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Technology – Sept'18

Scientists Grow Human Oesophagus In Lab

Syllabus: Science and Technology- developments and their applications and effects in everyday life

In News

- In a first, scientists have successfully grown oesophageal organoids — **miniature, functional versions of the human food pipe** — using stem cells, paving the way for new ways to study and test drugs against gut disorders.
- The human oesophageal tissue was grown entirely from pluripotent stem cells(PSCs), which can form any tissue type in the body.
- The development has intriguing consequences. It allows for the safe, detailed study of conditions related to our food channel in the lab and provides model samples to test therapies and drugs on.
- In addition to being a new model to study birth defects like esophageal atresia, the organoids can be used to study diseases like Eosinophilic esophagitis and Barrett's metaplasia, or to bioengineer genetically matched esophageal tissue for individual patients
- There are several diseases that can afflict people later in life. Some include oesophageal cancer, gastroesophageal reflux disease (GERD), or a rare ailment called achalasia -- a disease affecting the muscles of lower oesophagus that prevents contraction of the organ and the passage of food.
- These conditions require better treatments, and to reach them, it is important that both the genetic and biochemical mechanisms at play in the esophagus are understood. These organoids could be a game changer as they are ideal human tissues that can be experimented on safely.

Oesophagus

The oesophagus is also known as the **gullet or food pipe**.

- It is part of the digestive system, which is sometimes called the gastro-intestinal tract (GI tract).
- It is a long, muscular tube connecting one's mouth to stomach and is around 25cm long in adults.
- Upon swallowing food, the walls of the oesophagus squeeze together (contract). This moves the food down the oesophagus to the stomach.
- The oesophagus has four layers:
 - **The mucosa** – the inner layer, which is moist to help food pass smoothly into the stomach.
 - **The submucosa** – this contains glands that produce mucus (phlegm), which keeps the oesophagus moist.
 - **The muscularis** – the muscle layer, which pushes food down to the stomach.
 - **The adventitia** – the outer layer, which attaches oesophagus to nearby parts of the body.

World's First Hydrogen Train

Syllabus: Science and Technology- developments and their applications and effects in everyday life

In News

- Germany has rolled out the world's first hydrogen-powered train, signalling the start of a push to challenge the might of polluting diesel trains with an eco-friendly technology.
- Nicknamed **Hydrail**, these trains are called **Coradia iLint trains** and have been manufactured by Alstom, one of Europe's largest railway manufacturers.
- The train has batteries made of lithium-ion that is used in mobile phones and home appliances.
- Additionally, the train is equipped with **fuel cells** that produce electricity through a combination of hydrogen and oxygen, a process that leaves steam and water as the only emissions. Excess energy is stored in lithium ion batteries on board the train.
- Buying a hydrogen train is somewhat more expensive than a diesel train, but it is cheaper to run, the Coradia iLint trains can run for about 600 miles (1,000km) on a single tank of hydrogen, similar to the range of diesel trains.
- Further, hydrogen fuel cells have advantages over batteries. Instead of recharging, they can be easily refuelled like a gas or diesel engine.
- The European Commission has described hydrogen as an energy carrier with "great potential for clean, efficient power in stationary, portable and transport applications."
- However, hydrogen doesn't have the ready supply chain of diesel. To use hydrogen at the same or lower cost, a similar network needs to be built.
- Just like the steam-engine kickstarted the age of coal, the German train could just kickstart the age of hydrogen.

MoU on Block Chain Technology

Syllabus: Awareness in the fields of IT and Computers

In News

- The Union Cabinet has approved a Memorandum of Understanding (MoU) on **collaborative research in the field of blockchain and distributed ledger technologies**.
- The cabinet's approval will enable India's Export-Import (EXIM) Bank to launch research efforts in these fields with the participation of representative banks from BRICS financial bloc.
- The **Xiamen Declaration** signed in China on digital economy by the BRICS leaders had highlighted the importance of the digital economy and how the BRICS nations could leverage the thriving and dynamic digital economy that will foster global economic development and benefit everyone. Accordingly an MoU was suggested to be inked by all member banks.
- The MOU, which is a cooperative initiative under the BRICS Interbank Cooperation Mechanism, aims to **foster better understanding of DLT (distributed ledger technology)** and define areas where the technology can be deployed to **improve operational efficiency**.

- DLT holds potential for solutions to various challenges being faced in the financial sector space of the BRICS nations and it allows the banks to **study the applications of innovative technologies in infrastructure finance and bank products optimization.**

International Center for Transformative Artificial Intelligence

Syllabus: Awareness in the fields of IT and Computers

In News

- NITI Aayog, Intel and the Tata Institute of Fundamental Research (TIFR) have come together to set up a model International Center for Transformative Artificial Intelligence (ICTAI) towards developing and deploying AI-led application-based research projects.
- It will be located in Bengaluru, Karnataka.
- The model ICTAI aims to conduct advanced research to incubate AI-led solutions in three important areas – healthcare, agriculture and smart mobility.
- It aims to experiment, discover and establish best practices in the domains of ICTAI governance, fundamental research, physical infrastructure, compute and service infrastructure needs and talent acquisition.
- The intent is to develop standards and support policy development related to information technology such as data-storage, information security, privacy, and ethics for data capture and use.
- The model Centre also plans to develop AI foundational technologies to promote applied research that can scale for national impact and will lead to the creation of a vibrant and self-sustaining ecosystem.
- Another key area of its focus will be collaboration with industry leaders, startups, and AI services and product companies to productize technologies and IP and along the lines support skilling and talent development for world-class AI talent.
- The learnings and best practices developed through this model ICTAI will be used to set up the future ICTAIs across the country.
- Artificial Intelligence is going to be a transformative driver of economic growth and social progress, and the vision is to drive human-centric AI to benefit humanity in an inclusive manner with potentially transformative effects on society.

ICESAT-2

Syllabus: Awareness in the fields of Space

In News

- NASA has launched a satellite **Ice, Cloud and Land Elevation Satellite-2 (ICESAT-2)** into orbit to measure changes in the height of Earth's polar ice cover.
- The satellite launched aboard a United Launch Alliance (ULA) Delta II rocket from Vandenberg Air Force base will measure the average annual elevation change of land ice covering Greenland and Antarctica to within the width of a pencil, capturing 60,000 measurements per second.
- The ICESat-2 observatory contains a single instrument, an improved laser altimeter called ATLAS (Advanced Topographic Laser Altimeter System).

- ATLAS is designed to measure ice-sheet topography, sea ice freeboard as well as cloud and atmospheric properties and global vegetation.
- Satellite is also tasked with measuring ocean & land surfaces — even forests and provide scientists with useful estimates of forest densities, how much carbon is stored in them and wildfire behaviour.
- It uses a technique called **photon counting**. It fires about 10,000 pulses of light every second. Each of those shots go down to Earth and bounce back up on a timescale of about 3.3 milliseconds. The exact time equates to the height of the reflecting surface.
- It will extend and improve upon NASA's 15-year record of monitoring change in polar ice heights, which started in 2003 with the first ICESAT mission and continued in 2009 with NASA's Operation Ice Bridge — an airborne research campaign that kept track of accelerating rate of change.
- It is hoped that ICESat-2 can help produce the first robust maps of sea-ice thickness in the Antarctic. At the moment, the technique for assessing ice floes really only works in the Arctic.
- It will also help researchers narrow the range of uncertainty in forecasts of future sea level rise and connect those changes to climate drivers.

Transiting Exoplanet Survey Satellite

Syllabus: Awareness in the fields of Space

In News

- NASA's **orbital telescope Transiting Exoplanet Survey Satellite**, better known as TESS discovered two distant planets five months after its launch from the Cape Canaveral Air Force Station in Florida.
- The telescope is designed to find thousands of new **exoplanets – planets circling nearby stars** – including those that could support life over a two-year mission.
- It is designed to build on work of its **predecessor, the Kepler space telescope**, which discovered bulk of some 3,700 exoplanets documented during past 20 years & is running out of fuel.
- With four special cameras, TESS uses a detection method called **transit photometry**, which looks for periodic dips in the visible light of stars caused by planets passing or transiting, in front of them.
- The first planet **Pi Mensae c**, a super-earth orbits a bright yellow dwarf star Pi Mensae, just under 60 light-years from Earth.
- The second **LHS 3844 b**, a hot earth, orbits a red dwarf star LHS 3844, just under 49 light-years away.
- A planet is classified as a super-earth if it's at least three times the mass of Earth and can be as big as 10 times the size of Earth.
- Both planets appear to be Earth-like and rocky, but neither is habitable as both are too close to their stars for liquid water.

Cassini Spacecraft

Syllabus: Awareness in the fields of Space

In News

- Data from NASA's Cassini spacecraft has led to the scientists spotting a surprising feature emerging at Saturn's northern pole as it nears summertime — **a warming, high-altitude jet stream with a hexagonal shape**.
- The edges of this newly found vortex appear to be hexagonal, precisely matching a famous and bizarre hexagonal cloud pattern we see deeper down in Saturn's atmosphere. This warm vortex sits hundreds of miles above the clouds, in the stratosphere.
- The results suggest that the lower-altitude hexagon may influence what happens above, and that it could be a towering structure hundreds of miles in height.

Cassini

- The **Cassini–Huygens mission**, commonly called Cassini, was a **collaboration between NASA, the European Space Agency (ESA), and the Italian Space Agency (ASI)** to send a probe to study the planet Saturn and its system, including its rings and natural satellites.
- Cassini was the fourth space probe to visit Saturn and the **first to enter its orbit**.
- The lander Huygens landed on Saturn's largest moon **Titan**.
- Cassini was active in space for nearly 20 years, with 13 years spent orbiting Saturn, after entering orbit in July 2004.
- Its mission ended in September 2017, when Cassini's trajectory took it into Saturn's upper atmosphere and it burned up.

ISRO Launches Two U.K. Satellites

Syllabus: Awareness in the fields of Space

In News

- ISRO recently launched PSLV-C42 into orbit carrying two earth observation satellites from Britain. The satellites onboard are **NovaSAR and S1-4**.
- The launch was a collaboration between Surrey Satellite Technologies Limited and Antrix Corporation Limited, ISRO's commercial arm.
- India is seeking a larger share of the more than \$300 billion global space industry as it seeks to project itself as a global low-cost provider of services in space.
- The PSLV-C-42 launched the two satellites into a 583 km sun-synchronous orbit.
- A satellite is said to be in a sun-synchronous orbit when it changes its orientation throughout the year to ensure that the angle of sunlight is the same every time it passes over a particular geographical area on the surface of the earth.
- NovaSar is a Synthetic Aperture Radar that will be used for ship detection, maritime monitoring and flood monitoring, besides agricultural and forestry applications.
- The S1-4 is a high-resolution optical earth observation satellite which will be used for environment monitoring, urban management, and tackling disasters.

Dickinsonia

Syllabus: Awareness in the fields of bio-tech

In News

- Scientists have discovered an *ancient fossil of the earliest animal* on geological record — **Dickinsonia** — a strange oval creature with rib like segments running along its body that lived on Earth 558 million years ago.
- The animal, which grew up to 1.4 metres in length, was part of the **Ediacaran Biota (earliest animal group)** that lived on Earth 20 million years prior to the Cambrian explosion of modern animal life.
- The Cambrian explosion is the term given to the period of time in history when complex animals and other macroscopic organisms such as molluscs, worms, arthropods and sponges began to dominate the fossil record.
- Researchers found the Dickinsonia fossil so well-preserved in a remote area near the White Sea in the northwest of Russia, that the tissue still contained molecules of cholesterol, a type of fat that is the hallmark of animal life.
- The fossil fat molecules found prove that animals were large and abundant 558 million years ago, millions of years earlier than previously thought.
- Scientists have been debating for more than 75 years over what Dickinsonia and other fossils of the Ediacaran Biota were — giant single-celled amoeba, lichen, failed experiments of evolution, or the earliest animals on Earth.
- The fossil fat found in the earliest animal now confirms it as the oldest known animal **fossil**, solving a decades-old mystery.

Apsara U Reactor

Syllabus: Indigenization of technology and developing new technology.

In News

- Nine years after Apsara (the country's first and oldest atomic reactor) was shut down, the Bhabha Atomic Research Centre (BARC) has set in motion a higher capacity version Apsara-upgraded (U).
- Indigenously constructed, Apsara U is a swimming pool type research reactor that **uses plate type dispersion fuel elements made of low enriched uranium**.
- Using high neutron flux, the reactor will increase the indigenous production of radioisotopes for medical application by about 50% and will also be extensively **used for research in nuclear physics, material science and radiation shielding**.
- Radioisotopes generated via power generation in nuclear reactors, research reactors, accelerators and spent fuel are used in agriculture, healthcare, industry and even municipal waste management.
- This development has re-emphasised the capability of Indian scientists and engineers to build, complex facilities for health care, science education and research.

Apsara

- Apsara, in addition to being the **first nuclear research reactor in India** that reached criticality in August 1956, was also the **first in Asia**.

- A light water swimming pool-type reactor with a maximum power output of one megawatt thermal (MWT) was inaugurated by then Prime Minister Jawaharlal Nehru.
- The reactor was designed by the BARC and built with assistance from the **United Kingdom**.
- The production of radioisotopes in the country commenced with the commissioning of Apsara.