Science & Technology

Certain Animal Species Exhibit 'Biological Immortality'

Some animals are considered biologically immortal; not literally, but in the sense that they live indefinitely unless an external event—injury, disease, or drastic changes in their environment—kills them. Studying these species might provide us some insight into extending human lifespan beyond its current apparent upper limit of about 125 years.

Telomeres are the ends of chromosomes, which help protect the DNA. When the cell divides (mitosis) and the chromosomes reproduce, the telomeres shorten slightly because the division does not reach the tip of the chromosome. Shorter telomeres shorten lifespan because the cell is replicating progressively less effectively over time. This replication deficiency is one of the factors responsible for aging.

Planaria, a type of worm found all over the world, have an unlimited capacity to regenerate stem cells, if bisected. *ScienceDaily* reported Feb. 27, 2012 on a study led by Dr. Aziz Aboobaker at the University of Nottingham, which predicted that Planaria maintain their chromosome endings in adult stem cells via emission of an enzyme called telomerase.

Dr. Aboobaker:

"Asexual planaria worms demonstrate the potential to maintain telomere length during regeneration. Our data satisfy one of the predictions about what it would take for an animal to be potentially immortal and that it is possible for this scenario to evolve. The next goals for us are to understand the mechanisms in more detail and to understand more about how you evolve an immortal animal."

By restarting its life cycle, the so-called **Immortal Jellyfish** (*Turritopsis dohrnii*) can extend its life *ad infinitum*. Faced with an environmental or physical threat, disease, or aging, this species is able to transform into an earlier development stage, allowing individuals to perpetuate themselves in a constant cycle of aging and rejuvenation. A cellular process known as transdifferentiation occurs when a fully formed specialized adult cell—not a stem cell—becomes another type of adult cell. When the jellyfish returns to its previous life stage as a polyp, it also creates more organisms with the same genetic code, so as it rejuvenates, it also clones itself.

Though this process can be chemically induced, its mechanism remains a mystery.

The **American Lobster** maintains an ability to regenerate even in old age. *Science Direct* reports on a 1998 study by Wolfram Klapper, *et al.* which concluded that its longevity may be connected to the behavior of its RNA in generating telomerase enzymes, just as do planaria.

Lobsters don't live forever, however, because indefinite growth forces them to periodically renew the exoskeleton that protects them and which, once formed, does not change size. At a certain point in the life of the lobster, the metabolic effort, the amount of energy needed to change their shells, exceeds their capacity, causing them to die, sometimes by exhaustion, and sometimes by the collapse of their own armor.

There are also species that, although not "immortal," have an amazing capacity for body regeneration, as is the case of the **Mexican Axolotl,** a type of salamander.

Most of these long-lived species live underwater. What does this tell us about the importance and role of water?

Breakthrough in Source-Gated Transistors

A source-gated transistor (SGT) is a special type of transistor that combines two fundamental components of electronics—a thin-film transistor, and a metal-semiconductor contact. The SGT has many advantages over traditional transistors, including using less power and being more stable. SGTs are suitable for large-area electronics and are promising candidates to be used in fields such as medicine, engineering, and computing.

SGTs are not widely used, however, because their performance varies with temperature. To solve this problem, scientists from the University of Surrey have developed a new design for the transistor part called the "source," proposing adding very thin layers of insulating material at the source contact to change the way electric charges flow.

Dr Radu Sporea, at the Advanced Technology Institute, and project lead from the University of Surrey:

"We used a rapidly emerging semiconductor material called IGZO or indium-gallium-zinc oxide to create the next generation of source-gated transistors. Through nanoscale contact engineering, we obtained transistors that are much more stable with temperature than previous attempts. Device simulations allowed us to understand this effect."

According to ATI Undergraduate Salman Alfarisyi, who performed the simulations:

"Source-gate transistors could be the building block to new power-efficient flexible electronics technology

to help to meet our energy needs without damaging the health of our planet. For example, their sensing and signal amplification ability makes it easy to recommend them as key elements for medical devices that interface with our entire body, allowing us to better understand human health."

Their study is published in *IEEE Transactions on Electron Devices*, July 2023.

New Spacesuit Material Uses Liquid Metals To Repel Lunar Dust

Lunar dust is a huge problem for any activity on the Moon, by man or machine. Its microscopic particles, composed mostly of silicates and similar to volcanic ash, feature sharp and rough edges. The particles can enter the eyes and lungs, causing health problems. It also sticks to boots and gloves, as well as to machine parts. The lunar dust is so electrostatically charged that it actually levitates above the lunar surface!

On Oct. 30, Space.com reported on a new material being developed for the Artemis III crewed mission to the Moon, and possibly any other future missions to the Moon or Mars. It is called "Liquid Metal Electrostatic Protective Textile" (or LiqMEST), a flexible, stretchable prototype fabric under development at Hawai'i Pacific University (HPU).

Arif Rahman, an HPU assistant engineering professor, reported that:

"When activated, it generates an electric field that repels lunar dust, preventing the dust from adhering. This strategy can be applied both to spacesuits and fabric covers for lunar equipment during Moon missions."

This technology also shows promise for applications on Earth, e.g., dust storms in desert regions become electrically charged, generating static electricity. With future refinements, it's possible that such materials could be applied in regions such as the Sahel.

3D Printing for Building Houses

As reported Sept. 19 by 3DPrinting.com, the Thai company, Concrete Products and Aggregate Co. Ltd. (CPAC), has built what it claims is the world's first two-story concrete house using the 3D Prefabricated Prefinished Volumetric Construction process, or CPAC-PP3DVC.

Modules are built up in three dimensions on a factory floor and then brought to the building site—a combination of 3D printing and prefab house. In Saraburi in the Thai province of the same name, CPAC built a striking home of 68 square meters in this way—spacious enough for a small family. The modules even contain interior fittings for furniture, such as tabletops, and shelves.

The advantage of combining prefabricated housing with 3D printing is that there is no need for complex concrete printing systems to be on site, and the factory can mass-produce the modules for transport to multiple sites. Each module features distinctive curved walls, adorned with various parametrically-designed textures, with optimal wall thermal properties. The building's structural integrity combines the strength of 3D printed mortar walls with a steel frame. The concrete is treated by CPAC with an anti-mold surface with a special texture—especially important in warm regions with high humidity, such as Thailand.

Changes in Neptune's Climate Challenge Our Understanding of Earth's

Neptune is about 30 times farther away from the Sun than Earth. Because it has a tilt in its axis relative to the plane of its orbit, like every other planet, it therefore experiences seasons, but since it takes about 165 years to orbit the Sun, each of those seasons lasts about 40 years. Neptune's Summer began around 2005.

Neptune had already made things irritatingly difficult some 30 years ago, when the *Voyager* spacecraft in 1989 recorded temperatures *warmer* than its closest neighbor, Uranus, despite the fact that Neptune is over 1.6 billion kilometers *more distant* from the Sun, and should therefore have recorded *cooler* temperatures.

What happened on Neptune has implications for Earth precisely because it has just changed our ideas of the possible, and of what is to be considered "scientific certainty" on matters of astronomy, including climate.

In a study published April 11, 2022 in *Planetary Science Journal*, astronomer-researchers at the University of Leicester observed that halfway through its summer season, Neptune's southern hemisphere got *cooler* by 8° Celsius, between 2003 and 2018. That's like the temperature cooling between late June and the first week of August in the Earth's northern hemisphere. Over the next two years, in that same hemisphere, Neptune's south pole temperatures actually *rose* by 11° Celsius!

According to a *LiveScience* posting April 13, 2022, the researchers have since discovered that the Neptune-Uranus temperature readings likely involve, besides characteristics of the planet, the flipping of the Sun's magnetic poles, which causes cycles in the number of sunspots and subsequent changes in solar radiation and the solar wind.

Lead author Michael Roman:

"Neptune is itself very intriguing to many of us because we still know so little about it. This all points towards a more complicated picture of Neptune's atmosphere and how it changes with time."

The same could be said for Earth's dynamic atmosphere, weather, and climate.