

# Study sheds light on nerve regeneration following spinal cord injury

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McClellan discovered how the sea lamprey, an eel-like fish, regrows the neurons that comprise the long nerve "highways" that link the brain to the spinal cord. Credit: MU News Bureau

Fish, unlike humans, can regenerate nerve connections and recover normal mobility following an injury to their spinal cord. Now, University of Missouri researchers have discovered how the sea lamprey, an eel-like fish, regrows the neurons that comprise the long nerve "highways" that link the brain to the spinal cord. Findings may guide future efforts to promote recovery in humans who have suffered spinal cord injuries.

"There is a lot of attention to why, following a [spinal cord](#) injury, neurons regenerate in lower vertebrates, such as the [sea lamprey](#), and why they don't in higher vertebrates, such as humans," said Andrew McClellan, professor of biological sciences in the College of Arts and Science and director of the MU Spinal Cord Injury Program.

The study focuses on the regrowth of a particular group of [nerve cells](#) called reticulospinal neurons, which are necessary for locomotion. These neurons are found in the hindbrain, or the

brainstem, and send signals to the spinal cord of all vertebrates to control movements of the body, such as locomotor behavior. When these nerve cells are damaged by a spinal cord injury, the animal is unable to move below the level of injury. While humans and other higher vertebrates would be permanently paralyzed, the sea lamprey and other lower vertebrates have the ability to regrow these neurons and recover the ability to move within a few short weeks.

In the study, McClellan and his colleagues isolated and removed injured reticulospinal neurons from sea lamprey and grew them in cultures. They applied chemicals that activated a group of molecules, called second messengers, to see what effects they had on these neurons' growth. They discovered that activation of cyclic AMP, a molecule that relays chemical signals inside cells, acted somewhat like an "on" switch—essentially converting neurons from a non-growing state to a growing one. However, it had no effect on [neurons](#) that had already begun to grow.

McClellan says that the information learned from the study may shed light on studies of [neural regeneration](#) in mammals, including humans.

"In mammals, cyclic AMP does appear to enhance neural regeneration within the central nervous system in an environment that normally inhibits regeneration," McClellan said. "Cyclic AMP seems to be able to overcome some of these inhibitory factors and promotes at least some regeneration. Hopefully our studies with the lamprey can provide a list of conditions that are important for neural regeneration to help guide therapies in higher vertebrates, and possibly in humans."

**More information:** "Cyclic AMP stimulates neurite outgrowth of lamprey reticulospinal neurons without substantially altering their biophysical properties," *Neuroscience*, 2013.

Provided by University of Missouri-Columbia

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