



Why Two Heads?

FIGURE 1

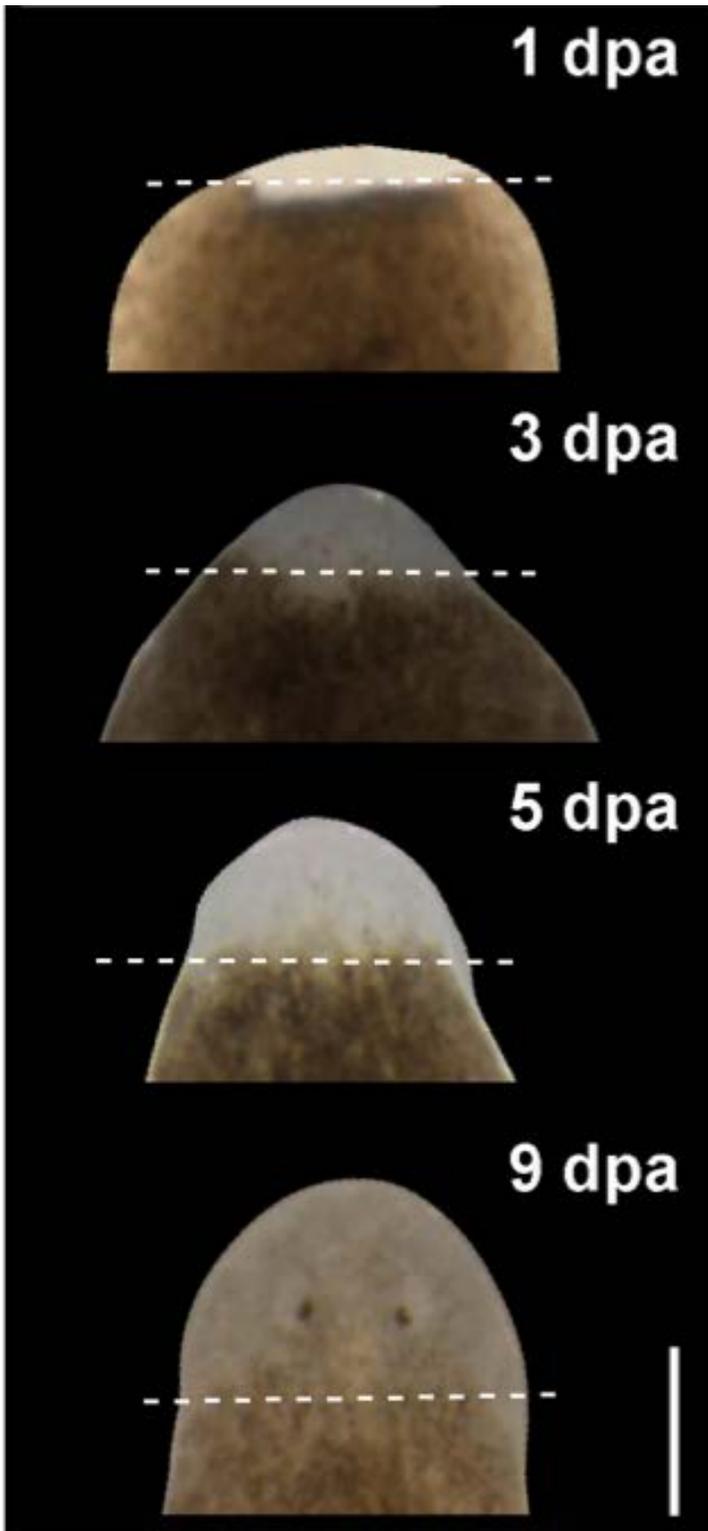


FIGURE 2



BACKGROUND INFORMATION

Planarians are simple multicellular animals called flatworms. They can detect light by using eyespots on their heads. They can also sense and respond to chemicals in their environment by using chemoreceptors on the sides of their bodies. Planarians both eat food and release waste through a tube called a pharynx, which sticks out of the middle of their body.

More than 100 years ago, scientists figured out that some planarians can regenerate parts of their bodies. Because of their simple nervous system, planarians do not feel pain when cut, only pressure. When cut, a planarian regenerates its missing end. How is this possible? Planarians have adult stem cells called neoblasts throughout their bodies. When a planarian is cut, its neoblasts multiply to make more stem cells. These stem cells then differentiate into the cells needed to replace the missing body parts. These regeneration abilities are far beyond those of the human body. However, understanding how planarians are able to regenerate lost tissues and body parts may provide clues for how to improve wound healing in humans.

How a planarian regenerates depends on where the planarian was cut. Figure 1 shows several images of a planarian that was cut across the top of its head, as shown by the dashed white line. The images show how the planarian's stem cells multiplied over the days postamputation (dpa) and eventually formed a new head.

A piece cut from a planarian can even form a new planarian. This new planarian regrows a head and a tail region in the appropriate places most of the time. Figure 2 shows two planarians from the same species. The one on the left is a typical individual for this species. The one on the right regenerated from a cut planarian treated with RNAi. RNAi is a technique that uses small pieces of RNA to turn off the function of specific genes. In this case, scientists used RNAi to turn off the gene for a protein that regulates polarity. Polarity is a property of organisms that have distinct ends, for example, distinct heads and tails. Polarity is maintained by proteins and other molecules throughout the organism's body. Because of RNAi, this planarian could no longer produce an important protein for maintaining polarity. As a result, the planarian's stem cells incorrectly formed two heads instead of one head and one tail.