

BOWHEAD

At over 200 years, the maximum lifespan of the bowhead whale exceeds that of all other mammals. The bowhead is also the second-largest animal on Earth, reaching over 80,000 kg¹. In spite of its very large number of cells, the bowhead is not highly cancer-prone, an incongruity termed Peto's Paradox². This has been explained by the evolution of additional tumor suppressor genes in larger animals, which is supported by research on elephants demonstrating expansion of the p53 gene^{3–5}. However, we show here that bowhead whale fibroblasts undergo oncogenic transformation after disruption of fewer tumor suppressors than required for human fibroblasts. Instead, analysis of DNA repair revealed that bowhead cells repair double-strand breaks with uniquely high efficiency and accuracy compared to other mammals. Further, we identified two proteins, CIRBP and RPA2, that are present at high levels in bowhead fibroblasts and increase the efficiency and fidelity of DNA repair in human cells. These results suggest that rather than possessing additional tumor suppressor genes as barriers to oncogenesis, the bowhead whale relies on more accurate and efficient DNA repair to preserve genome integrity. This strategy that does not eliminate cells but repairs them, may be critical for the long and cancer-free lifespan of the bowhead whale. Our work demonstrates the value of studying long-lived organisms in identifying novel longevity mechanisms and their potential for translation to humans.

Scary smarts

One of the biggest newsmakers of the year was artificial intelligence (AI). San Francisco tech company OpenAI's conversational bot ChatGPT, first launched in November 2022, was estimated to have more than 100 million monthly users by January 2023. People were simultaneously impressed and appalled by the capacity of AI based on **deep learning** (a technique inspired by the human brain) to write everything from poetry to class essays and research papers.

“In terms of public interest, I have not seen anything like this in my 30-year career,” says Colin Phillips, a psycholinguist at the University of Maryland and co-editor of the Annual Review of Linguistics.

Rapidly improving AI has left governments, scientists and consumers alike wondering how best to **harness its abilities** and guard against its misuse, including the **deepfakes** now featuring in scams and propaganda. International leaders agreed to work together to guide the technology at the UK's **AI Safety Summit** in November — hoping to get regulations in place before computers grow smarter than people.

Oldest black hole

A supermassive black hole some 13.2 billion light-years from Earth is [the most distant, most ancient supermassive black hole](#) ever observed. The monster dates to when the universe was just 470 million years old, making it about 200 million years older than [a record breaker announced in 2021](#) and 100 million years older than a black hole that claimed the title in July (SN: 12/18/21 & 1/1/22, p. 29). Because the newfound black hole boasts about the same heft as its surrounding galaxy, researchers think the black hole could have formed only through the collapse of a massive gas cloud. The finding could help shed light on how the universe's first generation of juggernaut black holes were born.

Heaviest animal ever

The animal kingdom appears to have a new heavyweight champion. An extinct whale aptly named *Perucetus colossus* might have weighed up to 340 metric tons, about [twice as much as the heaviest blue whales](#), an analysis of fossils found in Peru suggests (SN: 9/9/23, p. 5). The mighty mammal is thought to have prowled shallow waters 39 million years ago — but what it could have eaten to maintain its size remains a mystery.

New drugs help us lose weight — and understand why we gain it

The most talked-about science story in 2023 was the expanding use of the diet drugs called GLP-1 receptor agonists, most popularly known as Ozempic. Marketed as Wegovy when prescribed for weight loss, this drug and [a slew of others](#) have already helped thousands lose weight. In [2023, several studies](#) also showed GLP-1s reduced the risk of heart attacks and strokes in obese people.

But the drugs also shed light on the roots of obesity. Conventional wisdom holds that obese people lack willpower and therefore eat too much — or exercise too little. That's wrong, but this pervasive misconception has clouded scientific thinking for years.

Scientific evidence is pointing to obesity as a [hormonal malfunction](#), as I [wrote](#) in December 2022. The malfunction can stem from a diet too high in sugar and refined starch, according to [a recent study](#) by endocrinologist David Ludwig of Harvard. Once controversial, the hormonal view is harder to deny now, since the new drugs work by mimicking the hormone GLP-1 (glucagon-like peptide).

A mind-reading device?

According to a new study published in Nature Neuroscience, a model trained on functional magnetic resonance imaging scans of three volunteers was able to predict whole sentences they were hearing with surprising accuracy — just by looking at their brain activity, the MIT Technology Review reported.

"Given novel brain recordings, this decoder generates intelligible word sequences that recover the meaning of perceived speech, imagined speech and even silent videos, demonstrating that a single decoder can be applied to a range of tasks," the study said. The findings demonstrate the need for future policies to protect our brain data, the team said.

The MS microbe

Scientists have long suspected that multiple sclerosis is precipitated by an environmental trigger; likely some sort of microbial infection. The question is which microbe to blame.

Now, new research from Vincent Fischetti's laboratory suggests that a toxin produced by a *C. perfringens*—a common microbe found in sewage, marine sediment, soil, and the GI tracts of pets and farm animals—can trigger the inflammation characteristic of MS in mice.

Whether these findings will bear out in humans remains to be seen. "If this is the environmental trigger for MS, we can now start talking about a vaccine, monoclonal antibodies, or some other therapy," says Rashid Rumah, a physician scientist in the Fischetti lab.

Synthetic human embryos created from stem cells

Scientists at the University of Cambridge and the California Institute of Technology created synthetic human embryos using stem cells in a groundbreaking advance that sidesteps the need for eggs or sperm. The model embryos, which resemble those in the earliest stages of human development, could provide a crucial window on the impact of genetic disorders and the biological causes of recurrent miscarriage. However, the work also raises serious ethical and legal issues as the lab-grown entities fall outside current legislation in most countries. The structures do not have a beating heart or the beginnings of a brain, but include cells that would typically go on to form the placenta, yolk sac and the embryo itself.

Our immune systems have a lot in common with...coral reefs?

BU researchers studying the impact of climate change on coral reefs have been analyzing why some coral are more badly impacted by bleaching than others. Coral reefs can get sick, just like we can, and they're getting infected by a lot of new viruses and diseases as their immune systems get battered by environmental changes. According to the researchers, the same genes and proteins that regulate human immunity are also found in corals, sea anemones, and sponges, which means they can apply some of the same techniques used to study human illness to understanding what's ailing coral.

A bionic pancreas first developed in a BU lab has been cleared for people with type 1 diabetes

In May 2023, the US Food and Drug Administration cleared the iLet Bionic Pancreas that automates insulin delivery for people aged six years and older with type 1 diabetes. Instead of having to constantly measure their glucose levels and make complicated insulin dosing calculations, patients can let the wearable device—originally developed in the lab of Ed Damiano, a BU College of Engineering professor of biomedical engineering—automatically deliver tailored doses for them. There's no cure for type 1 diabetes, but the iLet provides some hope for the two million Americans with the chronic condition.