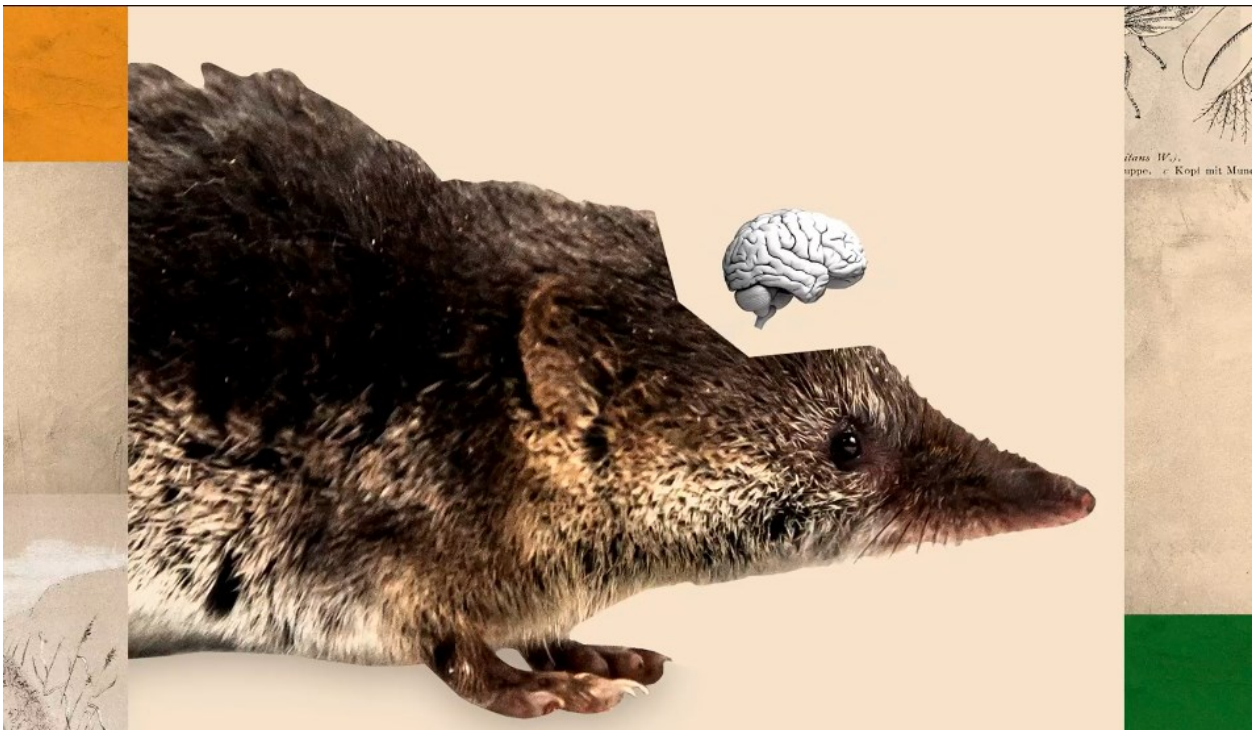
Why this mammal eats its own brain — and why it could matter for you
Unlocking the shrew's secret to shrinking its own cognitive tissue in winter – only to regrow it in spring – may help doctors treat neurodegenerative diseases in humans

By Dino Grandoni November 30, 2022 Washington Post



The shrew scampered across the sand, zipping its tiny, velvety body right, left, right, left.
In just a few seconds it found the prize concealed in the sandbox: a tasty mixture of earthworms, mealworms and other meat.

To quickly solve the puzzle in Dina Dechmann's lab, the shrew didn't just need to learn where its meal was hidden. Something else astounding happened in its head. It had to regrow its own brain.

"It's a crazy animal," said Dechmann, a behavioral ecologist at the Max Planck Institute of Animal Behavior in Germany. "We can learn a lot from the shrews."
To prepare for the depths of winter when food is scarce, many animals slow down, sleep through the cold or migrate to warmer locales.

Not the common shrew. To survive the colder months, the animal eats away at its own brain, reducing the organ by as much as a fourth, only to regrow much of brain matter in the spring.

The process of shrinking and expanding the brain and other organs with seasons — dubbed Dehnel's phenomenon — allows animals to reduce calorie-consuming tissue when temperatures drop. Researchers have discovered seasonal shrinkage in the skulls of other small, high-metabolism mammals, including weasels and, most recently, moles.
The shrew's incredible shrinking brain is more than just a biological curiosity. Understanding how these animals are able to restore their brain power may help doctors treat Alzheimer's, multiple sclerosis and other neurodegenerative diseases in humans.

"In the beginning, I couldn't quite grasp it," said John Dirk Nieland, an associate professor of health science and technology who is now researching drugs designed to mimic shrews' brain-altering chemistry in humans.

"It's really amazing the way they react and the way they respond," he added.

To survive the colder months, the common shrew eats away at its own brain, only to regrow much of its brain matter in the spring. (Malcolm Schuyl/Flpa/imageBROKER/Shutterstock)

A shrew that can't be tamed

For decades, few scientists grasped the implications of August Dehnel's 1949 discovery.

Born in Warsaw, Dehnel spent his early career studying bird eggs before the Nazi invasion of Poland interrupted his work on Europe's beavers and other mammals. The young zoologist served in the Polish army, though he remained devoted to his academic work during the war. Captured by the Germans, he gave biology lectures at a prisoner-of-war camp.

Back in the lab after the war, he noticed the skulls of shrews collected from the Białowieza Forest at the border of Poland and Belarus contracted and expanded with the seasons.

The high-metabolism mammal pursues insects, spiders, slugs and worms seemingly nonstop to survive. Ranging from the Scottish highlands to the Siberian tundra, it squeaks at pitches beyond human hearing, listening for reverberations to navigate underground.

Unlike deer or bears, shrews are too tiny to migrate and too hyper to hibernate when winter arrives. They live fast and die young, with an average life span of a little more than a year. "Their metabolism isn't set up for slowing down like that," Dechmann said.

That makes the jittery creatures awfully challenging to study in captivity.
The common shrew is one of the few mammals with a venomous bite, and it emits a nasty odor potentially to deter cats and other predators. To acclimate the shrews to the seasons, the team keeps its cages outdoors.

Dehnel himself struggled to cage and breed shrews, though he ultimately succeeded. And their metabolism is so high that Dechmann and her colleagues find it difficult to sedate them for scans.

"We cannot get them to sleep," she said. "It seems almost like a knockout state is not built in because they can't afford to become unconscious because they'll simply starve."

“They’re little bastards,” she added.

A common shrew sits in the snow. (Dea/A. Calegari/De Agostini/Getty Images)

Bigger isn’t always better

Shrews’ unorthodox strategy of reducing their brain power may help them save on energy during the winter, but it comes at a cost.

In a series of experiments involving finding food in a sandbox, larger-brained shrews in the summer outperformed their smaller-brained counterparts in the winter, Dechmann’s team found.

“It’s a compromise,” she said. “You make your brain smaller, you save energy, but you become — I don’t want to say stupid, but you become less good at solving certain learning tasks.”

But it’s what happens next that’s remarkable: In the spring, their brains grow back, and their ability to solve lab puzzles appears to return, too. The team is now testing the shrew’s ability to navigate a labyrinth made of LEGO pieces.

“The beauty of the shrew is that, yes, they shrink the brain, but what we see also is that in the spring, they can start growing the brain,” said Nieland, who also co-founded a biotech company named 2N Pharma.

The notion that, for some animals, a smaller brain is a better one is a difficult idea for many people to accept, Dechmann said. She and colleagues received hate mail

after publishing a study showing some bats evolved smaller brains to fly faster. Their paper was titled “Bigger is not always better.”

“People at the time did not want to believe that the brain would get smaller,” she said. “We have a large brain and that means we’re more intelligent.”
Figuring out how exactly shrews pull this off is the next step. Dechmann and Nieland — together with Liliana M. Dávalos, an evolutionary biologist at Stony Brook University in New York — received a grant from the French nonprofit Human Frontier Science Program to fund their shrew research.

For one, the shrew’s brain doesn’t regrow uniformly. The hippocampus expands back to normal, for instance, while the neocortex does not. Both of those parts of the brain help with memory.

And it’s the lipid-rich white matter strewn throughout the brain that appears to be disappearing, suggesting the tiny mammal’s body may be consuming portions of its own brain to make it through the winter.

The deterioration of white matter, which helps relay information in the brain, is a symptom of multiple sclerosis and other neurodegenerative illnesses.

Researchers are now searching for the proteins or other triggers responsible for the shrinkage and regrowth in the shrews’ noggins. “We are far from applied results,” Dechmann cautioned, though Nieland’s company is working on one drug right now.
If those chemicals are found, Nieland said, “we could maybe use these pathways also to treat brain diseases.”

For Dávalos, finding such an amazing ability in an animal right under European gardeners’ noses is remarkable in and of itself. The discovery suggests there is so much more to find in rainforests in the Amazon, Congo and elsewhere.
“How many centuries have people been studying the European fauna?” she said. “And how many thousands and thousands of scientists have been looking and they hadn’t seen this?”

“Think about all the amazing things that are out there hidden because we have never looked.”