
Science & Technology Briefs

Modified Pig Heart Is Transplanted to a Human Being for the First Time

The University of Maryland Medical Center [announced](#) on Jan. 10 what could be the first successful transplant in history of a heart from another species into a human.

On Jan. 7, surgeons replaced a 57-year-old man's heart with that of a pig. The procedure, given the go-ahead Dec. 31 by the U.S. Food and Drug Administration (FDA), was the first in decades to attempt transplanting a heart into a human from another species, and the first such operation ever to use a heart from a pig genetically engineered to avoid rejection by the human immune system.

Today, 110,000 Americans are on waiting lists for organ transplants. More than 6,000 die each year before getting one, according to the Federal government's organonor.gov website.

In the past, doctors have attempted transplanting organs from animals such as baboons and chimpanzees into humans, but recipients did not survive for long. With the advent of gene editing, researchers began to modify the genes of pigs to make their organs more acceptable to human immune systems.

In this particular case, the pig that provided the man's new heart had four genes knocked out and six human genes added, all with the aim of preventing immune rejection. An additional gene was knocked out to prevent the heart from continuing to grow after transplanting.

"This was a breakthrough surgery and brings us one step closer to solving the organ shortage crisis. There are

simply not enough donor human hearts available to meet the long list of potential recipients," said Bartley P. Griffith, MD, who transplanted the pig heart into the patient. So far, the heart is "working and it looks normal. We are thrilled, but we don't know what tomorrow will bring us. This has never been done before."

More information about this subject and the procedure is available in "Here's How Scientists Pulled Off the First Pig-to-Human Heart Transplant," [posted](#) Jan. 12 in *Science*.

Monoclonal Antibodies Available for COVID-19 Prophylaxis

Some good news for currently uninfected individuals with compromised immune systems or with vaccine allergies that prevent their being vaccinated against COVID-19. A two-antibody cocktail produced by AstraZeneca is expected to provide around six months of protection, of "pre-exposure prophylaxis of coronavirus disease (COVID-19) in certain adults and pediatric individuals 12 years and older."

In a [letter](#) Dec. 20, the U.S. Food & Drug Administration explained its issuance of an Emergency Use Authorization (EUA) for the use of AstraZeneca's monoclonal antibody cocktail, Evusheld (tixagevimab co-packaged with cilgavimab).

These two antibodies act in the same way as antibodies otherwise normally produced by the body, by attaching to areas on SARS-CoV-2's spike protein that prevent the virus from entering and infecting cells.

In its EUA, the FDA stated that

Evusheld is not authorized for treatment of individuals already infected with COVID-19, or who have been exposed to someone who is infected.

Tsunamis' Magnetic Fields Could Provide Early Warning

A study conducted by scientists at Kyoto University in Japan shows that the magnetic field generated by the motion of a tsunami arrives earlier than the wave itself, and that using measurements of these fields, scientists will be able to accurately forecast the height and direction of the tsunami. This may allow what could be a crucial few additional minutes of early warning to facilitate evacuation of people from endangered areas. Such data could be incorporated into a global tsunami warning system such as the Deep-ocean Assessment and Reporting of Tsunamis (DART). The [study](#) was published Oct. 18, 2021 in the American Geophysical Union's *Journal of Geophysical Research: Solid Earth*.

In electromagnetism, an electrical current generates a magnetic field around it, and conversely, an electrical current is generated when a conducting material moves through a magnetic field. A tsunami generates its own magnetic field as it moves through the electrically conductive seawater under the influence of Earth's magnetic field.

The study used data collected on the French Polynesian seafloor in the South Pacific Ocean from the 2009 Samoa and 2010 Chile tsunamis. Both the sea level change and the magnetic field were recorded for these tsunamis. Researchers had previously believed that the magnetic field would arrive

before the sea level change, but lacked the simultaneous measurements of sea level and magnetics to actually demonstrate that hypothesis.

In related research, the question of how Earth's magnetic field affects its climate is under investigation at numerous institutions. The investigations are based on research on "archeomagnetic jerks"—sudden, anomalous changes in local regions of Earth's magnetic field—some of which seem to correlate with significant climatic events. Long-term changes in the magnetic field can be detected by studying remanent magnetism in rocks. These local changes can result in enhanced cosmic-ray induced cloud formation.

Russia Deploys New Space Station Docking Module

On Nov. 24, Russia's new nodal module, Prichal, launched to the International Space Station (ISS) from the Baikonur launch site in Kazakhstan. The Progress M-17 space freighter undocked from the docking slot it was occupying at that time on Russia's multipurpose laboratory module (called Nauka) of the ISS, allowing Prichal to dock.

Prichal has six docking ports, one of which will mate with Nauka's Earth-facing port. The other five will be available for visiting spacecraft, including the Oryol crewed vehicle, helping to "expand the technical and operational capabilities of the orbital infrastructure of the Russian segment of the ISS," in the words of Dmitry Rogozin, Director General of Roscosmos, Russia's space agency. The first docking to the Prichal is slated for March 18.

Cosmonautics historian Alexandr Zheleznyakov [told](#) TASS on Nov. 23, the day before the launch, that it would set a new record, becoming the heaviest payload ever sent to the ISS atop a Soyuz-2 rocket. The overall weight of the payload was 8.18 metric tons, including about 700 kg of supplies including expendable equipment and

consumables; water purification means; medical control including sanitary and hygienic supplies; maintenance and repair tools; and food rations for the 66th Main Expedition crew.

Prichal is useful as part of the ISS not only because other station modules can not be connected with it, but because it is suitable as a nodal module of a future Russian Orbital Service Station (ROSS). Because NASA, the European Space Agency, and Roscosmos—and it appears also China—all use the International Docking System Standard, visiting spaceships from many countries will be able to dock at Prichal.

Earth-Defense Mission To Strike an Asteroid

On Nov. 23, NASA launched its 550-kilogram Double Asteroid Redirection Test (DART) mission aboard a SpaceX Falcon 9 rocket. The first of its kind, this mission, focused specifically on defense of the Earth, is designed to perfect technologies to counter dangerous incoming objects from space. DART will travel millions of miles to smash into Dimorphos, a football stadium-sized "moonlet" of the larger asteroid Didymos. It is expected that the impact will alter by several minutes its orbital period around Didymos.

Some 90% of near-Earth objects of a size comparable to the one that ended the reign of the dinosaurs, are believed to have been identified. Although there are no currently known threats, most near-Earth objects are smaller, and have not had their orbits determined (or even been detected).

When it comes to menacing asteroids, time is of the essence. This test mission will take nearly a year to reach its target, arriving late September or early October, and the change in the target's orbit is puny stuff. Nuclear explosives could be repurposed for planetary-defense missions, but what is really needed is a program for

nuclear-powered *rockets*, capable of reaching locations within the asteroid belt within weeks, rather than a year.

International cooperation on such a mission for the common defense of humanity and our home planet is essential.

Life of ISS Extended To Take Part in Continuous Human Presence in Space

NASA Administrator Bill Nelson announced Dec. 31 the Biden Administration's commitment to extend the occupation and use of the International Space Station (ISS) to 2030, from the previously announced retirement date of 2024, "and to work with our international partners in Europe (ESA, European Space Agency), Japan (JAXA, Japan Aerospace Exploration Agency), Canada (CSA, Canadian Space Agency), and Russia (State Space Corporation Roscosmos) to enable continuation of the groundbreaking research being conducted in this unique orbiting laboratory through the rest of this decade." Roscosmos head Dmitri Rogozin had earlier said Russia would withdraw from the station in 2025 when NASA did, under its previous plan.

ISS's unique microgravity laboratory has hosted more than 3,000 research investigations from over 4,200 researchers around the world, returning a flow of scientific, educational, and technological benefits. Nearly 110 countries and areas have participated in activities aboard ISS, including more than 1,500,000 students per year in STEM activities.

NASA's decision, combined with the Artemis program to return humans to the Moon by 2025, China's *Tiangong* space station now occupied and under construction in low Earth orbit, and the proposed Russian Orbital Space Station (ROSS), scheduled to begin construction in 2025, will ensure uninterrupted, continuous human presence and capabilities in space.