The amazing, regenerating axolotl

SCIENTIFIC NAME
Ambystoma mexicanum

TAXONOMY
PHYLUM: Chordata
CLASS: Amphibia
ORDER: Caudata
FAMILY: Ambystomatidae

Physical description

The axolotl is a salamander that does not undergo metamorphosis: adults remain aquatic and keep their gills. They owe their unique appearance in part to these feathery, protruding gills, arranged in three paired stalks behind their heads. Axolotls also have a distinctive caudal fin stretching from the head almost to the vent. Their blunt snouts and large mouths contribute to their charisma. Axolotls have four common color patterns: brown or gray with dark spots or mottling, melanoid (black), leucistic (pale pink with black eyes) or albino (gold, tan or pale pink with pink eyes).

Background

Axolotls are native to two freshwater lakes located south of Mexico City, called Xochimilco and Chalco. The animals are critically endangered in the wild, owing to urbanization, development and habitat destruction, but are relatively easy to breed in the laboratory. The first specimens were brought from Mexico to Paris in 1863. Many of today's laboratory axolotls are descendants of those specimens.

Husbandry

Axolotls prefer cool temperatures between 12 °C and 20 °C, ideally 15–18 °C. Their metabolism slows at lower temperatures; exposure to higher temperatures can lead to stress and increased appetite.

Axolotls are normally housed in large volumes of water to help buffer the system against water quality problems. Appropriate substrate materials include fine sand or rocks that are much larger than the animals' heads; axolotls are suction feeders and may ingest medium-sized gravel. Hiding places and visual barriers are provided to minimize aggression among animals.

These salamanders are carnivorous and locate food by smell. In the wild, they eat worms, insects and small fish. In captivity, they will eat a variety of readily available foods, including pellets used to feed trout and salmon, bloodworms, earthworms, waxworms and feeder fish.

Research résumé

As research models, axolotls are best known for their ability, unique among vertebrates, to regenerate missing body parts. Many studies have investigated the mechanisms controlling growth and patterning during limb regeneration. At the amputation site, a clump of progenitor cells forms and then regenerates the missing tissues. These progenitor cells have restricted potential and 'remember' their tissue origin[1,2]. Studies examining gene activation and expression during this process are ongoing.

In a different research context, axolotls were recently included in an analysis of the embryonic development of electrosensory organs that led to a new understanding of the evolution of vertebrates. The results suggest that nearly all vertebrates, including humans, descended from a predatory marine fish, with the 'sixth sense' of electroreception, that lived some 500 million years ago[3].

Axolotls also grabbed headlines in 2011 with the report that axolotl oocyte extract could activate tumor suppressor genes to prevent the growth of breast cancer[4]. Identifying which components of the oocyte extract were responsible for this activity is now a key objective in cancer research.

FOR MORE INFORMATION
http://www.ambystoma.org/
http://www.axolotl.org/

1. Krag, M. *et al.* Cells keep a memory of their tissue origin during axolotl limb regeneration. *Nature* **460**, 60–65 (2009).
2. Tanaka, E.M. & Reddien, P.W. The cellular basis for animal regeneration. *Dev. Cell* **21**, 172–185 (2011).
3. Modrell, M.S., Bemis, W.E., Northcutt, R.G., Davis, M.C. & Baker, C.V.H. Electrosensory ampullary organs are derived from lateral line placodes in bony fishes. *Nat. Commun.* **2**, 496 (2011).
4. Allegrucci, C. *et al.* Epigenetic reprogramming of breast cancer cells with oocyte extracts. *Mol. Cancer.* **10**, 7 (2011).