

Using the Axolotl in Undergraduate Course Work and Research (Re-awakening Student Curiosity for Living Creatures)

Karen Crawford
Department of Biology
St. Mary's College of Maryland
St. Mary's City, MD 20688

This report is a brief summary of how and why axolotls are especially useful in my teaching and research. I hope that it provides ideas for their use in other programs. I chose to study regeneration and development in *Ambystoma mexicanum*, axolotls, at St. Mary's College for several reasons. Most importantly, I wanted a system that would allow me to direct student projects during the semester with a minimum of interference from myself. Second, I needed a system that would enable the students to fit experiments, observations, tissue sampling, processing, and analysis into their often erratic schedules. Third, I wanted to have a system that would be easy to work with, highly visual, would lend itself to a wide variety of meaningful projects, and be capable of capturing the imagination of my students.

Some Examples. In the laboratory, axolotls have proven to be a great system for studying pattern formation in development and regeneration. Historically, the literature is filled with interesting studies for beginning students to find, read and comprehend. Although labor intensive, my students have found that

1. axolotls are very easy to care for,
2. the timing for experimental procedures and observations are flexible and therefore fit an undergraduate schedule easily,
3. experiments proceed at a pace that allows time to think about the results as they are happening, which encourages analysis of results as they are unfolding rather than only reporting upon what developed, and
4. working with live whole organisms teaches students a deeper respect for the ethical aspects of biological research.

In addition to these benefits, rearing axolotls in the laboratory and completing ex-

periments that yield new information about regeneration is relatively inexpensive.

Another benefit of working with axolotls is that they are a great draw for general student interest. Even students in our non-major biology course are able to understand the usefulness of regeneration experiments. During the first weeks of this class, I bring several different normal axolotl phenotypes into the lecture hall in addition to some metamorphosed experimental animals and request that the students make observations on the animals and think about several different questions. For example, how many different types of organisms are there and how closely are they related. This leads to a discussion of their observations, experiments that we might do to test some of their hypotheses, and an overview of the scientific method. These discussions often go beyond the classroom, resulting in non-major students (and even faculty) from outside the course visiting my research laboratory.

In the cell and molecular portion of our Principles of Biology course, I have used axolotls as an example in a genetics experiment. After requesting a dihybrid and test cross of wild-type and white mutant axolotls from the colony, without sharing this with the students, I have them observe the animals' development over the course of the semester. By the time the larvae have clearly exhibited their color phenotype, the students do ratios of the different colors, develop hypotheses about what genetic crosses were made to result in the observed ratios, and then test their hypothesis with the Chi-squared test. This has yielded fantastic results in the past. The students experience what it is like to make observations from a population of organisms, develop hypotheses, and test them statistically, and I get two more batches of larvae raised and ready for regeneration experiments in the lab.

Finally, in my Developmental Biology course, students use axolotl embryos to observe and manipulate normal vertebrate development (in comparison to *Xenopus*), in addition to limb regeneration experiments. For this each student is given an animal for the semester to care for and use in a regeneration experiment. After a seminar on regeneration, they must think up an experimental manipulation and present this experiment to the class. Students often pair up for this exercise exchanging blastemas for grafting experiments. Throughout the process the students must keep thorough notes in their lab books

Axolotl Newsletter Number 24

and harvest, stain, and process the regenerated limbs to analyze limb pattern in the regenerate. The students take great pride in their animals and experiments. Of all the different experiments and organisms that are used in this course, I have found that the students learn more about the process and re-

sponsibilities of scientific experimentation through these amphibians.

In summary, the axolotl is an undergraduate friendly system that encourages imagination and scientific thought. It is an integral component to my research and teaching at St. Mary's College of Maryland.