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Are There Traces of Regeneration Genes in Most Animals?

Since theoretically all animals have one ancestral origin, genes that help some species regenerate full structural limbs or organs could potentially be latent in animals without the same regenerative abilities. When scientists discovered hedgehog proteins and their related genes in the 1990s, animal experiments demonstrated how these genes worked similarly across multiple species. This meant that the same genes and cell mechanisms may be responsible for development in all living organisms (Shubin 2009). If this is the case, it could be that the genes responsible for high levels of regeneration in early animals (sponges, ctenophores) could still be present in more advanced animal types today, even though there seems to have been a major loss of consistent regenerative ability starting with the emergence of the Ecdysozoa clade (Bely 2010). Analyzing the genes of highly regenerative animals may be a start to understanding how regeneration could still be possible in non-regenerative animals.

Animal models are important for shedding light on the molecular activities involved in regeneration. The salamander can regenerate full body limbs, organs, and even its spinal cord and brain tissue. During salamander limb regeneration, genes that are part of the hedgehog signaling pathways are involved in the process wherein cells reprogram themselves to form a blastema for eventual regrowth (Joven et al., 2019). Even though specific mechanisms of salamander regeneration are unknown, we do know that these implicated hedgehog genes are present across multiple species, including humans. This could mean that similar regenerative cell mechanisms may be possible to replicate in human tissue, even if evolutionarily speaking, the full extent of regenerative ability has already been lost. Using Zebrafish as animal models, scientists have also discovered how enhancer elements use transcription factors to regulate the growth of new organ tissue (Kang et al., 2016). This suggests that certain genes may need to be activated before they can be useful in regenerating new structural elements and organs. It may be possible then, that humans may have not necessarily lost genes responsible for regeneration more than they have lost the elements to turn on regenerative processes. The idea of a finger or even a human hand being able to regenerate on its own does not seem impossible when this type of regeneration is possible in a few different distantly-related animals.

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