

VISIONIAS

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Classroom Study Material
SCIENCE AND TECHNOLOGY

September 2016 – October 2016

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1. BIOTECHNOLOGY

1.1. BIOTECH-KISAN AND CATTLE GENOMICS

Why in News?

- The Ministry of Science and Technology has launched two farmer-centric initiatives known as Biotech-KISAN and Cattle Genomics.

Biotech-KISAN (Krishi Innovation Science Application Network)

- **For Farmers:** The Biotech-KISAN is a Farmer centric scheme launched by of the Department of Biotechnology, where scientists will work in sync with farmers to understand problems and find solutions.
- **By Farmers:** Developed in consultation with the farmers. Biotech-KISAN aims to link farmers, scientists and science institutions across the country in a network that identifies and helps solve their problems in a cooperative manner.
- **Empower women:** The scheme includes the Mahila Biotech- KISAN fellowships, for training and education in farm practices, for women farmers. The Scheme also aims to support the women farmers/ entrepreneur in their small enterprises, making her a grass root innovator.
- **Connects Globally:** Biotech-KISAN will connect farmers to best global practices; training workshops will be held in India and other countries.
- **Hubs and Spoke.** In each of these 15 regions, a Farmer organisation will be the hub connected to different science labs, Krishi Vigyan Kendra and State Agriculture Universities co-located in the region. The hub will reach out to the farmers in the region and connect them to scientists and institutions.

Cattle Genomics

- Through this programme, the government aims to improve the genetic health of the cattle population through genomic selection. Genomic selection will ensure high-yielding, disease-resistant, resilient livestock.
- Genome sequencing of indigenous cattle breeds from all registered cattle breeds of India by involving various stakeholders is to start soon.
- The programme also envisages development of high-density DNA chips. This will reduce the cost and time interval for future breeding programmes and productivity of indigenous cattle would be enhanced.

“You are as strong as your foundation”

FOUNDATION COURSE

GS PRELIMS & MAINS

Approach is to build fundamental concepts and analytical ability in students to enable them to answer questions of Preliminary as well as Mains examination

Regular Batch

Duration: 8 Months

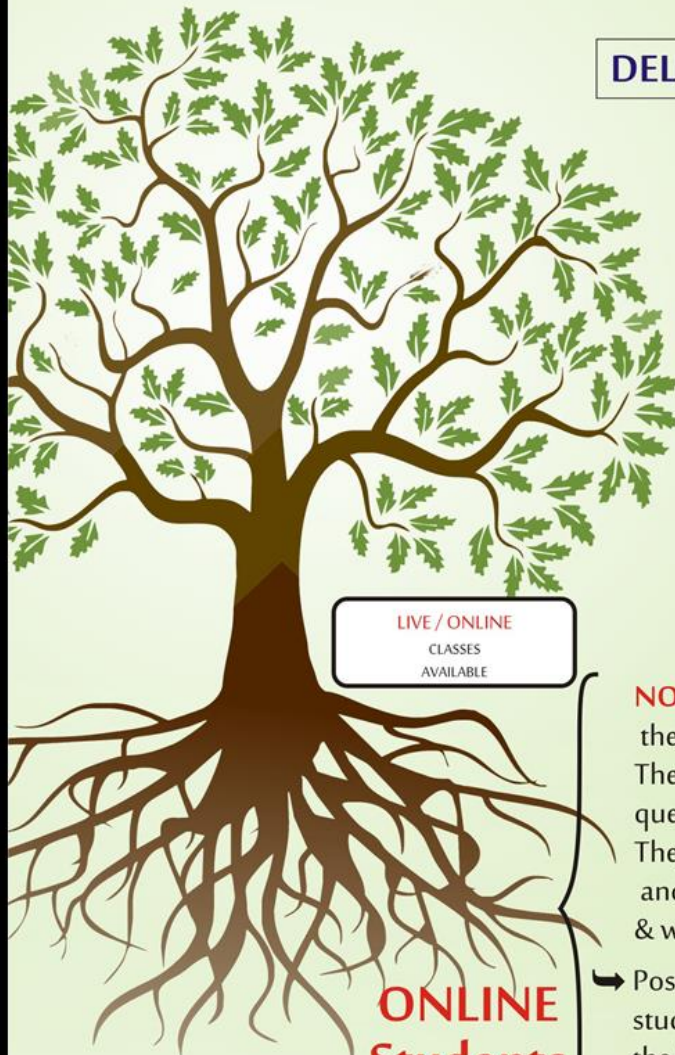
Weekend Batch

Duration: 8 Months, Sat & Sun

DELHI

JAIPUR

PUNE



LIVE / ONLINE
CLASSES
AVAILABLE

**ONLINE
Students**

- ↳ Includes comprehensive coverage of all the topics for all the four papers of GS mains , GS Prelims & Essay
- ↳ Access to recorded classroom videos at your personal student platform
- ↳ Includes comprehensive, relevant and updated study material
- ↳ Includes All India GS Mains, GS Prelims, CSAT & Essay Test Series

NOTE - Students can watch LIVE video classes on their ONLINE PLATFORM at their homes. The students can ask their doubts and subject queries during the class through LIVE Chat Option. They can also note down their doubts & questions and convey to our classroom mentor at Delhi center & we will respond to the queries through phone/mail.

- ↳ Post processed videos are uploaded on student's online platform within 24-48 hours of the live class.
- ↳ The uploaded Class videos can be viewed any number of times

2. NANOTECHNOLOGY

2.1. INDIAN RESEARCHERS PRODUCES STABLE SOLAR CELLS

Why in news?

- In a first, a researcher from Pune's Indian Institute of Science Education and Research (IISER) has successfully produced a stable, high-efficiency, all-inorganic perovskite nanocrystal solar cells.

Significance

- Silicone-based solar cells available currently are extremely expensive, so research to reduce their cost and increase efficiency is going on.
- Traditional research on solar cells has been around a hybrid organic-inorganic halide-perovskite material which has a high efficiency of 22%, but is stable under ambient conditions for a very short time.
- In earlier efforts on such a material the scientific community was developing bigger size crystals which made the product undesirable. Materials with perovskite structure have been the frontrunners in order to make solar cells cost-effective.
- The researcher was able to remove the organic element and introduce nanocrystals of cesium to develop a completely inorganic material which was also thermally stable.

What was done?

- The team replaced methyl ammonium, the organic component, with cesium to produce the material of cesium lead iodide. The size and developed nanocrystals was reduced which made the now all-inorganic material stable.
- Reducing the size of material to nanometer range, increases the surface to volume ratio tremendously, resulting into high surface energy making the high-temperature cubic phase crystal structure stable even at room temperature.
- The nano-crystals were assembled as a thin film having 10.77 per cent efficiency to convert sunlight to electricity and produce a high voltage of 1.23 volts.

The team was also able to prepare a long-range charge conducting film using this material which demonstrates that the material could be amenable to be used to develop an opto-electronic device.

“ The Secret To Getting Ahead Is Getting Started ”

ALTERNATIVE CLASSROOM PROGRAM *for*
GS PRELIMS & MAINS
2018 & 2019

- Approach is to build fundamental concepts and analytical ability in students to enable them to answer questions of Preliminary as well as Mains examination
- Includes comprehensive coverage of all the topics for all the four papers of G.S. Mains , GS Prelims & Essay
- Access to recorded classroom videos at personal student platform
- Includes comprehensive, relevant & updated study material
- Includes All India G.S. Mains, Prelim, CSAT & Essay Test Series of 2017, 2018 & 2019 (for students enrolling in 2019 program)
- A current affairs classroom course of PT 365 & Mains 365 of year 2018/2019 (for students enrolling in 2019 program)



3. ROBOTICS

3.1. SELF-DRIVEN CARS

Why in News?

- **nuTonomy**, a small firm, made history of sorts when it introduced a self-driving taxi service in Singapore.
- These cars powered by AI (Artificial Intelligence) can revolutionize the transport industry worldwide.

Significance

- They have the potential to reduce road accidents especially the ones caused by the human driver errors.
- They can reduce labor cost and thus in turn reduce the cost of travel and transport.
- It would give the interior of the cabin greater ergonomic flexibility apart from large unoccupied spaces.
- There would also be an improved ability to manage traffic flow, combined with less need for traffic police, vehicle insurance; or even road signage.
- Overall they will have a positive impact on the economy, transportation efficiency, and on public health and safety of transport.

An autonomous car (driverless car, self-driving car, robotic car) is a vehicle that is capable of sensing its environment and navigating without human input. Autonomous cars can detect surroundings using a variety of techniques such as radar, lidar, GPS, odometry, and computer vision.

Limitations

- **Issues with liability concern:** In case of an accident how a legal liability will be decided. Will be responsibility put on the manufacturer or the software developer or the user? The question is debatable and remains unanswered.
- **Unemployment:** Driver-less cars especially taxis will create large scale unemployment among the existing cab and other drivers.
- **Safety concern:** Issues like technology failure and cyber-attacks can pose huge threat to safety and security of the passengers and public at large.
- **Ethical issue** in case an autonomous car's software is to choose between whom to hit in case of an unavoidable crash.

(3 hours class, 30 min MCQ test, 30 min discussion)

- ☞ Specially designed to increase score in General Studies Paper -1
- ☞ Discussion of previous year's UPSC papers

Fast Track Course
for
GS
PRELIMS

- ☞ Class video to be uploaded on online portal (not downloadable but can be watched any number of times)
- ☞ Includes All India GS Prelims test series

DURATION
60 classes

LIVE / ONLINE
CLASSES
AVAILABLE

4. SPACE

4.1. GSLV F05 AND INSAT 3DR

- ISRO's GSLV F05 spacecraft has successfully placed INSAT 3DR satellite into a Geostationary Transfer Orbit (GTO) for eventually stationing in geosynchronous orbit.
- **INSAT-3DR**
 - ✓ It is an advanced weather satellite which is expected to provide a variety of meteorological services to the country.
 - ✓ It can provide imaging in Middle Infrared band to provide night time pictures of low clouds and fog.
 - ✓ It can also provide Imaging in two Thermal Infrared bands for estimation of Sea Surface Temperature (SST) with better accuracy.
- **GSLV F05**
 - ✓ **GSLV-F05** was the tenth flight of India's Geosynchronous Satellite Launch Vehicle.
 - ✓ This is the third successful launch with the indigenous cryogenic engine in GSLV.
 - ✓ It is a three-staged vehicle and cryogenic engine is used in the third and final stage. GSLVs are used to carry heavy satellites (usually 2 to 2.5 tonnes) into Geostationary Transfer Orbit.
- **Significance**
 - ✓ It was the first operational flight of GSLV carrying Cryogenic Upper Stage.
 - ✓ A successful launch will make ISRO engineers more confident about the GSLV-MkIII.
 - ✓ This successful launch will increase ISRO's market value and confidence in her satellite capabilities.
 - ✓ INSAT-3DR satellite continues the mission of the INSAT-3D satellite, which was launched in 2013.
 - ✓ INSAT 3DR will be able to map vertical changes of humidity, temperature and ozone content in Earth's atmosphere. Thus enhancing nation's meteorological capabilities.

4.2. PSLV SUCCESSFULLY LAUNCHES 8 SATELLITES

Why in News?

- ISRO (Indian Space Research Organisation) launched eight satellites in orbit in longest ever launch mission.
- It is for the first time that satellites in two different orbits were placed by the same rocket, PSLV-C35 (Polar Satellite Launch Vehicle).
- There was one weather satellite, SCATSAT-1 and seven others.

More on the Launch

- The advanced weather satellite was placed in polar sun synchronous orbit at an altitude of about 730km.
- SCATSAT-1 will now succeed the now defunct Oceansat-2 satellite launched in 2009.
- The data sent by the satellite SCATSAT-1 will help provide weather forecasting services.
- The rest of the seven satellites include PRATHAM from IIT Bombay and Pisat from PES University, Bangalore.
- There were five international customer satellites from Algeria, Canada and United States.

Challenges

- The main challenge was to shut down and restart the fourth-stage engine called **multiple burn technology**.
- This was to be done twice within a short span of time in a cold and low-gravity environment and letting it coast further.
- However, ISRO has demonstrated this technology in its two previous PSLV launches.

Significance

- Mastering the technology means that ISRO can now launch satellites from the same rocket thereby saving huge amount of money.
- It will also facilitate the launch of more commercial satellite in future.

4.3. GSAT 18 SATELLITE LAUNCHED

Why in News?

- India's latest communication satellite, **GSAT 18** was successfully launched from the spaceport of Kourou in French Guiana, South America.
- It is been built by ISRO and ISRO's Master Control Facility at Hassan, Karnataka is controlling the satellite.
- The Master Facility will also perform the initial raising manoeuvres using the Liquid Apogee Motor (LAM) of the satellite, placing it in a circular Geostationary Orbit.

GSAT Satellites

These satellites are India's indigenously developed technologies of communications satellites used for digital, audio, data and video broadcasting.

Challenges

India does not have any launcher capable of carrying heavier satellites like GSAT-18. However, Indian scientists are developing GSLV –III to overcome the challenge.

4.4. OTHER IMPORTANT NEWS

4.4.1. MORE THAN A BILLION STARS MAPPED

Why in news?

- A European satellite named **Gaia space probe** has mapped the precise positions and brightness of more than 1.14 million stars in the Milky Way.
- It is being lauded as the most accurate three dimensional map of the Milky Way.
- It has also pinned down the distances and motions of more than 2 billion stars.

More about the Mission

- **Gaia**, the European space probe was launched in 2013 and started collecting data in July 2014.
- It was launched to log the position, colour and brightness of a billion stars sending it an orbit around the sun, close to 1.5 million km from Earth.
- It has been able to map the star with so much accuracy thanks to its twin telescopes and a billion pixel camera.
- Gaia has not only mapped the distribution of the stars but also the neighbouring Small and Large Magellanic Clouds.

THE REAL RACE BEGINS. ARE YOU READY?



GS ADVANCED COURSE MAINS 2016

- Covers topics which are conceptually challenging
- Updated with current affairs and dynamic topics
- Approach is completely analytical and focussed on demands of the Mains examination
- Includes comprehensive, relevant and updated study material
- Includes All India GS Mains and Essay Test Series



5. IPR

5.1. RIGHT TO PHOTOCOPY

Why in news?

Delhi High Court handed out a landmark verdict for IP and Access to Knowledge, holding that the educational **exception under Section 52(1)(i)** – the reproduction of a work by a “teacher/pupil in the course of instruction” – of the Copyright Act was broad enough to cover the photocopying and creation of course packs.

Arguments supporting Delhi HC verdict

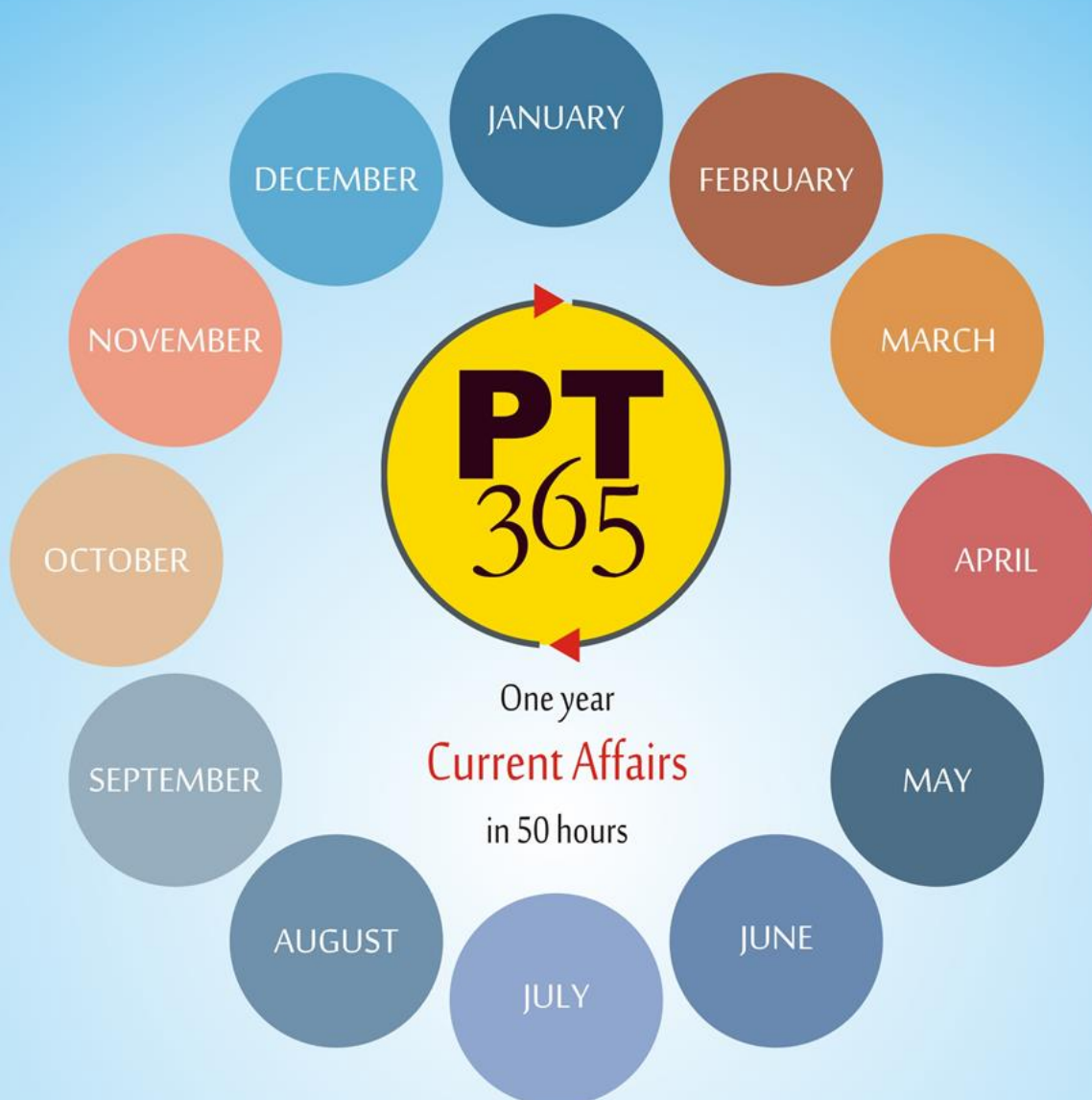
- To balance copyright protection with public interest in ensuring access.
- Ensures affordable access to expensive foreign quality educational material.
- Already Section 52(1) of copyright protection permits making of copies of literary works by a teacher or pupil in the course of instruction. Photocopying is just an extension as the material is mostly limited to university campus.

Arguments against

- Sidelines the efforts of writers and publishers and deprives them of livelihood, undermining the principle of natural justice.
- Commercial loss to publishers: If reputed publishers feel there is insufficient copyright protection, they may back out of Indian educational market. This will lead to less access to international knowledge in the long term.
- Humanities: Besides general neglect of these subjects in Indian universities, humanities may be further affected. As right to photocopy is allowed, less resources will be spent by the publishers in these areas.
- The judgement may be inconsistent with our IPR policy.

Way forward

- Balance between IPR and access issues: This will help creativity and intellectualism flourish in our society attracting intellectuals from over the globe to India and at the same time help achieve affordable access to quality education raising our educational standards.
- Provide easy access to public libraries as well in educational institutions with such educational material
- Monetize on photocopying for course-packs by having universities or photocopy shops purchase licences whereby publishers would be paid every time a course-pack was sold.



- ✎ Specific content targeted towards Prelims exam
- ✎ Complete coverage of current affairs of One Year
- ✎ Option to take exams in Classroom or Online along with regular practice tests on Current Affairs
- ✎ Support sessions by faculty on topics like test taking strategy and stress management.
- ✎ **LIVE** and **ONLINE** recorded classes for anytime anywhere access by students.

6. GOVERNMENT'S INITIATIVES TO PROMOTE INDIGENIZATION

6.1. INDIA SHOWS SECOND HIGHEST GROWTH IN SCIENCE RESEARCH

Why in News?

- According to Nature Index 2016 Rising Stars report, India ranks second position, only behind China, among countries with the highest increase in their contribution to high-quality scientific research.
- The Indian institutions that made to the top 100 highest performers across the globe include Council for Scientific and Industrial Research (CSIR), Indian Institute of Science Education and Research (IISER), Tata Institute of Fundamental Research (TIFR), Indian Institute of Science (IISc) and Indian Institute of Technology (IITs).

Significance

- The report reflects India's emergence as one of the world's largest economies.
- The report shows that India is moving in the right direction and hopefully, it will stimulate not only the government and individual scientists, but also young people in schools to take science more seriously.

Hurdles to Scientific Research in India

- The academic ambience in many universities does not encourage the research pursuits of faculties. Research management is another very serious problem.
- Students drifting to other job-oriented courses after graduation in science is prevalent in India owing to the widespread impression among them that unlike professional courses, a career in basic science is not lucrative.
- Lack of investment: India currently spends around one per cent of its GDP on research and development. In contrast, China spent about \$209 billion on research and development in 2015, or 2.1 per cent of its GDP.

Way Forward

- India needs to grow an attractive environment for research, so that students and academics who leave the country for higher studies and research opportunities have an incentive to return.

6.2. NIDHI

- NIDHI (**National Initiative for Development and Harnessing Innovations**) is an umbrella programme pioneered by the Department of Science and Technology
- It works towards nurturing knowledge-based and technology-driven ideas and innovations into successful start-ups.
- It also aims to provide technological solutions to the pressing needs of the society and create new avenues for wealth and job creation.
- NIDHI, by design connects and strengthens all the links of the innovation chain- scouting, sustaining, securing, scaling and showcasing.
- The key stakeholders of NIDHI includes various departments and ministries of the central government, state governments, academic and R & D institutions, mentors, financial institutions, angel investors, venture capitalists, industry champions and private sectors.
- Components of NIDHI that support each stage of a budding start-up are:
 - ✓ PRAYAS (Promoting and Accelerating Young and Aspiring Innovators & Start-ups), which aims to support innovators to build prototypes of their ideas by providing a grant up to Rs.10 lakhs and an access to Fabrication Laboratory (Fab Lab).
 - ✓ The Seed Support System which provides up to One Crore rupees per start-up and is implemented through Technology Business Incubators.
- With a view to drive the innovation and start-up centric new initiatives in a scaled up manner for its wider outreach across the country, a 450% increase in allocation (Rs. 180 crores) has been made in the Department's budget.



- ✎ Specific content targeted towards Mains exam
- ✎ Complete coverage of current affairs of One Year
- ✎ Doubt clearing sessions with regular assignments on Current Affairs
- ✎ Support sessions by faculty on topics like test taking strategy and stress management.
- ✎ **LIVE** and **ONLINE** recorded classes for anytime anywhere access by students.

7. HEALTH

7.1. HYPERELASTIC BONE

Why in News?

Researchers from Northwestern University in Illinois have developed a 3D printable ink that produces a **synthetic bone implant that rapidly induces bone regeneration and growth.**

Hyperelastic vs autograft

- An autograft is an option where a bone piece is taken from the patient's body usually from hip or rib, and implanted where it's needed elsewhere in the same patient's skeleton.
- Hyperelastic bone is a synthetic material that can be implanted under the skin for new bone to grow on, or used to replace lost bone matter altogether.

Significance

- Hyperelastic bone is made of hydroxyapatite, a naturally occurring mineral in our bones and teeth will provide strength to create bones.
- The hyperelastic material can be easily customised to any shape.
- This discovery is a breakthrough in reconstructive surgery.

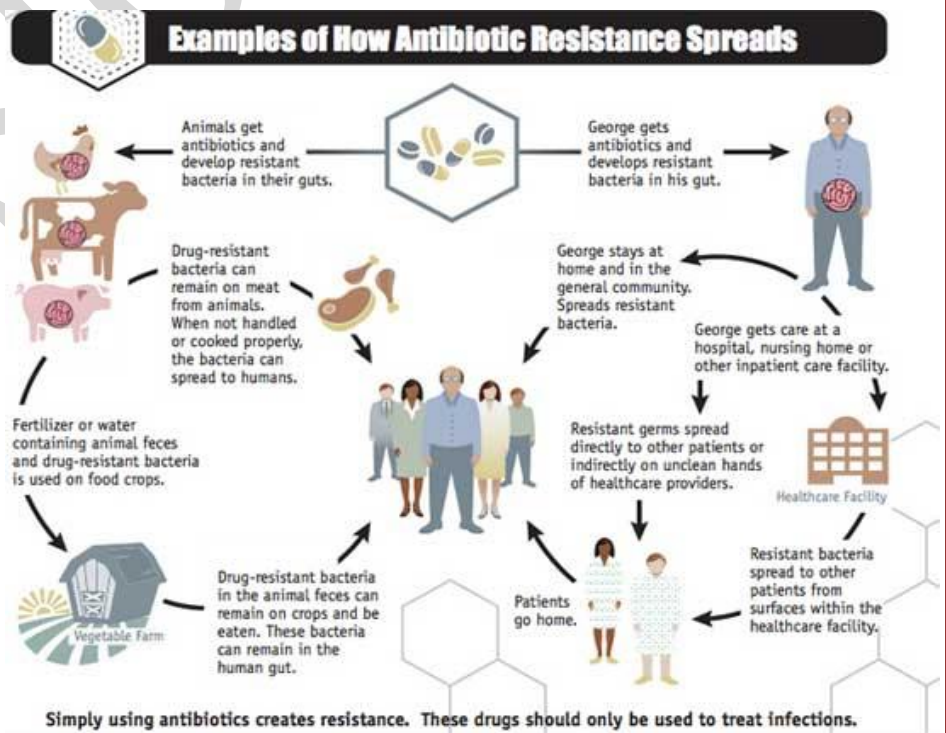
7.2. ANTIBIOTIC RESISTANCE

Why in News?

- A major study has found that neonates in India are increasingly dying due to alarming degree of drug resistance after being infected at birth facilities within 72 hours of their birth.
- The study found that nearly 26 percent of babies with sepsis died due to multi-drug resistance which made the disease untreatable.

Background

- India has become the focal point for drug resistance so much so that a new bacterium that was found to be resistant to a wide spectrum of antibiotics was named New Delhi-Metallo- Beta-Lactamase 1 in 2008.
- Individuals across all ages are highly drug resistant due to dreadful sanitation conditions (open defecation and untreated sewage systems) and uncontrolled use of antibiotics.
- Bacteria easily spread and thrive in India in humans, agriculture and livestock.
- One of the major problems that the country is facing is today AMR (Anti-microbial Resistance) is the treatment of TB.



What Has Been Done?

- In February, 2016, India launched the Red Line campaign. Under this campaign prescription only antibiotics were marked with a red line to curb irrational use.
- The government has also backed it up with a communication campaign so as to create awareness that red line medicines should not be taken without prescription.

7.3. ANTI-MALARIA BATTLE

Why in News?

- Scientists have discovered a new compound named *bicyclic azetidine series* that was found to act on all three stages of the malaria parasite, according to a study published in the journal Nature.

About The Discovery

- The compound was found to cure the disease with a single, low dose treatment.
- Also, it can provide prophylaxis; prevent disease transmission both in lab and in animals.
- The compound works by targeting the parasite's protein translation machinery. Protein translation is vital at every stage of the plasmodium life cycle.
- Since protein translation is quite vital for the parasite's functioning, mutation is quite unlikely. Therefore, there are less chances of parasite developing drug resistance against the compound.
- This discovery can be a stepping stone in the treatment of the disease and will also pave way for more therapeutic arsenals in the coming year.




7.4. GENES BEHIND INTELLECTUAL DISABILITY

Why in News?

- Researchers have for the first time identified 30 recessive inherited genes that play a role in intellectual disability as well as other brain disorders, according to the journal, Molecular Psychiatry.
- The research was carried out by scientists from Radboud University Medical Centre in Netherlands and University of Health Sciences in Pakistan.
- The research was carried out for five years and across three continents.

Intellectual Disability: Fact File

- Intellectual disability or ID (previously known as mental retardation) limits an individual's intellectual ability and practical skills.
- As many as 213 million people are affected by neuro-developmental disorder.
- It is measured by intelligent quotient below 70.
- Today, close to 1-3 percent population has some form of ID.
- Half of ID can be linked to poor nutrition and environmental causes while the other half is due to genetic disorders such gene mutations.
- This research can be applied for DNA screenings and determine the possibility of a couple producing an ID child.

A PUBLIC HEALTH SCORE		
DeNIS study looked at 13,530 infants in ICUs		
 Klebsiella	 Acinetobacter	<ul style="list-style-type: none"> • Multi-drug resistance to Acinetobacter was found in 82 per cent of the newborns
 E. coli		<ul style="list-style-type: none"> • Resistance to Klebsiella was found in 54 per cent and E. coli in 38 per cent
<ul style="list-style-type: none"> • Three 'superbugs' (pic) were linked with more than half the infections in the infants 		
<ul style="list-style-type: none"> • 56,524 newborns in India die each year from microbial resistant bacteria 		

8. MISCELLANEOUS

8.1. INTERNET GOVERNANCE

Why in news?

- ICANN has hosted its 57th meeting in Hyderabad from November 3-9. This is the first meeting after the US Government relinquished its operational authority over the Internet in September last year.
- ICANN57 is the Annual General Meeting for all of ICANN. According to the recommendations of the meeting strategy working group, this meeting showcases the work of ICANN.

What is ICANN?

- ICANN is a non-profit organization that manages the Domain Name System (DNS), which helps organise the Internet with the allotment of domain names such as .com, .org and .net. It also allocates country domain titles like “.in” and “.cn,”.
- It introduces new generic top-level domains (TLDs), and the operation of root name servers.
- It holds three public meetings each year to discuss issues related to development and implementation of Internet policies, and has recently completed an exercise where the US government gave up oversight of Internet naming functions.

Recent Developments

- Creating ICANN in 1998, the US government had promised to eventually pass to it the full authority and responsibility for all DNS functions, it however stuck to its root signing authority.
- Recently, US declared its decision to extricate itself from direct authority over the internet root file.
- ICANN will independently control the root file, and take all decisions regarding it, without any direct US oversight.
- New oversight mechanism, largely made up of groups internal to the “ICANN system,” has been instituted.

Existing issues

- All critical controls have shifted to a US non-profit, which remains fully subject not only to the whims of the judicial and legislative and executive branches of the US government.
- A largely independent and unchecked private organisation can run amok towards self-aggrandisement

India's stand

Previous Stand: India demanded a multilateral body under United Nations to govern the internet. All other stakeholders were envisaged to be in Advisory Capacity in the new organisation.

Present Stand

- India has now moved away from its previous narrow position. Now India stands for the multi-stakeholder approach, which will include all stakeholders like governments, industry, NGOs, Students, Scientists etc.
- The change in India's stand globally signals potential openness to consultative policy-making.

Need of Multi-stakeholder agency

- Internet belongs to all, therefore all stakeholders like government, industry, media, youth etc shall be on equal footing.
- If IG is vested in a body under UN then it may undermine the national laws and policies, hence eventually it will undermine the democratic institutions.
- If intergovernmental body under UN or outside is given the powers of IG, then it will not be obliged to engage any stakeholders. Therefore advisory role would with that organisation only.

Way forward

Most appropriate way forward is to incorporate ICANN under international law in the form of a treaty (or some such agreement) with

- Jurisdictional immunities to ICANN.
- Larger public policy principles should be laid out for ICANN.
- Compliance to them should be ensured by an oversight board.
- Special digital bench of the International Court of Justice as per treaty for further compliance.

8.2. NOBEL PRIZE IN MEDICINE/PHYSIOLOGY

Why in News?

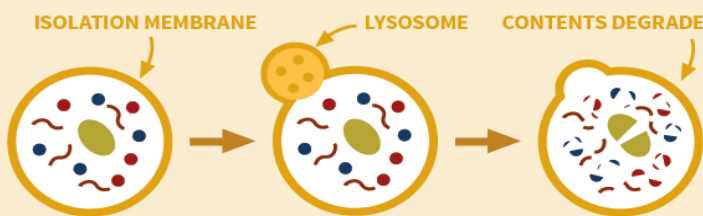
Yoshinori Ohsumi, a Japanese cell biologist was awarded the 2016 Nobel Prize in Physiology or Medicine for “his discoveries of mechanisms for autophagy”.

About Autophagy

- Autophagy is a greek term for “self-eating”.
- It is a fundamental process for degrading and recycling cellular components.
- This discovery of the mechanism of autophagy will aid in the fight against diseases such as cancer, Parkinson’s disease and Alzheimer’s.

The Nobel Prize in Physiology or Medicine 2016 was awarded to **Yoshinori Ohsumi** for establishing the mechanisms of autophagy – the process by which cells degrade and recycle their components

AUTOPHAGY: WHAT IT IS AND HOW IT WORKS



‘Autophagy’ originates from Greek and means ‘self-eating’. It refers to a process where cells disassemble unnecessary or malfunctioning cell components.

The components to be degraded are encapsulated in membranes, then transported to the lysosome, the part of the cell which degrades them.

Yoshinori Ohsumi used yeast cells to investigate autophagy. He proved that autophagy occurs in yeast cells, and identified the genes essential for the process. He eventually identified the proteins that control autophagy.



1992

IDENTIFIES AUTOPHAGY IN YEAST CELLS



1993

IDENTIFIES GENES INVOLVED IN AUTOPHAGY



1998

IDENTIFIES CONTROL PROTEINS



AUTOPHAGY

- CREATES ENERGY FOR CELLS
- HELPS ELIMINATE BACTERIA/VIRUSES
- CONTRIBUTES TO EMBRYO DEVELOPMENT
- ELIMINATES DAMAGED CELL COMPONENTS
- DISTURBANCES LINKED TO DISEASE

WHY DOES THIS RESEARCH MATTER?

Autophagy provides energy and building materials for cellular components. It also removes damaged cell components, important for combating the aging process. Parkinson’s, diabetes, and cancer have all been linked to disruptions in the autophagy process.

8.3. NOBEL PRIZE IN PHYSICS 2016

Why in News?

The Nobel Prize 2016 in Physics was awarded to David J. Thouless, F. Duncan M. Haldane and J. Michael Kosterlitz for **“theoretical discoveries of topological phase transitions and topological phases of matter.”**

What is it?

- Topology refers to the study of geometrical properties and spatial relations unaffected by the continuous change of shape or size of figures.
- It is referred to as the modern version of geometry.
- The scientists studied different phases (such as solid, liquid and gas) of different materials. These phases were characterized using topology.

Significance

- The study is being applauded as the meeting point of topology and phase transitions.
- It will help make the study of phase transitions easier.

The Nobel Prize in Physics 2016 was awarded to **David Thouless, Duncan Haldane, and Michael Kosterlitz** for using mathematical models to explain strange behaviour in unusual states of matter.

UNUSUAL PHASES OF MATTER

Unusual phases of matter occur at very high or low temperatures. At low temperatures, solids can become superconductors, and allow electricity to flow without resistance. Theory predicted this couldn't happen in two dimensional systems – the Nobel-winning research showed it could.

TOPOLOGY, BAGELS, AND SUPERCONDUCTORS

When a thin conducting layer is cooled to near absolute zero and placed in magnetic field, its conductance varies as the magnetic field changes. However, it changes in integer steps, something physics couldn't explain. This problem was one of those solved by the Nobel Laureates using topology.

Topology refers to properties unaffected by size or shape of an object. For example, a bagel and a picture frame are topologically identical: they both have one hole. Electrons in the conducting layer act as one entity, and as such their conductance goes up in integer steps.

WHY DOES THIS RESEARCH MATTER?

Though this research may seem abstract, researchers have since discovered topological states of matter in ordinary 3D materials. They could be used in electronics, insulators, superconductors, and future quantum computers. Research on them is still ongoing.

8.4. NOBEL PRIZE IN CHEMISTRY 2016

Why in News?

- The Nobel Prize in Chemistry 2016 was awarded to Frenchman Jean-Pierre Sauvage, British-born Fraser Stoddart and Dutch scientist Bernard "Ben" Feringa for **"developing miniscule machines at the molecular level."**

Significance

- These molecular machines with controllable movements can perform a task when energy is added.
- Machines will eventually prove to be invaluable - doing things no other machines can do.

The Nobel Prize in Chemistry 2016 was awarded to **Jean-Pierre Sauvage, Sir Fraser Stoddart, and Bernard Feringa** for the design and production of molecular machines with controllable movements.

This year's chemistry Nobel Prize is awarded for work on molecular machines which are a thousand times thinner than a human hair. The machines are formed from mechanically interlocked ring-shaped molecules which are able to move relative to each other.

● RING-SHAPED MOLECULE 1 ● RING-SHAPED MOLECULE 2 ● BINDING SITE

● ORGANIC-BASED COORDINATING RINGS ● CENTRAL COPPER ION

● 'SHUTTLE' ● BULKY GROUPS ● 'STATIONS' ● REST OF MOLECULE

|| DOUBLE BOND; ISOMERISATION DRIVES ROTATION

Jean-Pierre Sauvage created a pair of interlocking rings (called a catenane). One ring could rotate around the other when energy was added.

Fraser Stoddart made a ring-shaped molecule attached to an axle (a rotaxane) which could shuttle up and down. He also helped produce a rotaxane-based computer chip.

Ben Feringa produced the first molecular motor by constructing a molecule that responded to light and heat and spun in a particular direction.

WHY DOES THIS RESEARCH MATTER?

Research is investigating using molecular machines to transport and release drugs to specific cells in the body. They could also find future uses in electronic devices. The tasks they can accomplish are constantly expanding, so they may have further as yet unforeseen uses.

8.5. DNA: DATA STORAGE

- A team from Microsoft and the University of Washington along with Twist Bioscience, a San Francisco start-up, reached a milestone by successfully storing 200 MB of digital data in DNA.
- DNA has been carrier of genetic data for generations.
- Significance
 - ✓ DNA possesses some of the attractive properties important for storing data.
 - ✓ It is very stable; synthetic DNA can remain intact for thousands of years.
 - ✓ DNA is never going to become obsolete as it holds blueprint of the living system.
 - ✓ It has high packing density- 1 kg of DNA is enough to store all the data available in the world.
- Limitations
 - ✓ Encoding and decoding data in DNA is a complex task, it requires more time and money.
- However this limitation is fast erasing as with technological advancements storing data into DNA structure will only become cheap, quick and less complicated.

8.6. RANGE OF BRAHMOS TO BE DOUBLED

Why in News?

- India and Russia have approved the proposal to double the range of **BrahMos**, world's first supersonic missile.

What is it?

- Russia and India teamed up in 1998 to develop this missile on the lines of Russia Yakont anti-ship missile.
- The range of the missile was limited to 290km.
- For ranges to be higher than 300km, the country must be a member of Missile Technology Control Regime (MTCR).
- Following **India's accession to MTCR**, the range of the missile will be increased to 600 km.
- Brahmos is capable of hitting targets beyond the radar and can be launched from sea-based and land based systems. Air based systems are still being tested.
- Brahmos has already been deployed by the Army and Navy in anti-ship and precision strikes.

Significance

- Extending the range of the missile will enhance its stand-off capability and its operational radius. With extended range, speed and accuracy, Brahmos is a force to rely on.

8.7. SOLUTION TO MARINE OIL SPILLS

Why in News?

- Indian researchers have developed a **membrane with exceptional hydrophobic and high oil-loving (oleophilic) properties**.
- Researchers from the Indian Institute of Science Education and Research (IISER), the Central Salt Marine Chemicals Research Institute (CSMCRI), Bhavnagar and National Chemical Laboratory, Pune contributed to the development.

How does it Work?

The membrane acts like a filter. When water-oil mixture is passed through the membrane, the oil permeates by rapid absorption while water is retained above the membrane. The oil permeation is 100 percent in the case of oil-water mixture.

Significance

Water-oil emulsification takes place in the seas when water gets mixed with oil under high water current conditions. The membrane is effective in separating oil and water from an emulsion and in solving the problem of oil spills.

8.8. ICGS SHIPS COMMISSIONED

Why in News?

- Two **Indian Coast Guard Ships: Aryaman and Atulya** have been commissioned into the service.

What is it?

- These coast guard ships are eighteenth and nineteenth in the series of twenty **fast Patrol Vehicles (FPVs)**.
- Aryaman and Atulya have been built by Cochin Shipyard Limited.
- Atulya will be based at Kochi while Aryaman will be based at Vishakhapatnam.
- Special features include Integrated Bridge Management System (IBMS) and Integrated Machinery Control System (IMCS).
- Integrated bridge system (IBS) is a kind of navigation management system which links other systems to provide all the details pertaining to ship's navigation at one place. (in box)

Significance

- The ships are equipped with state-of-the-art machinery, navigational equipment and advanced communication.
- They can be used for various jobs such as surveillance, search, rescue and interdiction.

8.9. MAKING BRACKISH WATER POTABLE

Why in News?

- Researchers at IIT Madras have devised a method that can convert brackish water into potable water in less than 12 paise per litre.

What is it?

- Researchers used a stack of tissue paper to make graphene.
- Graphitic electrodes were then covered with graphene.
- The electrodes are then dipped in brackish water.
- A potential of 1.8 volt is applied to the electrodes, the water gets deionised to become potable water.

Pros

- Brackish water turns into potable water with less than 500 parts per million (ppm) of sodium chloride which is less than permissible limit for drinking water.
- Filters will last 10 years making the invention highly feasible.
- The process is not only cheaper than reverse osmosis but also saves a lot of water.
- Reverse osmosis is an energy intensive procedure and cause 60-75 percent of the water to be rejected as waste.
- The average water wastage in case of **capacitive deionisation** is only 25 percent.
- The process shows great promise for solving the problem of water scarcity.

8.10. WORLD'S LARGEST RADIO TELESCOPE BEGINS OPERATIONS

Why in News?

- World's largest telescope, **Aperture Spherical Telescope or FAST** began operations from China's Guizhou Province.

What is it?

- Measuring 500 metres in diameter, the telescope is stationed in a natural basin in the county of Pingtang.
- It took five years and an investment of \$180 million to complete.
- The telescope surpasses the 300 meter Arecibo Observatory in Puerto Rico.

Significance

- The telescope would search for signals from stars and galaxies as well as extra-terrestrial life.
- The project demonstrates China's rising ambitions in space.

8.11. FOSSILS FOUND POINTS TO LIFE ON EARTH 3.7 BILLION YEARS AGO

Why in news?

- Scientists have found fossils of a tiny structure called stromatolites in ancient sedimentary rock along the Greenland's ice caps.

Significance

- The finding has push back the date of origin of life on earth by hundreds of millions years. (Note: In geological terms, earth was originated 4.5 bn years ago)
- The structure and geology of the rock in which the stromatolite fossils has been found points to a rapid emergence of life on earth.
- The finding will also through light on the kind of earliest form of life that existed on earth and how they evolved.
- The finding will have great implication on our understanding of life on Mars and other planets. Probably a very basic life might have existed of Mars.

Stromatolites are calcareous mound built up of layers of lime-secreting cyanobacteria and trapped sediment, found in Precambrian rocks as the earliest known fossils.

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