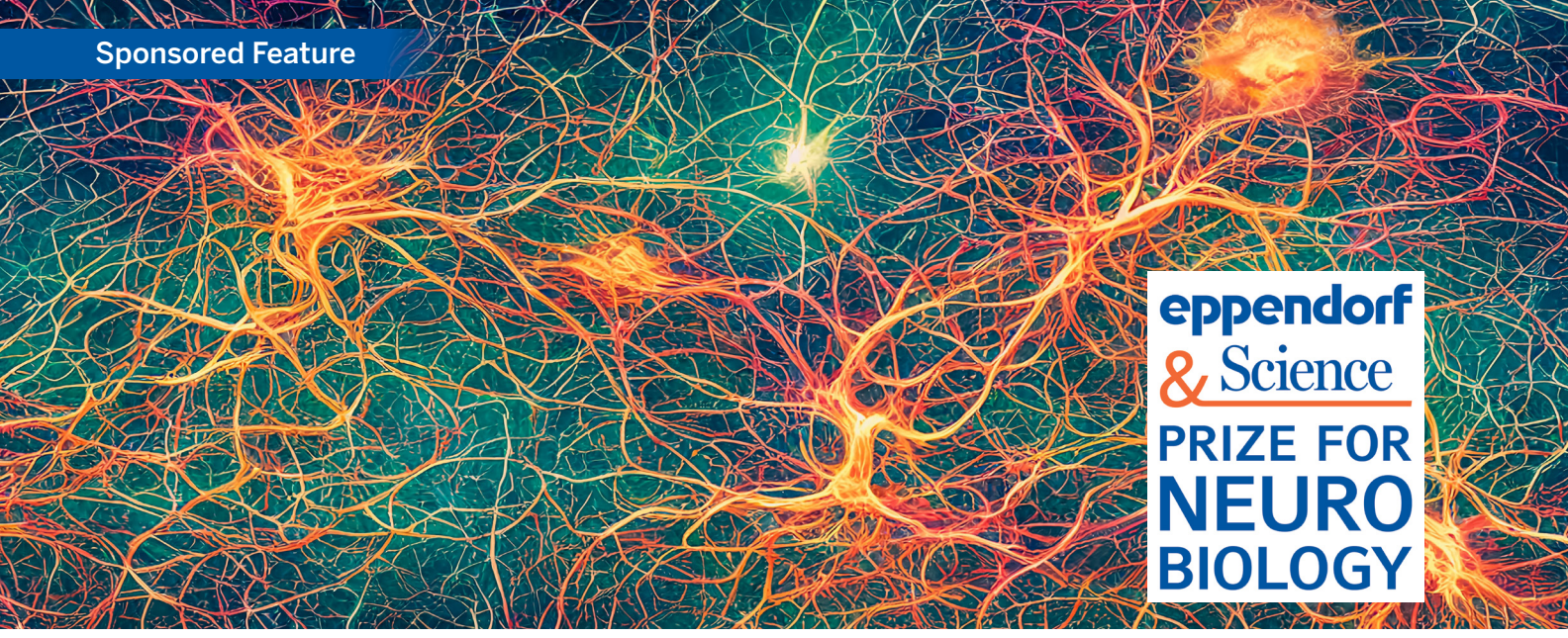

Recognizing advances in neurobiology: The 2024 Eppendorf & Science Prize

This year's Eppendorf & Science Prize for Neurobiology winner and finalists are advancing our understanding of sensory responses, spinal cord recovery, and nutrient transport in the brain. Their research holds promise for future medical advances in treating airway dysfunctions, spinal cord injuries, and neurological diseases.

Most of us have had the unpleasant experience of water going down the wrong pipe or stomach acid refluxing into our airways. We have an immediate and strong reaction to swallow and cough, a protective reflex that depends on precise communication between sensory cells, a conversation Laura Seeholzer is eager to listen in on.

"Sensory biology of the airways is an understudied area of research," says Seeholzer. "But since there are such rapid advancements in cell-based and gene-based therapies, it's exciting to think that the molecular details I'm working out could someday help us understand why babies or the elderly aspirate [while feeding]."

Seeholzer, a postdoctoral fellow at the University of California, San Francisco, received this year's Eppendorf & Science Prize for Neurobiology for her work on understanding the molecular and cellular bases of how our airways sense external threats. Two finalists, Rosemary J. Cater and Claudia Kathe, were also named.

Airway's defense

Protecting the airway is, of course, critically important to the body. Seeholzer discovered a network of cells lining the throat that, upon detecting water or acid, release the neurotransmitter ATP (adenosine triphosphate). These neuroendocrine cells behave both like neurons and endocrine cells, releasing hormones in response to nervous system stimuli. The released ATP molecules then trigger nearby sensory neurons in the vagus nerve—the longest cranial nerve in the body, which extends from the brainstem through the neck and into the abdomen—delivering the message that it's time to cough.

Before Seeholzer's work, scientists knew that neuroendocrine cells played a role in airway repair, but they did not understand their connection to sensory neurons. Seeholzer's research showed that this interaction was crucial for driving protective airway reflexes, and she was the first to confirm the presence of neuroendocrine cells in the larynx. "When I started this work, there were under 10 papers ever published on these cells. I was not sure what cell type I was looking at," she says.

Looking ahead, Seeholzer hopes her findings can lead to better treatments for people with laryngeal sensory dysfunctions such as laryngeal hyposensitivity, in which individuals fail to detect harmful stimuli, resulting in chronic lung damage, particularly in older adults and infants. She also aims to contribute to a better understanding of laryngeal hypersensitivity, which causes chronic cough.

"The exercise of writing the essay for the Eppendorf prize helped me take a bird's eye view of the project," she adds. "It helped me think and talk about my research in a more exciting and relatable way for non-scientists to understand this protective process."

Spine reorganization post injury

Since she was in school, Claudia Kathe has been amazed by how little we know about how our brain and spinal cord function. That curiosity has driven her to pursue a career in science, and she recently started a laboratory at the University of Lausanne to understand how neurons within the spinal cord reorganize after a spinal cord injury.

Kathe discovered that a specific population of neurons, marked by visual system homeobox 2 (*Vsx2*), plays a key role in this reorganization. She found that while Vsx2 neurons don't seem to play a significant role in motor function for a person with a healthy spinal cord, these neurons are crucial for restoring walking after a spinal cord injury. "I was shocked that one population stands out that much," she says.

This discovery has earned her a nomination as one of the finalists for the Eppendorf & Science Prize for Neurobiology. Now, Kathe hopes this success will widen the impact of her research. "As a young researcher at this stage of my career, being a finalist for the Eppendorf and Science Prize for Neurobiology gives me very important visibility. But it will also help my work have a wider reach because it is important for general neuroscience," she says.

Left: Claudia Kathe, **Center:** Laura Seeholzer, **Right:** Rosemary J. Cater

In her new lab, she is now exploring why certain neuronal populations, like those marked by *Vsx2*, are capable of such plasticity while others are not, and how these mechanisms may contribute to maladaptive motor functions such as spasticity, a common complication after spinal cord injuries.

The blood-brain barrier puzzle

Rosemary J. Cater, who has recently started her laboratory at the University of Queensland's Institute for Molecular Bioscience, was chatting with a physician friend about her work when she realized he did not fully understand what the blood-brain barrier was. That moment convinced her to apply for the Eppendorf & Science Prize for Neurobiology: "I thought then, well, if even someone who is well-educated doesn't understand this, it'd probably be beneficial if I try to communicate this to a broad audience," she says.

The brain is our most vital and complex organ, responsible for everything from basic bodily functions to higher-level thinking and emotions. It contains an intricate network of hundreds of billions of cells connected by a system of blood vessels that spans approximately 400 miles. Each cell in the brain is packed with over a billion tiny fat molecules known as phospholipids, with more than half of these being a specific type called phosphatidylcholine. This fat molecule plays a crucial role in maintaining the structure and function of cell membranes in the brain.

In 1956, scientist Eugene P. Kennedy discovered how our bodies produce phosphatidylcholine through three enzymatic steps. While our cells can synthesize some phosphatidylcholine components, they cannot produce the choline head group. "You can't make cell membranes unless you obtain choline through your diet," Cater says.

However, delivering choline to the brain is complicated by the blood-brain barrier, a protective layer that tightly regulates what can enter the brain from the bloodstream. This barrier consists of tightly packed endothelial cells lining the blood vessels in the brain that limit the passage of molecules and rely on specialized transporter proteins to allow essential nutrients like choline to cross.

Cater identified and characterized one such protein called FLVCR2 as the primary transporter for choline. "Understanding how nutrients like choline are transported into the brain not only clarifies how the brain functions optimally but also opens new avenues for treating neurological diseases linked to nutrient delivery issues," Cater says.

The prize

Established in 2002, the Eppendorf & Science Prize for Neurobiology recognizes the growing importance of neurobiology in understanding brain function. Every year, it honors young scientists under 35 for outstanding neurobiological research based on molecular and cell biology methods conducted in the past 3 years. The winner receives a USD 25,000 check, full support to attend the prize ceremony held in conjunction with the Annual Meeting of the Society for Neuroscience in the U.S., complimentary products worth USD 1,000 from Eppendorf, an invitation to visit Eppendorf in Hamburg, Germany, and publication of an essay about their research in *Science*. The finalists' essays are also published in *Science,* and they receive full support to attend the prize ceremony and USD 1,000 in complimentary Eppendorf products.

For more information on the Eppendorf & Science Prize for Neurobiology, go to www.eppendorf.com/prize.

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