Bill 471 (Romero and Steinberg)--the California Stem Cell and Biotechnology Education and Workforce Development Act of 2009--signed by the Governor. CIRM is responsible for appropriating funds for stem cell research in California and operates using funds from California Bond Sales, not Federal funds.

The Stem Cell Units

These are the topics covered by each unit and a description of each. Units are structured so that students first gain basic biology knowledge then bridge to activities and projects designed to stimulate student interest in stem cell policy, ethics, and research as well as regenerative medicine and biotechnology.

Unit 1: Embryonic stem cells, in-vitro fertilization and pre-implantation genetic diagnosis

- Go to Unit 1

Recommended for beginning biology classes, a review or overview for AP students, community college, biotechnology, and anatomy/physiology classes. Time suggested for unit - approximately six days.

Compares natural fertilization with in vitro fetilization. Describes a developing embryo, including the location of totipotent and pluripotent stem cells and the ethics of genetic diagnosis and uses of embryos.

Unit 2: Adult stem cells, homeostasis and regenerative medicine

- Go to Unit 2

Recommended for Biology, AP Biology, biotechnology, and anatomy/physiology classes, lower division college level. Time suggested for unit - approximately seven days

Highlights the differences between wound healing and regeneration, reviews idea of regeneration in animals, identifies how adult stem cells affect homeostasis in humans, explains the differences between adult stem cells and progenitor cells, studies cell-based therapies and pharmaceutical developments, and includes examples of medical tourism.

Unit 3: The microenvironment, its role in cell fate decisions and cancer

- Go to Unit 3

Recommended for advanced/AP/IB level classes, biotechnology, college level. Time suggested for unit - ten days

Studies the relationship of stem cells and their environment, and how this directs proliferation and differentiation. Highlights how different signals control genes to produce phenotypes. Investigates how factors of microenvironments help to determine cell fate. Explains how gene aberrations and microenvironment contribute to cancer.

Unit 4: The immune system and the hematopoietic stem cell lineage tree

- Go to Unit 4

Recommended for advanced/AP/IB level classes, college level. Time suggested for unit - 10 days

Constructs a context for blood cell lineage with microscope study of blood cells, investigates the origin of blood and diversity of blood cell types, discusses the function of white blood cells in immunity and familiarizes students with blood diseases and immune disorders. Students have a chance to diagnose disorders through case studies.

Unit 5: Developing induced pluripotent stem cells

- Go to Unit 5

Recommended for advanced/AP/IB level classes, biotechnology, college level. Time suggested for unit - 10 days

Discusses what induced pluripotent cells are and why they've been researched and developed. Readings present topics from the most current research on iPS, including transcription factors used to create iPS, problems encountered in iPS development and ethics of creating these cells.
