

# You & Technology Aug-2019



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# GOOD MORNING TIMES S&T (AUGUST-2019)

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## General Studies Paper-3 – S&T – August 2019

### 1. IRON ION BATTERY

IIT Madras has fabricated a rechargeable iron ion battery and registered initial success.

- The rechargeable iron ion battery has been designed using mild steel as the anode.
- The iron ion battery is cost-effective and the amount of energy that can be stored in the battery is also high.
- While lithium ions are the charge carriers in lithium ion battery, the  $\text{Fe}^{2+}$  ions perform that function in the case of iron ion battery.
- When fabricated under controlled conditions, the amount of energy that can be drawn from the iron ion battery is 220 Wh per kg, which is 55-60% of lithium ion battery's performance.
- In iron ion battery, vanadium pentoxide is used as the cathode. Vanadium pentoxide was chosen as it has a layered structure with very large spacing between the layers.
- The large inter-layer spacing in vanadium pentoxide allows iron ions to easily move in and bind to the interlayers of the cathode and also easily get detached and move back to the anode.

#### **Benefits of iron over Lithium:**

- Iron has favourable physico-chemical properties like lithium.
- The redox potential of iron ion is higher than lithium ion and the radius of the  $\text{Fe}^{2+}$  ion is nearly the same as that of the lithium ion.
- Iron is more stable during the charging process and therefore prevents short-circuiting of the batteries. This, when compared with the popular lithium metal-based batteries helps cut down the cost and make it safer to handle.

### 2. MICHAEL FARADAY AND ELECTROMAGNETIC INDUCTION

On August 29 in 1831, British scientist Michael Faraday discovered electromagnetic induction.

- This discovery has led to important inventions such as electric motors, transformers, inductors, and generators.

#### **Who was Michael Faraday, and how did he discover electromagnetic induction?**

- Michael Faraday is a Scientist from England, with pioneering contributions in both chemistry and electromagnetism.

His contributions:

- He discovered Benzene, electromagnetic induction, diamagnetism, electrolysis, and the effect of magnetism on light.

#### **What is Faraday's law and how did it come about?**

- Faraday wrapped a thick iron ring with two coils of insulated wire, one on each side of the ring.
- One coil was connected to a battery, and the other to a galvanometer.
- When the battery circuit was closed, Faraday saw a momentary deflection on the galvanometer.
- A similar momentary deflection but in the opposite direction was seen when the battery circuit was opened.
- This observation led to the discovery that a change in a magnetic field produces an electromotive force and current in a nearby circuit.
- This phenomenon, called electromagnetic induction, was later mathematically modelled by James Clerk Maxwell and came to be known as Faraday's Law.

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## **3) HYDROTHERMAL CARBONISATION**

Recently, IIT Kharagpur has developed Hydrothermal Carbonisation technology which can generate energy from solid waste with high moisture content.

### **About Hydrothermal Carbonisation**

- The technology is aimed at conversion of wet biomass into hydro-char (a coal like fuel) under suitable temperature and pressure conditions.
- The hydro-char, rich in carbon and high calorific content, can be utilized as fuel, as an alternative for coal, as feedstock for gasification, as a soil additive for nutrient enrichment, or as an adsorbent for activated carbon.
- Its by-products include ash which can be applied as a plant nutrient enhancer because of its phosphorus content, and also a potassium loaded liquid that can be used for watering plants.

### **Why India needs such technology?**

- High percentage of wet waste: Of the 55 million tonnes of Municipal Solid Waste generated every year in India, 85% is biodegradable waste which has a very high moisture content ranging between 60 and 70 per cent of the total.
- Realisation of target: the technology will help India in achieving the renewable energy target of 10 GW bio power by 2022.
- Indegenisation of technology: This technology is already in use in Japan and Germany. And the development has led to India having its own technology.

## **4) GRAVITATIONAL LENSING**

Recently, the NASA has announced that plan to use the phenomena of gravitational lensing in its research.

- The National Aeronautics and Space Administration (NASA) is using the James Webb

Space Telescope to conduct wide range of investigations across the fields of astronomy and cosmology.

o Recently, NASA announced that they plan to investigate how new stars are born. For this, they will take the help of a natural phenomenon called “gravitational lensing”.

o This programme is called **TEMPLATES** (Targeting Extremely Magnified Panchromatic Lensed Arcs and Their Extended Star Formation).

### **About Gravitational lensing**

• It is a phenomenon, which occurs when a huge amount of matter, such as a massive galaxy or cluster of galaxies, creates a gravitational field that distorts and magnifies the light from objects behind it, but in the same line of sight. o These large celestial objects will magnify the light from distant galaxies that are at or near the peak of star formation. So, in a way these objects act as natural, cosmic telescopes and are called gravitational lenses.

o As a result, the galaxies appear much, much brighter than they actually are, because they’ve been highly magnified up to 50 times.

### **Applications of Gravitational Lensing**

- Study the galaxies, which are very far away- and can be seen otherwise with even the most powerful space telescopes.
- Observe invisible things in the Universe- since dark matter doesn’t emit or absorb light on its own, so it can’t be observed directly. Using this effect, it can be worked out how much dark matter exists in the universe.
- Understand the star formation- by studying how those galaxies are forming their stars, and how that star formation is distributed across the galaxies.
- Understand the past- e.g. The Milky Way today forms the equivalent of one Sun every year, but in

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the past, that rate was up to 100 times greater. Using this effect, the scientists can look billions of years into the past in order to understand how our Sun formed.

## **5) HYPERLOOP**

Richard Branson's Virgin Hyperloop One has signed an agreement with the Maharashtra government to build a Hyperloop that will cut the travel time between Mumbai and Pune to 25 minutes from the 3 hours it now takes by road.

### **What is hyperloop transportation system?**

- It is a transportation system where a pod-like vehicle is propelled through a near-vacuum tube connecting cities at speeds matching that of an aircraft.
- The hyperloop concept is a brainchild of Tesla founder Elon Musk. US-based Hyperloop Transport Technology (HTT) claimed it costs \$40 million per kilometre to build a hyperloop system while building a high-speed train line would cost almost twice. The hyperloop system is being designed to transport passengers and freight.

### **How it operates?**

- In hyperloop transportation, custom-designed capsules or pods are expected to zip smoothly through continuous steel tubes which are held at partial vacuum. The pod which sandwiches the passenger compartment between an air compressor upfront and a battery compartment in the rear is supported by air caster skis at the bottom.
- The skis float on a thin layer of air provided under high pressure, eliminating rolling resistance and allowing for movement of the pods at high speeds. These capsules are expected to be driverless with estimated speeds of 1,000 km/h. Linear induction motors that are placed along the tube control the speed of the pod. Electronically-

assisted acceleration and braking determines the speed of the capsule.

### **The Problems Plaguing the Hyperloop:**

- Constructing a tube hundreds of kilometers long would be an engineering marvel in of itself. However, introducing a tube hundreds of kilometers long that operates at a near perfect vacuum which can support the force of capsule weighing thousands of kilograms as it travels hundreds of kilometers an hour is nothing short of sci-fi fantasy.
- Small scale experiments reveal the fundamentals of the idea are sound. Although, in the real world, there are too many factors that cannot be accounted for with a small scale design. In the real world, there are tens of thousands of kilograms of atmospheric pressure which threatens to crush any vacuum chamber.
- There is also the problem with thermal expansion which threatens to buckle any large structure without proper thermal expansion capabilities. The Hyperloop would also be stupendously expensive. There are many unavoidable problems facing the Hyperloop that threaten the structural integrity, and every human life on board. The problems can be addressed, but at a great cost.

## **6) WHAT IS INDIA'S DEEP OCEAN MISSION?**

- Ministry Of Earth Sciences Plans Rs 8000 Crore 'Deep Ocean Mission' To Boost India's Sea Exploration Capabilities.

### **What will be mined from the deep ocean?**

- One of the main aims of the mission is to explore and extract polymetallic nodules. These are small potato-like rounded accretions composed of minerals such as manganese, nickel, cobalt, copper and iron hydroxide.

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- They lie scattered on the Indian Ocean floor at depths of about 6,000 m and the size can vary from a few millimetres to centimetres. These metals can be extracted and used in electronic devices, smartphones, batteries and even for solar panels.

## How is it regulated?

- The International Seabed Authority (ISA), an autonomous international organisation established under the 1982 United Nations Convention on the Law of the Sea, allots the 'area' for deep-sea mining.

- India was the first country to receive the status of a 'Pioneer Investor' in 1987 and was given an area of about 1.5 lakh sq km in the Central Indian Ocean Basin (CIOB) for nodule exploration. In 2002, India signed a contract with the ISA and after complete resource analysis of the seabed 50% was surrendered and the country retained an area of 75,000 sq km.

## Which are the other countries that are in the race to mine the deep sea?

- Apart from the CIOB, polymetallic nodules have been identified from the central Pacific Ocean. It is known as the Clarion-Clipperton Zone.

- China, France, Germany, Japan, South Korea, Russia and also some small islands such as the Cook Islands, Kiribati have joined the race for deep sea mining. Most of the countries have tested their technologies in shallow waters and are yet to start deep-sea extraction.

## What will be the environmental impact?

- According to the International Union for Conservation of Nature (IUCN), these deep remote locations can be home to unique species that have adapted themselves to conditions such as poor oxygen and sunlight, high pressure and extremely low temperatures.

- Such mining expeditions can make them go extinct even before they are known to science. The deep sea's biodiversity and ecology remain poorly understood, making it difficult to assess the environmental impact and frame adequate guidelines.

- Environmentalists are also worried about the sediment plumes that will be generated as the suspended particles can rise to the surface harming the filter feeders in the upper ocean layers. Additional concerns have been raised about the noise and light pollution from the mining vehicles and oil spills from the operating vessels.

## Is deep sea mining economically viable?

- The latest estimate from the ISA says it will be commercially viable only if about three million tonnes are mined per year. More studies are being carried out to understand how the technology can be scaled up and used efficiently.

## 7) VIKRAM SARABHAI JOURNALISM AWARD IN SPACE SCIENCE, TECHNOLOGY AND RESEARCH

As part of centenary year celebrations of Dr. Vikram Sarabhai, father of Indian space programme, ISRO has announced its "Vikram Sarabhai Journalism Award in Space Science, Technology and Research".

- The award recognizes and rewards journalists who have actively contributed towards the field of space science, applications, and research.

- Eligibility: The nominations are open to all Indians who have a good experience in journalism.

- The names of the selected candidates will be announced on August 1st, 2020.

## About Vikram Sarabhai and his contributions:

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• Vikram Sarabhai was born on August 12, 1919. Sarabhai was instrumental in forming India's future in astronomy and setting up the country's space research facilities.

Key contributions:

- Based on his persuasion, the Indian government agreed to set up the Indian National Committee for Space Research (INCOSPAR) in 1962.
- Sarabhai was the first chairman of the committee.
- The INCOSPAR was restructured and renamed as Indian Space Research Organisation (ISRO) in 1969.
- Sarabhai founded the Physical Research Laboratory in Ahmedabad in the year 1947. The laboratory started its operation from RETREAT, Sarabhai's residence in Ahmedabad. Its first topic of research was cosmic rays.
- He also set up India's first rocket launch site in Thumba, a small village near the Thiruvananthapuram airport in Kerala.
- Vikram Sarabhai was also responsible for bringing cable television to India. His constant contact with NASA paved a way for the establishment of Satellite Instructional Television Experiment (SITE) in 1975.
- Sarabhai was the mastermind behind building India's first satellite, Aryabhata.
- He was one of the founding members of the Indian Institute of Management, Ahmedabad (IIMA).
- Vikram Sarabhai received the Padma Bhushan in 1966 for his contribution to India's progress. He was also awarded the Padma Vibhushan in 1972, posthumously.

## 8) INDIA'S ANTI-SATELLITE (ASAT) MISSILE

Four months after India successfully tested its anti-satellite (ASAT) capabilities, experts tracking the debris created by the event have reported that 40% of it has still not decayed. India had claimed after the test that the debris would decay within 45 days after the event.

### What is it?

- Mission Shakti is a joint programme of the Defence Research and Development Organisation (DRDO) and the Indian Space Research Organisation (ISRO).
- As part of the mission, an anti-satellite (A-SAT) weapon was launched and targeted an Indian satellite which had been decommissioned. Mission Shakti was carried out from DRDO's testing range in Odisha's Balasore.

### Significance:

- India is only the 4th country to acquire such a specialised and modern capability, and Entire effort is indigenous. Till now, only the US, Russia and China had the capability to hit a live target in space.

### Why do we need such capabilities?

- India has a long standing and rapidly growing space programme. It has expanded rapidly in the last five years. The Mangalyaan Mission to Mars was successfully launched. Thereafter, the government has sanctioned the Gaganyaan Mission which will take Indians to outer space.
- India has undertaken more than 100 spacecraft missions consisting of communication satellites, earth observation satellites, experimental satellites, navigation satellites, apart from satellites meant for scientific research and exploration, academic studies and other small satellites. India's space programme is a critical backbone of India's security, economic and social infrastructure.

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• The test was done to verify that India has the capability to safeguard our space assets. It is the Government of India's responsibility to defend the country's interests in outer space.

## Raising concerns:

- Outer space has become an "arena of rivalry between major powers." At the same time, there was common concern on space debris. Satellites today have to avoid almost 6,00,000 debris of over 1cm travelling at speed faster than a bullet.
- As space gets increasingly crowded, there is need to regulate space traffic on the lines of air traffic or railways.

## What is space debris?

- Space junk is an ever-growing problem with more than 7,500 tonnes of redundant hardware now thought to be circling the Earth. Ranging from old rocket bodies and defunct spacecraft through to screws and even flecks of paint – this material poses a collision hazard to operational missions.
- The rising population of space debris increases the potential danger to all space vehicles, but especially to the International Space Station (ISS), space shuttles, satellites and other spacecraft.

Technologies that can tackle the problem in future are:

- Moving an object out of the way by altering its orbit is one method of diverting a potential crash, but the sheer amount of debris requires constant observation and prediction – by any means necessary.
- Nasa's Space Debris Sensor orbits the Earth on the International Space Station. The sensor was attached to the outside of the space station's European Columbus module in December 2017. It will detect millimetresized pieces of debris for at least two years, providing information on whatever hits it such as size, density, velocity,

orbit and will determine whether the impacting object is from space or a man-made piece of space debris.

- REMOVEdebris, satellite contain two cubesats that will release simulated space debris so that it can then demonstrate several ways of retrieving them.
- Deorbit mission: There are two emerging technologies being developed under what's known as the e.Deorbit mission to grasp the wayward space junk, or to catch it.
- Other technologies include moving objects with a powerful laser beam. It is important to start doing that soon, current scientific estimates predict that without active debris removal, certain orbits will become unusable over the coming decades.

## Way ahead:

- Arms race in outer space should not be encouraged. India has always maintained that space must be used only for peaceful purposes. It is against the weaponisation of Outer Space and supports international efforts to reinforce the safety and security of space based assets.
- India believes that Outer space is the common heritage of humankind and it is the responsibility of all spacefaring nations to preserve and promote the benefits flowing from advances made in space technology and its applications for all.

## 9) PARKER SOLAR PROBE

On August 12, NASA's Parker Solar Probe completed a year in service. It is part of NASA's "Living With a Star" programme that explores different aspects of the Sun-Earth system.

- The probe seeks to gather information about the Sun's atmosphere and NASA says that it "will revolutionise our understanding of the Sun". It is

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also the closest a human-made object has ever gone to the Sun.

## About the mission:

### • What is it?

NASA's historic Parker Solar Probe mission will revolutionize our understanding of the sun, where changing conditions can propagate out into the solar system, affecting Earth and other worlds. Parker Solar Probe will travel through the sun's atmosphere, closer to the surface than any spacecraft before it, facing brutal heat and radiation conditions — and ultimately providing humanity with the closest-ever observations of a star.

• **Journey:** In order to unlock the mysteries of the sun's atmosphere, Parker Solar Probe will use Venus' gravity during seven flybys over nearly seven years to gradually bring its orbit closer to the sun. The spacecraft will fly through the sun's atmosphere as close as 3.9 million miles to our star's surface, well within the orbit of Mercury and more than seven times closer than any spacecraft has come before.

• **Goals:** The primary science goals for the mission are to trace how energy and heat move through the solar corona and to explore what accelerates the solar wind as well as solar energetic particles.

### **Parker Solar Probe has three detailed science objectives:**

1. Trace the flow of energy that heats and accelerates the solar corona and solar wind.
2. Determine the structure and dynamics of the plasma and magnetic fields at the sources of the solar wind.
3. Explore mechanisms that accelerate and transport energetic particles.

### **Why study corona?**

• The corona is hotter than the surface of the sun. The corona gives rise to the solar wind, a

continuous flow of charged particles that permeates the solar system. Unpredictable solar winds cause disturbances in our planet's magnetic field and can play havoc with communications technology on Earth. Nasa hopes the findings will enable scientists to forecast changes in Earth's space environment.

### **Why do we study the sun and the solar wind?**

- The sun is the only star we can study up close. By studying this star we live with, we learn more about stars throughout the universe.
- The sun is a source of light and heat for life on Earth. The more we know about it, the more we can understand how life on Earth developed.
- The sun also affects Earth in less familiar ways. It is the source of the solar wind; a flow of ionized gases from the sun that streams past Earth at speeds of more than 500 km per second (a million miles per hour).
- Disturbances in the solar wind shake Earth's magnetic field and pump energy into the radiation belts, part of a set of changes in near-Earth space known as space weather.
- Space weather can change the orbits of satellites, shorten their lifetimes, or interfere with onboard electronics. The more we learn about what causes space weather – and how to predict it – the more we can protect the satellites we depend on.
- The solar wind dominates the space environment. As we send spacecraft and astronauts further and further from home, we must understand this space environment just as early seafarers needed to understand the ocean.

## **10) MAGNETOSPHERIC MULTISCALE MISSION**

The Magnetospheric Multiscale mission (MMS) recently made the first precise measurements of an

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interplanetary shock using high-resolution instruments.

- These interplanetary shocks provide ideal test beds for learning about larger universal phenomena.

## About Magnetospheric Mission:

- NASA's MMS investigates how the Sun's and Earth's magnetic fields connect and disconnect, explosively transferring energy from one to the other in a process that is important at the Sun, other planets, and everywhere in the universe, known as magnetic reconnection.

- Reconnection limits the performance of fusion reactors and is the final governor of geospace weather that affects modern technological systems such as telecommunications networks, GPS navigation, and electrical power grids.

## Science Goals:

- MMS reveals, for the first time, the small-scale three-dimensional structure and dynamics of the elusively thin and fast-moving electron diffusion region.
- It does this in both of the key reconnection regions near Earth, where the most energetic events originate.

## Mission Objective:

- By observing magnetic reconnection in nature, MMS provides access to predictive knowledge of a universal process that is the final governor of space weather, affecting modern technological systems such as communications networks, GPS navigation, and electrical power grids.
- MMS will establish knowledge, methods and technologies applicable to future space weather missions and the future growth and development of space weather forecasting.
- MMS sensors will measure charged particle velocities, as well as electric and magnetic fields, with unprecedented (milliseconds) time resolution

and accuracy needed to capture the elusively thin and fastmoving electron diffusion region.

- MMS probes reconnection of solar and terrestrial magnetic fields in the dayside and nightside of Earth's magnetosphere, the only natural laboratory where it can be directly observed by spacecraft.

## 11) FEDOR

Russia has launched an unmanned rocket into space.

- It is carrying a life-size humanoid robot that will spend 10 days learning to assist astronauts on the International Space Station.

- Known as FEDOR, which stands for Final Experimental Demonstration Object Research, the Skybot F-850 is the first humanoid robot to be sent to space by Russia.

- The robot's main purpose is to be used in operations that are especially dangerous for humans onboard spacecraft and in outer space.

- FEDOR, who is the size of an adult and can emulate movements of the human body, has apparently embraced his mission, describing himself as "an assistant to the ISS crew".

## Significance:

- Fedor copies human movements, a key skill that allows it to remotely help astronauts or even people on Earth to carry out tasks while the humans are strapped into an exoskeleton.
- Fedor is described as potentially useful on Earth for working in high radiation environments, demining and tricky rescue missions.

## Background:

- Fedor is not the first robot to go into space.
- In 2011, NASA sent up Robonaut 2, a humanoid robot developed with General Motors that had a similar aim of working in high-risk environments.

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- In 2013, Japan sent up a small robot called Kirobo along with the ISS's first Japanese space commander.

## **12) CANINE DISTEMPER VIRUS (CDV)**

A recent study published in Threatened Taxa notes that 86% of the tested dogs around Ranthambhore National Park in Rajasthan carried Canine Distemper Virus (CDV) antibodies in their bloodstream.

- This means that the dogs are either currently infected or have been infected sometime in their life and have overcome the disease. This finding points out that there is an increased risk of disease transfer from the dogs to tigers and leopards that live in the park.

### **Background:**

- Last year, over 20 lions from the Gir forest succumbed to the viral infection and now a guideline has been prepared by the National Tiger Conservation Authority to prevent the spillover of the disease to wild animals.

### **What needs to be done?**

- The easy way out is prevention. Managing any disease in a wildlife population is extremely difficult. Most dogs are free ranging and not owned by any particular person in the village.
- The government should take the initiative to vaccinate the dogs around wildlife sanctuaries in the country. This would be a good time to vaccinate against rabies as well. It is an investment that requires time and effort but increasing herd immunity will reduce chances of disease spillover to wildlife.

### **What is Canine Distemper Virus?**

- Canine Distemper Virus (CDV) is a viral disease that infects the gastrointestinal, respiratory, and central nervous systems.

Spread:

- Dogs who have not been vaccinated for Canine Distemper are the most at-risk. While the disease can also be contracted when improperly vaccinated or when a dog has high susceptibility to bacterial infection, these cases are rare.

- CDV can be spread through direct contact (licking, breathing air, etc.) or indirect contact (bedding, toys, food bowls, etc.), though it cannot live on surfaces for very long. Inhaling the virus is the primary method of exposure. There is no known cure for CDV.

## **13) ROTAVIRUS**

The Health Ministry has drawn an ambitious plan under the 100 days agenda of the newly elected government, wherein it has been decided to provide Rotavirus vaccine to every child across all States and Union Territories by September, 2019.

- The vaccine has been developed indigenously under a public-private partnership by the ministries of science and technology and health and family welfare.

### **About Rotavirus:**

- Rotavirus is a leading cause of severe diarrhoea and death among children less than five years of age.
- It is responsible for around 10% of total child mortality every year.

### **Rotavirus-Signs and Symptoms:**

- Kids with a rotavirus infection have fever, nausea, and vomiting, often followed by abdominal cramps and frequent, watery diarrhea.
- Kids may also have a cough and runny nose.
- Sometimes the diarrhoea that accompanies a rotavirus infection is so severe that it can quickly lead to dehydration.
- As with all viruses, though, some rotavirus infections cause few or no symptoms, especially in adults.

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Transmission:

- Rotavirus is transmitted by the faecal-oral route, via contact with contaminated hands, surfaces and objects, and possibly by the respiratory route. Viral diarrhea is highly contagious.

Background:

- Out of all the causes of diarrhoea, rotavirus is a leading cause of diarrhoea in children less than 5 years of age. Rotavirus diarrhoea presents in similar manner like any other diarrhoea but can mainly be prevented through rotavirus vaccination.
- Other diarrhoea can be prevented through general measures like good hygiene, frequent hand washing, safe water and safe food consumption, exclusive breastfeeding and vitamin A supplementation.

## **14) STUDY TO CHECK ANTIBIOTIC RESISTANCE IN GANGA**

The government has commissioned a ₹9.3 crore study to assess the microbial diversity along the entire length of the Ganga and test if stretches of the 2,500 km long river contain microbes that may promote “antibiotic resistance”.

The aims of the research project is to:

- Indicate the type of “contamination” (sewage and industrial) in the river and “threat to human health (antibiotic resistance surge)”.
- Identify sources of *Escherichia coli*, a type of bacteria that lives in the gut of animals and humans.

**Need for such studies:**

- A 2017 report commissioned by the Union Department of Biotechnology and the U.K. Research Council underlined that India had some of the highest antibiotic resistance rates among bacteria that commonly cause infections.

- Another study reported that levels of resistance genes that lead to “superbugs” were about 60 times greater during the pilgrimage months of May and June than at other times of the year.

**What is it?**

- Antimicrobial resistance (AMR) is the ability of a microorganism (like bacteria, viruses, and some parasites) to stop an antimicrobial (such as antibiotics, antivirals and antimalarials) from working against it. As a result, standard treatments become ineffective, infections persist and may spread to others.
- The term is used in the context of resistance that pathogens or cancers have “acquired”, that is, resistance has evolved.
- When an organism is resistant to more than one drug, it is said to be multidrug-resistant.

**Why is Antibiotic Resistance a Big Deal?**

- The discovery of antibiotics less than a century ago was a turning point in public health that has saved countless lives. Although antibiotic resistance develops naturally with normal bacterial mutation, humans are speeding it up by using antibiotics improperly. According to a research, now, 2 million people a year in the US develop antibiotic-resistant infections, and 23,000 of them die of those infections.

**Why is the medical community worried?**

- Basically, superbugs are becoming more powerful and widespread than ever. Medical experts are afraid that we’re one step away from deadly, untreatable infections, since the mcr-1 *E.coli* is resistant to that last-resort antibiotic Colistin. Antibiotic-resistance is passed relatively easily from one bacteria to the next, since it is transmitted by way of loose genetic material that most bacteria have in common.
- The World Health Organization (WHO) is afraid of a post-antibiotic world, where loads of bacteria

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are superbugs. Already, infections like tuberculosis, gonorrhea, and pneumonia are becoming harder to treat with typical antibiotics.

Need of the hour:

- A multi-stakeholder approach, involving private industry, philanthropic groups and citizen activists is needed.
- Private pharmaceutical industries must take it upon themselves to distribute drugs in a responsible manner.
- Philanthropic charities must fund the development of new antibiotics, while citizen activists must drive awareness.
- These stakeholders must appreciate that the only way to postpone resistance is through improved hygiene and vaccinations.

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All the Best to all my Economics students...

Hope this material will help you.

God bless...JAI Hind

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