

CASE TEACHING NOTES for

SALAMANDER SUPERPOWERS



A Question of Regeneration

by
Sarah Stonefoot
University at Buffalo
State University of New York

INTRODUCTION

This case is intended for a human biology course, but with modification it could be used in a developmental biology class. Students should be aware of some general concepts relating to the human body and its structures to be able to understand the issues presented in the case. A general knowledge of current stem cell research would be useful. It is not necessary for students to have a thorough knowledge of the research, but rather to be aware of its current presence in the science field. This will help them to evaluate the case and the ideas it presents.

The case is not heavily laden with science, but it can serve as a launching pad for a discussion of stem cells and regeneration. The meat of the case will lie in the students' research efforts to find answers to the questions and in the classroom discussion that follows. The case is important because stem cells/cloning are hot topics among researchers, politicians, and the media. There are serious ethical questions as well as scientific and health related issues that need to be addressed now and in the future.

Objectives

The overall purpose of this case is to broaden students' knowledge on current scientific issues. It illustrates how there is often more than one possible answer to a scientific question, and shows how it is important to explore different aspects of a problem. Specifically, the case deals with a new way of approaching stem cell research by considering salamander regeneration and whether a similar process might be possible for humans. Upon completion of the case, students should come away with a better understanding of:

- certain types of cells, e.g. stem cells, totipotent, pluripotent, unipotent;
- cell differentiation;
- regeneration as it occurs in a salamander;
- terms such as blastema, cell dedifferentiation, transdifferentiation, and pattern formation; and
- various advantages and disadvantages of providing "natural regeneration" in humans as opposed to stem cell transplants for wound and organ repair.

CLASSROOM MANAGEMENT

This case is structured as a directed case study. Students are given the case ahead of time along with four sets of questions addressing relevant issues. Students should assemble into groups of four and then divide up the question sets so that each student in the group is responsible for one set.

Each question set examines a different aspect of the case. The first set raises some general issues about regeneration and stem cells while providing useful background information for the next set of questions, which covers salamander regeneration in particular. The third set examines studies that are being conducted to learn more about regeneration in salamanders and how that knowledge can be applied to humans. The last set evaluates the advantages of using a regeneration method similar to that found in salamanders rather than stem cell transplants. It also raises issues relating to the possibility of actually conducting such processes in humans and any problems that might arise. Students should use any needed references to develop answers before the next class.

At the start of the next class session, students should reassemble into their groups and share answers so that everyone in the group understands each concept that is addressed. Essentially, each group member is responsible for educating other group members about any unique concepts raised in their assigned question set. Once the groups have been given adequate time to answer the question sets within their groups, the teacher should run a general discussion that covers appropriate answers.

Following the question/discussion period, each group of students is asked to write a one-page statement answering the question: “Should the scientific community put forth effort and money to investigate the possibility of humans regenerating cells in the manner found in salamanders?” The statement should not be simply an opinion piece but cite facts and information that they obtained from the questions they answered prior to class. Each student should contribute to the final decision.

The students are given the case but are expected to come up with the majority of resources on their own. Since the case is not a strong source of scientific information, the questions will serve to guide the students in their research. They should be able to answer the questions with information they can locate through magazine articles, news articles, abstracts, and online resources. A general biology textbook may also be useful to familiarize them with some of the general cell related terms. Also, Chapter 13 in **Wolpert *et al.* 2002** is very good on regeneration. The Internet and news articles will be helpful in obtaining current information regarding regeneration and the studies that have been conducted or are currently underway.

ANSWER KEY

Answers to the questions posed in the case study are provided in a separate answer key to the case. Those answers are password-protected. To access the answers for this case, go to **the key**. You will be prompted for a username and password. If you have not yet registered with us, you can see whether you are eligible for an account by reviewing our **password policy and then apply online** or write to **answerkey@sciencecases.org**.

REFERENCES

Print

- Caltech Biology Forum. 2000. “Stem Cells: The Science of Regeneration,” *Engineering and Science* 63:1, pp. 16-25. Available at: **<http://pr.caltech.edu/periodicals/EandS/articles/Stem%20Cell%20Forum%20Feature.pdf>**
- Wolpert, *et al.* 2002. *Principles of Development*, 2nd edition. New York: Oxford University Press.

Internet

- “Amphibian Limb Regeneration,” *Cell and Developmental Biology Online*. 2000. **<http://www.uoguelph.ca/zoology/devobio/210labs/regen1.html>**

- “Basic Salamander Anatomy,” *The Salamander Chronicles*. 14 May 1999.
<http://www.total.net/~kaymur/salamr5.htm>
- Pearson, Helen. “The Regeneration Gap,” *Nature Science Update*. 22 Nov 2001.
<http://www.nature.com/nsu/011122/011122-14.html>
- Pollack, Andrew. “Missing Limb? Salamander May Have the Answer”, *New York Times*. 24 Sept 2002.
http://eric.stamen.com/net/nyTimes_092302a.html

Acknowledgements: Publication of this case study was made possible by a grant from The Pew Charitable Trusts.

Date Posted: 09/18/03 nas

Originally published at http://www.sciencecases.org/regeneration/regeneration_notes.asp

Copyright © 2003 by the [National Center for Case Study Teaching in Science](#). Please see our [usage guidelines](#), which outline our policy concerning permissible reproduction of this work.