

Stem Cell Gold Rush Educator Guide

A resource for using QUEST video and audio in the classroom

Watch it online at <http://www.kqed.org/quest/television/stem-cell-gold-rush> | TV story length 10:19 minutes

Listen online <http://www.kqed.org/quest/radio/new-life-for-embryonic-stem-cell-research> | Radio story length 5.50 minutes

QUEST SUBJECTS

Life Science	Biology Health Environment
Earth Science	Geology Weather Astronomy
Physical Science	Physics Chemistry Engineering

PROGRAM NOTES

Watch **Stem Cell Gold Rush**

California's landmark stem cell research program made headlines nationally, but what's the latest story behind the science? QUEST investigates the potential for medical breakthroughs in the next decade and how the Bay Area is leading the way.

Listen to **New Life for Embryonic Stem Cell Research**

As President Barack Obama reverses the ban on federal funding for embryonic stem cell research, the resulting boom in this cutting-edge medical technology will benefit California's research institutes in a big way.



In these segments you will find...

- an explanation of how stem cells are developed and examples of potential uses for stem cells.
- the difference between embryonic stem cells and adult stem cells.
- how federal and state laws are affecting the use of stem cells in scientific studies.

CA SCIENCE STANDARDS

Grade 7

Cell Biology

1. All living organisms are composed of cells, from just one to many trillions, whose details usually are visible only through a microscope. (a, e, f)

Structure and Function in Living Systems

5. The anatomy and physiology of plants and animals illustrate the complementary nature of structure and function. (a, b)

TOPIC BACKGROUND

You began life as an individual cell. By the time you were born, that cell had gone through millions of divisions. By adulthood, you're made up of approximately 100 trillion individual cells -- over 200 different types of cells -- working together. Each cell, or group of cells, has a specific task or specialty. Those specialties allow an organism to function.

There are two types of stem cells. Embryonic stem cells are found in the very early stages of an organism's development. These cells are undifferentiated; they have the potential to turn into any type of cell. Adult stem cells, found in children and adults, have begun the transformation into a specific type of cell.

To cultivate embryonic stem cells in a laboratory, scientists begin with a fertilized embryo -- called a blastocyst -- that has divided into about 100 to 150 cells. The inner cells, the stem cells, are removed and reproduced in a culture. These genetically identical cells are called a stem cell line.

Stem cells have many potential benefits. Scientists are interested in using embryonic stem cells to develop treatments and cures for a number of diseases, including heart disease and juvenile diabetes. One of the current research challenges is to understand the mechanism that leads to cell specialization so that specific cells can be developed in a controlled environment.

In 2001, President George W. Bush stopped federal funding for research based on new stem cell lines, restricting funds to research that used stem cell lines developed by August 2001. This is a problem for many researchers who need to develop new stem cell lines due to limitations with the existing lines. In November 2004, California voters approved Proposition 71, the California Stem Cell Research and Cures Act. It established the California Institute for Regenerative Medicine, which now regulates and funds stem cell research.

Media Enhance Education

Video and audio can be powerful tools for meaningful learning. It all depends on you, the educator. The key to using media effectively is preparation. Make the most of learning opportunities by encouraging students to become active viewers and listeners. Pick and choose from the suggested questions and activities to offer an engaging media experience.

Questioning

Oftentimes, teachers and students become frustrated during a media segment when students can't find the answers to a long list of questions. Provide a limited number of questions or topics for students. This focuses their attention during a media segment, helps to keep them engaged and generally results in higher quality answers. QUEST Ed. has provided a number of options for focus questions ranging from fact based to opinions, as well as "big picture" ideas.

PRE-VIEWING

- What have you heard about stem cells and what questions do you have about them?
- Review cell basics, life cycle, mitosis and the terms "embryo" and "fetus."
- Do you think scientists should be able to do research on stem cells? Why or why not?

VIEWING FOCUS

NOTE: You may choose to watch the television segment twice with your students: once to elicit emotional responses and get an overview of the topic and again to focus on facts and draw out opinions.

- Why are embryonic stem cells called "pluripotent"?
- What are some differences between adult stem cells and embryonic stem cells?
- Why are some people against using embryonic stem cells for research?
- What did President Bush decide in 2001 and what did California voters decide in 2004?
- What is Dr. Srivastava studying and how is the use of stem cells helping his research?

POST-VIEWING – Links to activities mentioned here can be found on the following page.

- **Review** students' answers to the Viewing Focus Questions.
- **Reflect** on your original opinion about stem cell research. Has anything changed since watching this story?
- **Create** a brochure to advocate your position on stem cell research.
- **Role-play** one position on stem cell research and debate your classmates.
- **View** additional videos and images of stem cells and stem cell research.
- **Vote** on whether or not we should allow cloning for stem cell research. Does your position change when your thoughts are challenged?

Science is all about innovation, creativity and freedom of investigation. The last several years, that's been somewhat stifled, at least in the stem cell field.

~ Dr. Deepak Srivastava, Director, Gladstone Institute of Cardiovascular Disease, UCSF

LESSON PLANS / ACTIVITIES

Nuclear Transplants Teaching Guide Scientific American Frontiers: The Bionic Body
<http://www.pbs.org/saf/1107/teaching/teaching2.htm>

- Students model the removal of a cell nucleus and the insertion of a nuclear implant that controls cell development.

Stem Cell Research Policy: Create and Advocacy Brochure A NewsHour with Jim Lehrer Extra

<http://www.pbs.org/newshour/extra/teachers/lessonplans/august01/stemcells/index.html>

- After researching the science and the controversy around stem cell research, students create brochures to display their knowledge and a point of view.

Is Stem Cell Research Ethical? Lesson Plan Religion and Ethics NewsWeekly

<http://www.pbs.org/wnet/religionandethics/lessons/stem-cell-research/background/388/>

- Students explore the controversy generated by embryonic stem cell research, paying particular attention to the question of ethics. Using a debate model, students assume the roles of different interest groups and prepare, present and defend their positions. (This lesson is better suited for older students.)

Stem Cells NOVA scienceNow

<http://www.pbs.org/wgbh/nova/sciencenow/3209/04.html>

- Using this interactive, students can explore arguments for and against stem cell research and cast their votes, see a slide show of the cloning process, watch a 15-minute video about stem cells, read an interview concerning alternative means of cloning cells, find recent news and ask questions to an expert. Watch **NOVA scienceNow's** update on stem cells at <http://www.pbs.org/wgbh/nova/sciencenow/3302/06.html>

WEB SITES



“Understanding Genetics” The Tech Museum of Innovation

<http://www.thetech.org/genetics/news.php?id=23>

<http://www.thetech.org/genetics/news.php?id=18>

<http://www.thetech.org/genetics/ask.php?id=163>

<http://www.thetech.org/genetics/ask.php?id=211>

- Read articles by geneticists that explain the basics of stem cells, recent stem cell discoveries and controversies. These sites also have links to additional articles and stem cell Web sites, including the National Institutes of Health stem cell Web site.



“Stem Cells: Cells with Potential” The Exploratorium

http://www.exploratorium.edu/imaging_station/research/stem_cells/story_stem_cells1.php

- Read about the basics of stem cell research, listen to researcher Bruce Conklin explain why this science is so important and watch a video of beating heart cells grown from mouse stem cells. Also, click on “Gallery” to visit the Microscope Imaging Station and see more photos of stem cells.

Look for the



indicating resources from QUEST partner organizations

VISIT OUR PARTNERS

The Bay Institute
www.bay.org

California Academy of Sciences
www.calacademy.org

Chabot Space and Science Center
www.chabotspace.org

East Bay Regional Park District
www.ebparks.org

Exploratorium
www.exploratorium.edu

Girl Scouts of Northern California
www.girlscoutsbayarea.org

Golden Gate National Parks Conservancy
www.parksconservancy.org

The J. David Gladstone Institutes
www.gladstone.ucsf.edu

Lawrence Berkeley National Laboratory
www.lbl.gov

Lawrence Hall of Science
www.lawrencehallofscience.org

Monterey Bay Aquarium
www.mbayaq.org

Monterey Bay Aquarium Research Institute
www.mbari.org

Oakland Zoo
www.oaklandzoo.org

The Tech Museum of Innovation
www.thetech.org

UC Berkeley Natural History Museums
<http://bnhm.berkeley.edu/>

U.S. Geological Survey
www.usgs.gov

OTHER WAYS TO PARTICIPATE IN QUEST



LOG ON

www.kqed.org/quest



LISTEN

**KQED 88.5 FM San Francisco &
89.3 FM Sacramento**
Fridays at 6:30am and 8:30am



WATCH

KQED Channel 9
Tuesdays at 7:30pm

IMAGE CREDITS

Stem Cell Research: Sheraz Sadiq



Soon after Barack Obama is sworn in as President, he is expected to reverse the ban on federal funding for embryonic stem cell research. The resulting boom in this cutting-edge medical technology will benefit California's research institutes in a big way. David Gorn explains.

Up on the sixth floor of the UC San Francisco Children's Hospital, a five-month-old baby boy named Ryder Ortiz is hooked up to a roomful of machinery.

ORTIZ: So this is his breathing machine. They've closed his chest, his chest was left open. And these are his chest tubes, he's got three of them.

Ryder's mom, Angela, explains that her son was born with something called hypoplastic left heart syndrome. That is, he's missing the left ventricle of his heart. The small boy looks lost in his giant bed, among all his tubes and cords and machines.

ORTIZ: For the first two weeks of his life, I had never held him. That was very hard for me because you know just having a baby that's what you do, I mean, you comfort and hold when he's upset. And not doing that, that's difficult.

Ryder just had his second of three surgeries to sort of re-plumb his circulatory system. It's jerry-rigged now so he can get by on three heart chambers instead of four. His mom says "Ryder" means warrior, and that the name fits him. She's eager, and a little scared, to bring him home after the next month's final surgery.

ORTIZ: Ryder's our little fighter. He's really coming along. He's doing good. But I don't think anybody is really prepared for what's going to happen until they're here, you know?

Ryder's doctor has been here a lot. Deepak Srivastava is Director of the Gladstone Institute of Cardiovascular Disease at UCSF. He says it's surprising just how many kids have similar problems.

SRIVASTAVA: One percent of all babies born are born with a heart defect. People don't realize that- one percent. It's an enormous number.

And Ryder may just be the kind of patient who could benefit from stem cell research. Embryonic stem cells are a revolution in medicine, Srivastava says. They offer the potential of treatment for everything from heart valve malfunctions to Alzheimer's, from pancreatic disease to stroke.

SRIVASTAVA: Most diseases of mankind could in some way be impacted by stem cell research.

Stem cell research only just started about a decade ago. And that's about the time President George Bush issued an executive order limiting federal funding of embryonic stem cell research only to existing lines of embryonic cells. If Obama



reverses that executive order this week, it could mean some federal funding of medical research could shift over to stem cell work, with as much as a 20-fold change in grant money, from 30 million dollars to roughly half a billion dollars, Srivastava says. And more immediate funding for stem cell research could come as soon as Congress passes a stimulus package, says Robert Klein.

KLEIN: The medieval age is over for stem cell research.

Klein is chair of the California Institute for Regenerative Medicine, a state stem-cell-research agency that was created back in 2004 by passage of state Proposition 71. California has raised about 1.5 billion dollars so far in state bond money and matching private funds to spend on stem cell work. So it has steadily moved ahead of the curve, Klein says, while the rest of the country has been red-lighted by a lack of federal funding.

KLEIN: It's ironic to be able to collaborate with other nations, and not be able to collaborate with other states.

Using human embryos for scientific research has sparked controversy. Opponents of abortion believe that life begins at conception and killing an embryo to extract stem cells is ending a human life. Others say embryos are not people but tiny clumps of cells with the potential to become people, and are discarded at fertility clinics every day. Embryonic stem cells are much more valuable to researchers than adult stem cells, because they're pluripotent. That is, they can be used to make any other cell tissue. Klein says the benefits of embryonic stem cell work far outweigh the concerns.

KLEIN: Never in human history have we been able to rebuild part of a human organ. To rebuild a heart or to build new islet cells for the pancreas so we eliminate diabetes. To rebuild a human liver is unprecedented in human history.

ORTIZ: He opened his eyes... Awww.

In 5-month-old Ryder Ortiz's case, stem cell research holds out hope that, eventually, he'll be able to grow a new heart chamber. And as Dr. Srivastava watches Angela Ortiz cooing with and comforting the baby, he says that would be a miracle he wants to see.

SRIVASTAVA: Can we grow a left ventricle? This is not a trivial problem. But this is where we need to head; this has to be the vision for the future.

ORTIZ: He IS sucking on it. He IS? Aww...

Patients will be able to some applications of stem cell work in just a few years, Srivastava says. The bigger revolution of using stem cells to help regenerate damaged organs could happen in 7 to 10 years. For Quest, I'm David Gorn, KQED Radio News.