

Will axolotls show us the secret of brain regeneration?

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Humans have a very limited capacity to regenerate lost body parts compared to salamanders. The “Internet’s favorite” cute axolotls are actually amazing creatures in terms of regeneration ability. An axolotl is able to regenerate its damaged limbs, heart, spinal cord, and even brain and thus rarely has age-related diseases [1].

When part of the axolotl’s telencephalon is removed, progenitor cell proliferation in the ventricular zone is stimulated, and newly produced cells migrate to the damaged area, differentiating into neurons and rebuilding the lost tissue [2]. Using single-cell RNA sequencing, researchers have identified genes that are activated to increase progenitor cells’ differentiation into neuroblasts and, in turn, into the same types of neurons that were originally lost [3]. Cell types and gene expression patterns in the telencephalon of axolotls share similarities with the neocortex in mammals, suggesting a common evolutionary ancestry in brain development [3,4].



Figure: Axolotls, by Eموke Dénes (CC BY-SA 4.0); https://commons.wikimedia.org/wiki/File:Ke_-_Ambystoma_mexicanum_-_6.jpg

Besides regenerating lost neurons, the axonal connections between the damaged part and the other brain areas are restored to certain degrees [3]. The axolotl body somehow knows which types of neurons are needed to be replenished in which places. But while these regenerated neurons are electro-physiologically functional, they organize within a different tissue architecture [5]. The long-distance axonal pathways and circuit physiology that existed prior to damage are not restored.

Studying the axolotl brain may lead to future innovations in medical interventions for treating brain injury in humans. Unfortunately, despite the regenerative power, axolotls are not magical creatures that can revive themselves. They are now critically endangered mainly due to negative impacts from human activities. Biodiversity, in itself, is an immensely valuable source of knowledge about the natural intelligence that humans can use to develop our information systems [6], especially from the *ecomindsponge* perspective [7]. We need to protect the axolotls if we want to continue learning about their wonderful secrets.

References

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