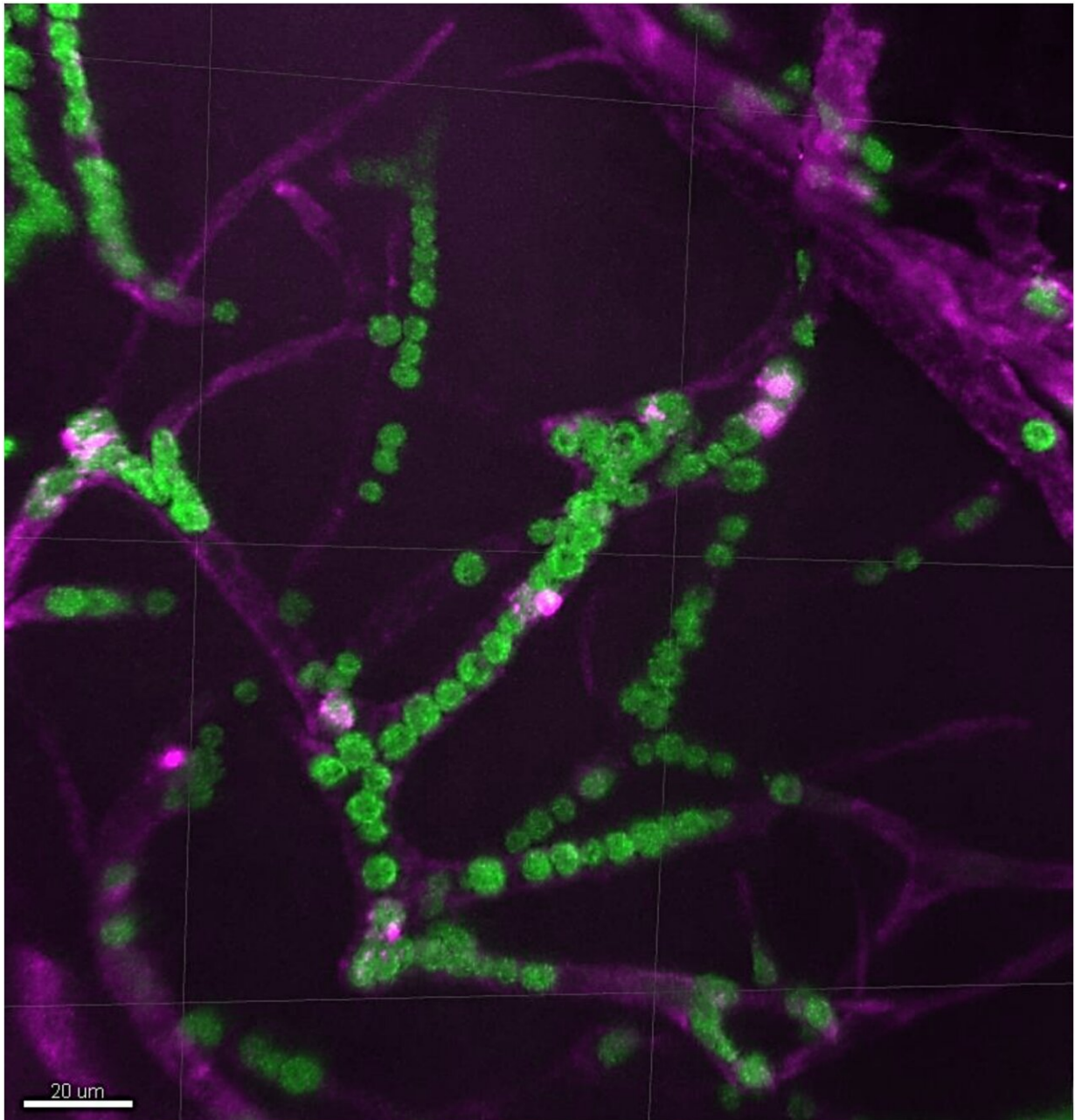


# **Photosynthesizing algae injected into the blood vessels of tadpoles supply oxygen to their brains**

October 13 2021

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The injected green algae (green) sit inside the blood vessels (magenta) like a string of pearls. Credit: Özugur et al./iScience

Leading a double life in water and on land, frogs have many breathing techniques—through the gills, lungs, and skin—over the course of their

lifetime. Now German scientists have developed another method that allows tadpoles to "breathe" by introducing algae into their bloodstream to supply oxygen. The method developed, presented October 13 in the journal *iScience*, provided enough oxygen to effectively rescue neurons in the brains of oxygen-deprived tadpoles.

"The algae actually produced so much [oxygen](#) that they could bring the nerve cells back to life, if you will," says senior author Hans Straka of Ludwig-Maximilians-University Munich. "For many people, it sounds like [science fiction](#), but after all, it's just the right combination of biological schemes and [biological principles](#)."

Straka was studying [oxygen consumption](#) in tadpole brains of African clawed frogs (*Xenopus laevis*) when a lunch conversation with a botanist sparked an idea to combine plant physiology with neuroscience: harnessing the power of photosynthesis to supply [nerve cells](#) with oxygen. The idea didn't seem far-fetched. In nature, algae live harmoniously in sponges, corals, and anemones, providing them with oxygen and even nutrients. Why not in vertebrates like frogs?

To explore the possibility, the team injected [green algae](#) (*Chlamydomonas reinhardtii*) or cyanobacteria (*Synechocystis*) into tadpoles' hearts. With each heartbeat, the algae inched through blood vessels and eventually reached the brain, turning the translucent tadpole bright green. Shining light on these tadpoles prompted both algae species to pump out oxygen to nearby cells.

After distributing algae to the brain, the researchers isolated the tadpole's head and placed it in an oxygen bubble bath with essential nutrients that would preserve the functioning of the cells, allowing the team to monitor neural activity and oxygen levels. As the researchers depleted oxygen from the bath, the nerves ceased firing and fell silent. However, illuminating the tadpole head restarted the [neural activity](#) within 15 to 20

minutes, which is about two times faster than replenishing the bath with oxygen without the algae. The revived nerves also performed as well or even better than before oxygen depletion, showing that the researchers' method was quick and efficient.

"We succeeded in showing the proof of principle experiment with this method. It was amazingly reliable and robust, and in my eyes, a beautiful approach," says Straka. "Working in principle doesn't really mean that you could apply it at the end, but it's the first step in order to initiate other studies."

While the researchers think their findings may someday lead to new therapies for conditions induced by stroke or oxygen-scarce environments, such as underwater and high altitudes, algae are far from ready to enter our blood circulation. The team's next step is to see whether the injected algae can survive inside living tadpoles and continue oxygen production without causing an immune response that wreaks havoc on the animals.

Straka also envisions his research benefiting other laboratories that work with isolated tissues or organoids. Introducing oxygen-producing [algae](#) could help these tissues thrive and raise their survival rates, potentially reducing the need for [live animals](#) for experiments.

"You have to have new ideas and new concepts to explore; this is one of the ways science is driven," says Straka. "If you are open-minded and think it through, all of a sudden, you can see all the possibilities from one idea."

**More information:** *iScience*, Özugur et al.: "Green oxygen power plants in the brain rescue neuronal activity"

[www.cell.com/iscience/fulltext ... 2589-0042\(21\)01126-3](http://www.cell.com/iscience/fulltext...2589-0042(21)01126-3) , DOI: [10.1016/j.isci.2021.103158](https://doi.org/10.1016/j.isci.2021.103158)

Provided by Cell Press

Citation: Photosynthesizing algae injected into the blood vessels of tadpoles supply oxygen to their brains (2021, October 13) retrieved 27 April 2024 from <https://phys.org/news/2021-10-photosynthesizing-algae-blood-vessels-tadpoles.html>

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