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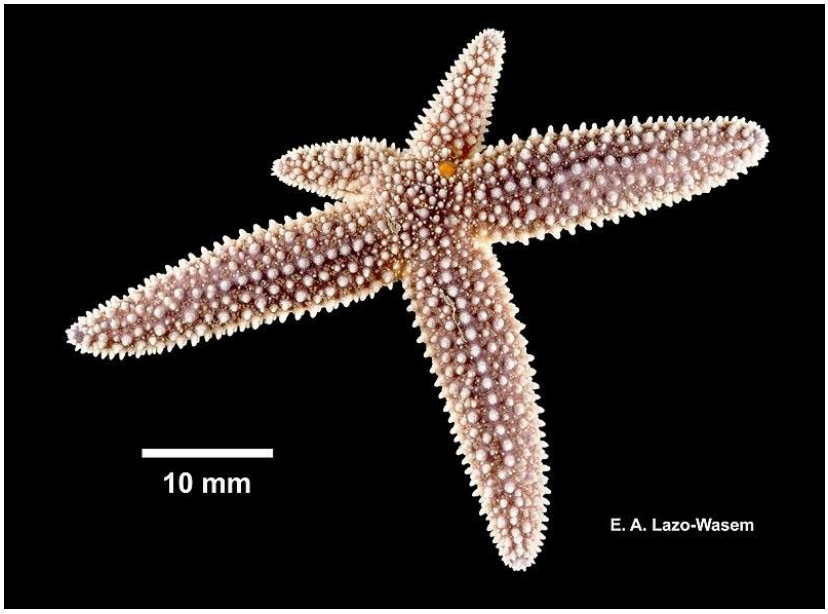
Hands-on experiments with planaria

Planaria infosheet

Freshwater planaria are nonparasitic invertebrate animals belonging to the phylum Platyhelminthes, the flatworms. They have a coating of mucus and are able to move rapidly through the combined action of their tail and cilia, which are located on the underside of their bodies.[1,2,3] The brains of planaria coordinate a variety of sensory systems in response to different environmental cues.[4] Planaria can sense a variety of signals coming from the external environment and quickly display distinct behaviour, depending on the type of stimulus, including light, chemicals, heat, touch, vibrations, and magnetic or electric fields.[5] Planaria are hermaphroditic animals that can reproduce asexually or sexually, with internal fertilisation.[6]

An asexual specimen of *Dugesia subtentaculata*
Image: Eduard Solà/Wikimedia, CC BY-SA 3.0

Many animals throughout the tree of life show regenerative capabilities, for example, starfish arm regeneration, fish tail-fin regeneration, lizard tail regeneration, and salamander limb regeneration. In extreme cases, such as in hydra and planaria, each tissue fragment can regenerate a complete, new organism.[7]



Many starfish can regrow lost portions. Here, you can see a Forbes sea star (*Asterias forbesi*) regrowing two lost arms. *Image: Eric A. Lazo-Wasem/Wikimedia, CC0 1.0*

Although all multicellular organisms depend on stem cells for their survival, planaria are particularly useful for the study of regeneration and the biology of stem cells because they can regenerate a complete individual from virtually any fragment of their body in a relatively short time.[8] This extraordinary capability is not shared by the nematode worm *Caenorhabditis elegans* or the fruit fly *Drosophila melanogaster*, which are two very popular animal models used in laboratories around the world.[9]

The planarians' remarkable ability to regenerate is due to the large number of adult pluripotent stem cells, known as neoblasts, found throughout its body. Neoblasts, which make up 20–30% of a planarian's cells, are the only cells capable of dividing and can differentiate into any cell type in the animal.[4,8,10]

Planaria grow when feeding and degrow when starving and can undergo as much as a 40-fold change in body length or an 800-fold change in total cell numbers.[8] Planaria can survive prolonged starvation periods, ranging from several months to well over a year, depending on the species.[11] During this time, they reduce their size, while remaining a functioning, proportioned, and regeneration-capable worm. This degrowth is caused by changes in cell number not cell size and is fully reversible: once food is available again, the animals regrow to their original size.[12]

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