



PEP - 2024

PRELIMS EXCLUSIVE PROGRAMME

ONE STOP DESTINATION FOR PRELIMS PREPARATION

SCIENCE & TECHNOLOGY

HANDOUTS



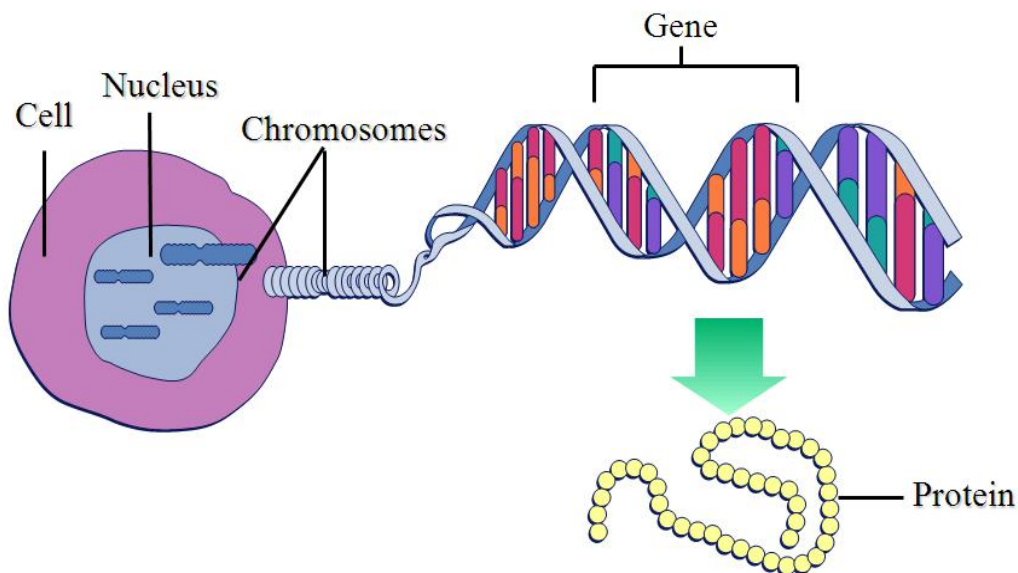


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BIOTECHNOLOGY

- Biotechnology deals with techniques of using live organisms or enzymes from organisms to produce products and processes useful to humans.
- Making curd, bread or wine, which are all microbe-mediated processes, could also be thought as a form of biotechnology.
- However, it is used in a restricted sense today, to refer to such of those processes which use genetically modified organisms to achieve the same on a larger scale.
- Modern biotechnology using genetically modified organisms was made possible only when man learnt to alter the chemistry of DNA and construct recombinant DNA. This key process is called recombinant DNA technology or genetic engineering.
- The applications of biotechnology include therapeutics, diagnostics, genetically modified crops for agriculture, processed food, bioremediation, waste treatment, and energy production.



What is a cell?

- Cells are the basic building blocks of all living things.
- Cells also contain the body's hereditary material and can make copies of themselves.
- Cells have many parts, each with a different function.
- Some of these parts, called organelles, are specialized structures that perform certain tasks within the cell.

What is a chromosome?



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Notes

- In the nucleus of each cell, the DNA molecule is packaged into thread-like structures called chromosomes.
- Each chromosome is made up of DNA tightly coiled many times around proteins called histones that support its structure.
- Chromosomes are not visible in the cell's nucleus—not even under a microscope—when the cell is not dividing.
- However, the DNA that makes up chromosomes becomes more tightly packed during cell division and is then visible under a microscope.
- Most of what researchers know about chromosomes was learned by observing chromosomes during cell division.

What is DNA?

- DNA, or deoxyribonucleic acid, is the hereditary material in humans and almost all other organisms.
- Nearly every cell in a person's body has the same DNA.
- Most DNA is located in the cell nucleus (where it is called nuclear DNA), but a small amount of DNA can also be found in the mitochondria (where it is called mitochondrial DNA or mtDNA).
- Mitochondria are structures within cells that convert the energy from food into a form that cells can use.

Genes, Proteins, and DNA

- The human body is made up of trillions of cells.
- Each cell has a copy of genome—the total collection of all your genes and DNA.
- Genes are instructions that every cell in your body uses to make the proteins they need to function.
- Genes can be found in long chains of molecules called deoxyribonucleic acids (DNA) that are twisted together into the shape of a double helix.
- There are 4 DNA molecules that are identified by the letters A, T, C, and G. Combinations of these letters make up the genetic instructions that our cells use to make proteins. Our genes can also be a source of disease.
- Small breaks in DNA are incredibly common and are normally uneventful. DNA breaks can happen from sunlight, for example, or during cell divisions that happen as we grow. Our cells have built-in DNA repair processes that constantly fix these breaks as they occur.
- However, breaks are sometimes repaired incorrectly, creating what is known as a mutation. Mutations can occur spontaneously or be passed down from our parents. Mutations can also change how our cells function, and may lead to serious diseases such as sickle cell disease (SCD), Leber congenital amaurosis 10 (LCA10), cancer, and many others.

What is Genome sequencing?

- Genome sequencing is figuring out the order of DNA nucleotides, or bases, in a genome—the order of As, Cs, Gs, and Ts that make up an organism's DNA.
- The human genome is made up of over 3 billion of these genetic letters.
- The rules of base pairing (or nucleotide pairing) are:
 - a) A with T: the purine adenine (A) always pairs with the pyrimidine thymine (T)
 - b) C with G: the pyrimidine cytosine (C) always pairs with the purine guanine (G)

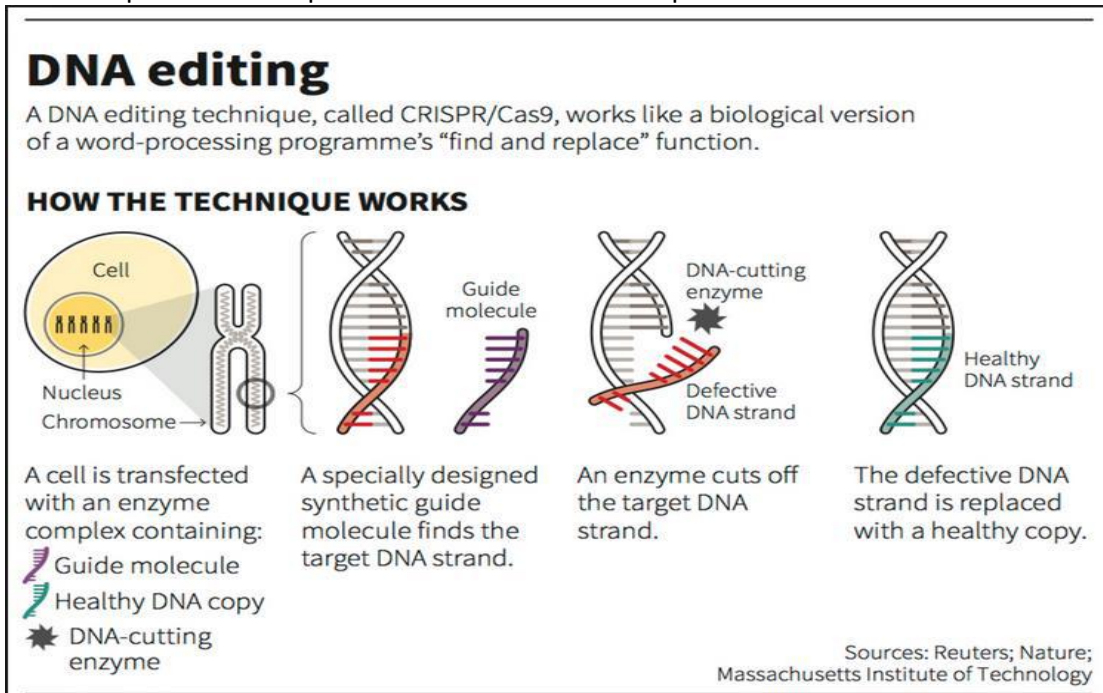
What is genome editing?



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- Gene editing (or genome editing) is the insertion, deletion or replacement of DNA at a specific site in the genome of an organism or cell.
- It is usually achieved in the lab using engineered nucleases also known as molecular scissors
- Editing the genome can be achieved using engineered nucleases such as CRISPR-Cas9, ZFNs or TALENs, viral systems such as rAAV (Recombinant Adeno-Associated Virus) and also transposons.
- A recent one is known as CRISPR-Cas9, which is short for clustered regularly interspaced short palindromic repeats and CRISPR-associated protein 9.



What is CRISPR-Cas9?

- It is currently the simplest, most versatile and precise method of genetic manipulation.
- CRISPR-Cas9 was adapted from a naturally occurring genome editing system in bacteria. The bacteria capture snippets of DNA from invading viruses and use them to create DNA segments known as CRISPR arrays. The CRISPR arrays allow the bacteria to "remember" the viruses (or closely related ones). If the viruses attack again, the bacteria produce RNA segments from the CRISPR arrays to target the viruses' DNA. The bacteria then use Cas9 or a similar enzyme to cut the DNA apart, which disables the virus.
- The CRISPR-Cas9 system works similarly in the lab. Researchers create a small piece of RNA with a **short "guide" sequence that** attaches (binds) to a specific target sequence of DNA in a genome. The RNA also binds to the Cas9 enzyme.
- As in bacteria, the modified RNA is used to recognize the DNA sequence, and the Cas9 **enzyme cuts the DNA at the targeted** location.
- Once the DNA is cut, researchers use the cell's own DNA repair machinery to add or delete pieces of genetic material, or to make changes to the DNA by replacing an existing segment with a customized DNA sequence.

What are the Applications of gene editing?

- Targeted gene modification in plants
- Gene therapy in eradicating diseases. It can help fight against blood-related disorders such as haemophilia, sickle cell anaemia, and Beta-Thalassemia.



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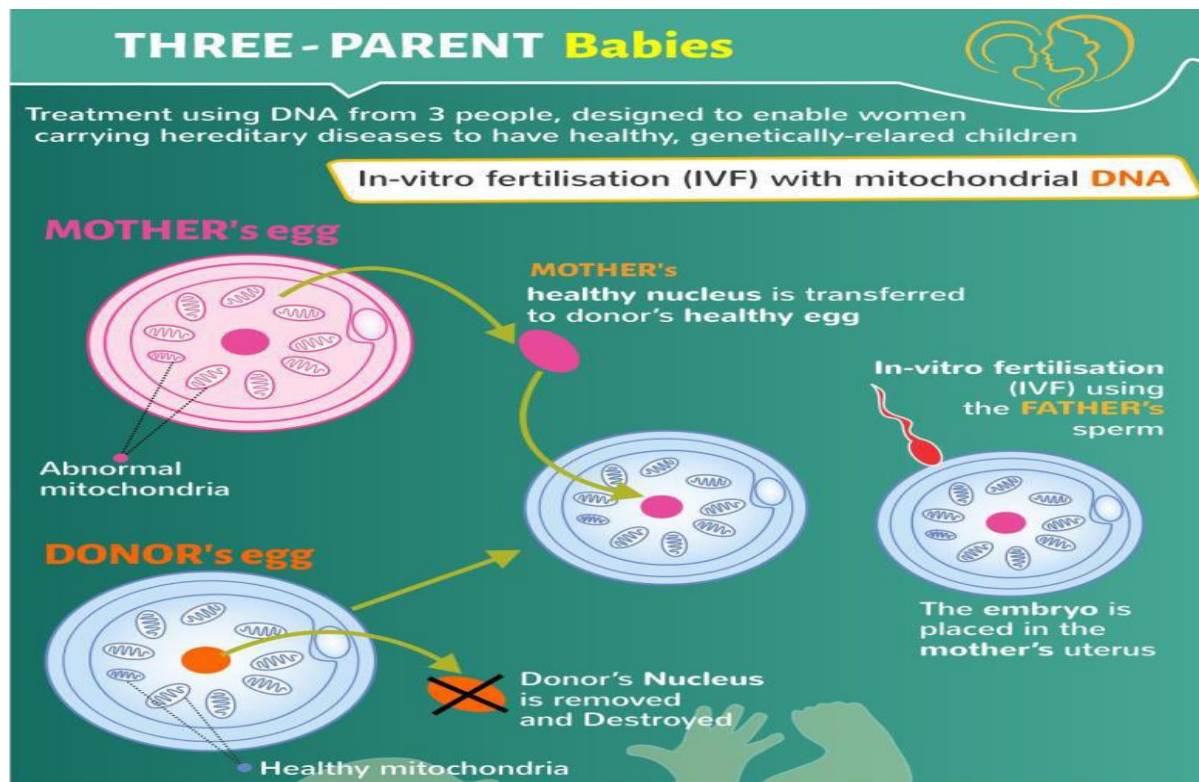
- Industrial biotechnology (e.g. developing 'third generation' biofuels and producing chemicals, materials and pharmaceuticals).
- Biomedicine (e.g. pharmaceutical development, xenotransplantation, gene and cell-based therapies, control of insect-borne diseases).
- Reproduction (e.g. preventing the inheritance of a disease trait).
- Engineering mosquitoes to control malaria and dengue.

Issues with gene-editing

- Due to the possibility of off-target effects (edits in the wrong place creating properties different from those that were intended) and Mosaicism (when some cells carry the edit but others do not, leading to presence of two or more populations of cells), safety is of primary concern.
- Most of the changes introduced with genome editing are limited to somatic cells, which are cells other than egg and sperm cells. These changes affect only certain tissues and are not passed from one generation to the next. However, changes made to genes in egg or sperm cells (germline cells) or in the genes of an embryo could be passed to future generations.
- A 'gene drive' can propagate a set of genes with negative traits throughout a population which may lead to disappearance of the whole targeted population with severe ecological consequences.
- There are at present no standard norms for standardisation of norms for clinical trials for checking the efficacy of the treatment.
- Concerns over 'Designer Babies': Engineering human embryos raises the prospect of designer babies, where embryos are altered for social rather than medical reasons e.g. to increase height or intelligence.

[Notes](#)

3-PARENT BABY





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- Recently, a team of Greek and Spanish doctors has produced a baby from three people **using maternal spindle transfer technique (a method of Mitochondrial Replacement Therapy)**.
- The mitochondria are organelles inside cells that are involved in releasing energy by **producing adenosine triphosphate (ATP)**, the key energy currency that drives metabolism.
 - o Mitochondria are referred to as the **powerhouse of the cell**.
- In addition to energy production mitochondria also **helps to regulate the self-destruction of cells** (apoptosis), necessary for **production of substances such as cholesterol** and heme (a component of haemoglobin).
- While most of DNA is found in cell nucleus, some DNA is also found in the mitochondria, it is called mitochondrial DNA (mtDNA).
- Mitochondria are **inherited solely from the mother** and this results into cases of babies been born with **rare mitochondrial diseases** if mother has the faulty mtDNA.
- Certain disorders caused due to mtDNA dysfunction are diabetes, respiratory disorders, Huntington's disease, Parkinson's disease, Alzheimer's disease etc.
- There is currently **no cure for mitochondrial diseases**.

About "three-parent" babies

- Mitochondrial Replacement therapy (MRT) is a form of **In Vitro Fertilization (Assisted Reproductive Technology)**.
- It is used to **replace mother's faulty Mitochondrial DNA with healthy Mitochondria from a donor woman** during IVF process, thus the name- "three-parent" baby.
- The resulting child is still **conceived from two parents** and will have **nuclear DNA from the woman and her partner, and mitochondrial DNA from the donor**.
- The donor's mitochondria contribute **just 37 genes to the child**, compared with more than 20,000 from the parents. That is a **negligible amount** and far less than one would gain from a blood transfusion or organ transplant.
- **No other characteristics** in terms of intelligence, eye colour, hair colour, height etc. are changed.
- **Advantages:** It could **prevent severe genetic diseases** being passed from mother to offspring and can be used to **treat infertility**.
- The United Kingdom became the first country in 2015, to have officially approved procedures to create **"three-parent" babies**.

Issues involved

- **Safety Implications:** Long term evolutionary implications and unintended consequences on the heredity and future generations are unknown.
- **Religious Grounds:** Some groups believe that technologies which manipulate or interfere with human eggs and embryos should not be used.
- **Social Issues:** These techniques **being expensive**, could benefit certain economically forward social groups only. It can also arise due to the **tripaternal aspect**, as children formed from these techniques might be subjected to mental agony due to discrimination or it may cause legal complications.
- **Ethical Issues:** Parents may misuse the technique to get "genetically modified" or "designer" babies.
- **Future Health Issues:** It could result in children being at higher risk of cancer and pre-matured ageing and would need to be monitored all their lives.



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Way Forward

MRT technique should be developed and administered in a regulated environment such that it can be used to prevent fatal diseases while ensuring that it is not misused and only those who need it get access to it.

Process of MRT

The Process of **Mitochondrial Replacement Therapy** can be done by two methods – Pronuclear transfer and Spindle transfer.

- **Spindle Transfer**
 - In this method the spindle and associated chromosomes from the normal mitochondria are removed and destroyed and the spindle and related chromosomes from the mother's eggs/abnormal mitochondria are transferred to the emptied donor egg.
 - The reconstituted egg is fertilised with sperm from father and the embryo with normal mitochondria and maternal and paternal genomes is transferred to the uterus.
- **Pronuclear Transfer**
 - In this method, first mother's eggs with abnormal mitochondria and the donated egg with normal mitochondria are fertilised with sperm.
 - Then the pronuclei from the normal mitochondria are destroyed and the pronucleus from zygote of the abnormal mitochondria is transferred to the emptied zygote.
 - After this procedure the embryo with normal mitochondria and maternal and paternal genome is transferred to the uterus.

Stem cell

- Stem cells are the **body's raw materials — cells from which all other cells with specialized functions are generated.**
- Under certain conditions in the body or a laboratory, stem cells divide to form more cells called **daughter cells.**
 - These daughter cells either become **new stem cells (self-renewal)** or become **specialized cells (differentiation)** with a more specific function, such as blood cells, brain cells, heart muscle cells or bone cells.
 - No other cell in the body has the natural ability to generate new cell types.
- **Classification based on Stem Cells formation at different times of human lives**
 - **Embryonic stem cells:** These are the Stem cells that exist only during the earliest stage of development.
 - **Adult Stem Cells:** These are the cells that can multiply when there is a need to repair adult organs and tissues. These cells are present in almost all organs of the human body.
 - **Induced pluripotent stem cells (iPSC's):** These cells are not found in the body but made in the laboratory from cells of the body. The iPSC cells have properties similar to those of embryonic stem cells. Human iPSC's were generated in 2007.
- Depending on their ability (potency) to develop into different specialized cells, stem cells can be
 - **Totipotent** – can form all cells of the body including the ones in the extra embryonic membranes (placenta). In humans, the 2 cell staged zygote is totipotent
 - **Pluripotent** – can become virtually any cell in the body except those needed to support and develop a fetus in the womb

[Notes](#)



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- **Multipotent**(limited ability to differentiate) -can give rise only to a small number of different cell types. Eg. bone marrow contains multipotent stem cells that can give rise to all blood cell types but not other cells.
- **Unipotent** – Found in adult tissues, unipotent stem cell has the lowest differential potential of all the stem cells.

Stem cell therapy

- It also known as regenerative medicine, promotes the repair response of diseased, dysfunctional or injured tissue using stem cells or their derivatives.
- It is a type of treatment option that uses a patient's own stem cells to repair damaged tissue and repair injuries.
- It is used to treat more than 80 disorders including neuromuscular and degenerative disorders. Eg. Bone-marrow transplant is used in Leukemia(blood cancer), sickle-cell anemia, immunodeficiency disorders.
- Stem cells are usually taken from one of the two areas in the patient's body: bone marrow or adipose (fat) tissue in their upper thigh/abdomen. Because it is common to remove stem cells from areas of stored body fat, some refer to stem cell therapy as "Adipose Stem Cell Therapy" in some cases.
- Once stem cells are removed from one of these locations, they are placed in a "centrifuge machine" that spins them very, very quickly and concentrates the substances that are most valuable (including up to seven different types of natural growth factors).
- The sample of concentrated stem cells is then injected directly into the patient's affected, painful area– allowing the cells' growth factors to go to work immediately, building new skin cells, connective tissue and so on.

Challenges in SCT

- **Unknown side-effects:** Like any other new technology, it is completely unknown what the long-term effects of such an interference with nature could be
- **Limitations of adult cells:** The disadvantage of adult stem cells is that the cells of a particular origin would generate cells only of that type, like brain cells would generate only brain cells and so on.
- **Potential Rejection:** If the cells used in the therapy are embryonic, then the cells will not be from the same human body and there are chances of rejection.
- **Potential use in negative activities:** It can be used to create bio-weapons or weapons of mass destruction

India and Stem Cell Therapy

- According to the Indian Council of Medical research, all stem cell therapy in India considered to be experimental except bone marrow transplants
- Stem cell therapy is legalized in India
- Umbilical cord and adult stem cell treatment are considered permissible
- Embryonic stem cell therapy and research is restricted

Genetically modified (GM) organisms and GM foods

- Genetic modification is the process of altering the genetic makeup of an organism.
- This has been done indirectly for thousands of years by controlled, or selective, breeding of plants and animals.
- Modern biotechnology has made it easier and faster to target a specific gene for more-precise alteration of the organism through genetic engineering.



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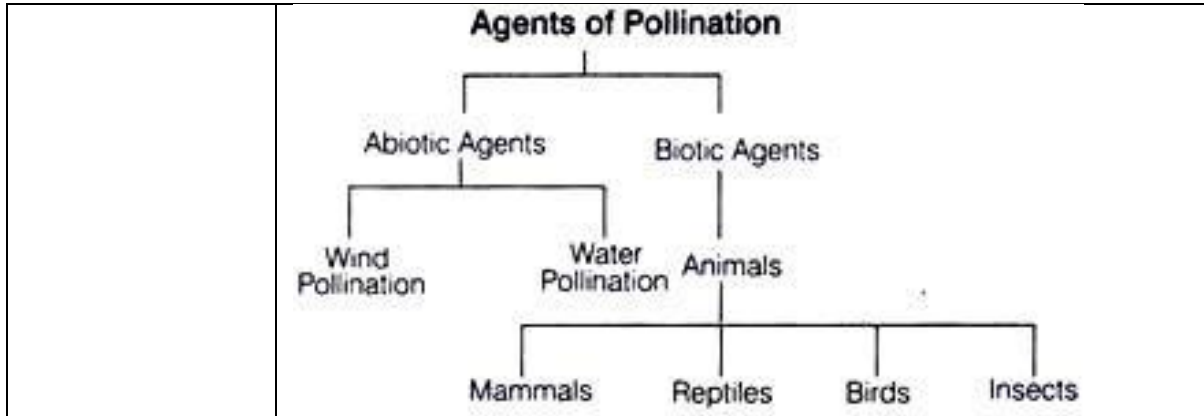
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- Genetically modified organisms (GMOs) can be defined as organisms in which the genetic material (DNA) has been altered in a way that does not occur naturally by mating and/or natural recombination.
- The technology is often called “modern biotechnology” or “gene technology”, sometimes also “recombinant DNA technology” or “genetic engineering”.
- It allows selected individual genes to be transferred from one organism into another, also between nonrelated species.
- Foods produced from or using GM organisms are often referred to as GM foods.

What are the primary methods of genetically modifying crops?

- **Selective breeding:** Two strains of plants are introduced and bred to produce offspring with specific features. Between 10,000 and 300,000 genes can be affected. This is the oldest method of genetic modification, and is typically not included in the GMO food category.
- **Mutagenesis:** Plant seeds are purposely exposed to chemicals or radiation in order to mutate the organisms. The offspring with the desired traits are kept and further bred. Mutagenesis is also not typically included in the GMO food category.
- **RNA interference:** Individual undesirable genes in plants are inactivated in order to remove any undesired traits.
- **Transgenics:** A gene is taken from one species and implanted in another in order to introduce a desirable trait.

<p>Earliest evidence of insect pollination</p>	<p>The first known instance of an insect pollinating a flower happened 99 million years ago, according to a study which pushes the earliest documented instance of the process back by at least 50 million years than previously thought.</p> <p>What are the types of pollination?</p> <ul style="list-style-type: none">• Autogamy (Self-pollination) - It is the kind of pollination in which the pollen from the anthers of a flower is transferred to the stigma of the same flower, e.g., wheat, rice, pea, etc.• Geitonogamy - It is a kind of pollination where the pollen grains from the anther of the flower are transferred to the stigma of another flower borne on the same plant but at different branches. It usually occurs in plants, which show monoecious condition, e.g., Cucurbita.• Xeno-gamy (Cross-Pollination) - It involves the transfer of pollen grains from the flower of one plant to the stigma of the flower of another plant. This is the only type of pollination which brings genetically different types of pollen grains to the stigma during pollination, e.g., papaya, maize, etc. <p>What are the agents of pollination? The agents responsible for pollination in angiosperms have been grouped into two main categories.</p>
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Biomarkers

A study has found that it is now possible to tell in advance if a person with oral cancer of the gum and cheek has lymph node metastasis even before surgery is undertaken.

What are biomarkers?

- Biomarkers are molecules that indicate normal or abnormal process taking place in your body and may be a sign of an underlying condition or disease.
- Various types of molecules, such as DNA (genes), proteins or hormones, can serve as biomarkers, since they all indicate something about your health.
- Biomarkers may be produced by the cancer tissue itself or by other cells in the body in response to cancer.
- They can be found in the blood, stool, urine, tumor tissue, or other tissues or bodily fluids.
- Notably, biomarkers are not limited to cancer.
- There are biomarkers for heart disease, multiple sclerosis, and many other diseases.

What are the uses of Biomarkers?

Medical use of Biomarkers

- Biomarkers can be used to find out:
- what will happen to you when you use a particular treatment
- or don't use the treatment and
- the risk of you developing certain medical conditions.

Diagnostic use of Biomarkers

- An example of a diagnostic use of biomarkers is the measurement of biomarkers in blood to tell if you've had a heart attack.
- Measuring the levels of enzymes, hormones and proteins in your blood enables a doctor to determine the severity of your heart attack and how much damage your heart has suffered.

What is Metastasis?

- Metastasis means that cancer spreads to a different body part from where it started.
- It is also called "metastatic cancer," "advanced cancer," or "stage 4 cancer."
- For example, a cancer that is large but has not spread to another body part can also be called advanced cancer or locally advanced cancer.

Biosimilars

Centre for Cellular & Molecular Biology (CCMB) has joined hands with the Ghaziabad-based Indian Pharmacopoeia Commission (IPC) to facilitate



	<p>regulatory process for biosimilars and herbal drugs.</p> <p>What are Biologics?</p> <ul style="list-style-type: none">• Biological products are medicines made from living organisms.• It is manufactured through highly complex manufacturing processes and must be handled and administered under carefully monitored conditions.• Biologics include a wide variety of products such as gene and cell therapies, therapeutic proteins, monoclonal antibodies, and vaccines.• Biologics are used to prevent, treat or cure a variety of diseases including cancer, chronic kidney disease, diabetes, cystic fibrosis, and autoimmune disorders. <p>What are biosimilars?</p> <ul style="list-style-type: none">• A biosimilar is a biologic that is “similar” to another biologic medicine (known as a reference product).• Biosimilars are highly similar to the reference product in terms of safety, purity and potency, but may have minor differences in clinically inactive components.
<p>Strains of bacterium – for arsenic pollution</p>	<p>Using two indigenous strains of bacterium isolated from arsenic-contaminated field, researchers from CSIR-National Botanical Research Institute has shown that arsenic can be effectively removed from contaminated soil with the help of microbes.</p> <p>What are the two strains of bacteria?</p> <ul style="list-style-type: none">• Bacillus flexus• Acinetobacter junii <p>What is Arsenic?</p> <ul style="list-style-type: none">• Arsenic (As) has an atomic number of 33.• This element historically has a reputation for being used as a poison, although many other uses have been found.• Arsenic has three common allotropes, gray, yellow, and black arsenic.• Gray arsenic is the most stable form.• Yellow arsenic is the most unstable and the most poisonous.• Arsenic has one stable isotope, As-75.• Arsenic is still produced as a byproduct of copper purification.• It is used in vast pesticides for agriculture.• Arsenic is actually added to livestock feed to produce higher weight animals and to fight disease. <p>What are the sources of Arsenic exposure?</p> <ul style="list-style-type: none">• People are exposed to elevated levels of inorganic arsenic through:• Drinking contaminated water• Using contaminated water in food preparation and irrigation of food crops• industrial processes• eating contaminated food and smoking tobacco.• Long-term exposure to inorganic arsenic is mainly through



	<p>drinking-water and food.</p> <ul style="list-style-type: none">• This can lead to chronic arsenic poisoning.• Skin lesions and skin cancer are the most characteristic effects. <p>What is Bioremediation?</p> <ul style="list-style-type: none">• Bioremediation is the application of a biological treatment, mainly microbes, to the cleanup hazardous contaminants in soil and surface or subsurface waters.• These microorganisms can be used to transform them to less harmful forms.• The bacteria feed on the contamination, deriving nutrition for growth and for reproduction. <p>The microbes will survive and consume their contaminant food source until the unwanted pollutant is remediated.</p>
<p>Golden rice</p>	<p>The International Rice Research Institute along with its partners has successfully cultivated Golden Rice in a controlled environment on IRRI campus.</p> <p>What is golden rice?</p> <ul style="list-style-type: none">• Golden rice is the collective name of rice varieties that are genetically modified to counter vitamin A deficiency in developing countries.• European scientists developed the first strain of Golden Rice towards the end of the 1990s.• Golden rice differs from standard rice in that it contains extra genes one from maize and one from bacterial origin together responsible for the production of provitamin A (beta-carotene) in the rice grain.• Provitamin A colors the grains yellow-orange, hence the name 'Golden Rice'.• Once absorbed into the body, provitamin A is converted into vitamin A.• Provitamin A is found in many fruits and vegetables; it is also what makes carrots orange, for example.• Research has indicated that one cup of Golden Rice can provide up to 50 per cent of the daily requirement of an adult for vitamin A.• The Golden Rice can be grown just the same way we grow normal rice. There is no change in cost of cultivation.• It reduces water use by up to 30 per cent without any yield loss.• It should not be stored for more than three months. It may lose its nutrients after that. <p>Vitamin A deficiency</p> <ul style="list-style-type: none">• Vitamin A deficiency generally occurs due to an imbalanced diet including limited access to fresh fruit, vegetables and animal products.• Persistent deficiency in this vital nutrient can result in blindness, illness and even death.• Vitamin A deficiency also compromises the immune system, which



	<p>means children die from common diseases including diarrhea, respiratory tract infections and measles.</p> <p>International Rice Research Institute</p> <ul style="list-style-type: none">• It is an independent, nonprofit, research and educational institute, founded in 1960 by the Ford and Rockefeller foundations with support from the Philippine government.• The institute, headquartered in Los Baños, Philippines, has offices in 17 rice-growing countries in Asia and Africa. Its regional centre was opened recently in Vanarasi.• It is dedicated to reducing poverty and hunger through rice science; improving the health and welfare of rice farmers and consumers; and protecting the rice-growing environment for future generations.• IRRI is a member of the CGIAR Consortium, a global research partnership committed to a food-secure future.
<p>Food fortification</p>	<p>Department of Food and Public Distribution under the Ministry of Consumer Affairs recently approved a centrally-sponsored pilot scheme on fortification of rice and its dispersal through Public Distribution System (PDS).</p> <p>More on news</p> <ul style="list-style-type: none">• Financial assistance of up to 90 per cent in case of North-Eastern, Hilly and Island States and up to 75 per cent in case of rest of the States has been extended by GOI.• Government of India has also advised all states and UTs especially those states and UTs, which are distributing wheat flour through PDS, to distribute fortified wheat flour through PDS. <p>What is food fortification?</p> <ul style="list-style-type: none">• Food fortification is the deliberate addition of one or more micronutrients to food so as to correct or prevent a deficiency and provide a health benefit.• These nutrients may or may not have been originally present in the food before processing.• Food fortification is a “complementary strategy” and not a replacement of a balanced & diversified diet to address malnutrition. <p>Food fortification:</p> <ul style="list-style-type: none">• Can improve the health of a large section of the population, all at once since the nutrients are added to staple foods that are widely consumed.• is safe method of improving nutrition among people as the quantity added is very small and well-regulated as per prescribed standards.• is a socio-culturally acceptable way to deliver nutrients to people as it does not require any changes in food habits and patterns of people and does not alter the characteristics of the food—the taste, the feel, the look.• is cost effective and delivers quick results. The Copenhagen



Consensus estimates that every 1 Rupee spent on fortification results in 9 Rupees in benefits to the economy.

Challenges to food fortification

- **Voluntary nature:** Fortification continues to be voluntary rather than mandatory leading to limited efforts to fortify by state governments and private sector.
- **Poor implementation by states:** Although some states have adopted fortification in ICDS, MDMS and PDS, but due to lack of definitive policy guidelines, budgetary constraints, technical knowledge and logistic support, states have not adopted fortification in a holistic manner.
- **Weaknesses of FSSAI:** It lacks resources and manpower to effectively carry out its mandate.
- **Lack of awareness:** There is a lot of misinformation and ignorance about the usage and benefits of fortified food as of now.

Way forward

- **Nationwide Implementation:** Pan-India implementation of fortification via government schemes would amount to only an increment of 1 percent of the total budget allocated annually.
- **Support to states:** Merely issuing orders and notifications from Government of India will not suffice as state governments require hand-holding support and should be sensitised about the benefits fortification and must be enabled to procure fortified staples in various programs.
- **Ensure Standards:** Compliance with FSSAI standards w.r.t macronutrient content and quality must be strictly enforced.
- **Awareness:** A mass awareness campaign about food fortification is needed to scale up demand from consumers in the open market.
- **Promote food processing industry:** It will go a long way in improving the nutritional value of staple food.

Why the need for food fortification?

- **Nearly 70% of people** in India **consume less than half** of their **recommended dietary allowance (RDA) of micronutrients**. The deficiency of micronutrients is also known as **“hidden hunger”** and leads to various diseases like Night Blindness, Goitre, Anaemia and various birth defects.
- According to the National Family Health Survey (NFHS-4):
- **58.4 percent of children** (6-59 months) are **anaemic**.
- **53.1 percent women** in the reproductive age group are **anaemic**.
- **35.7 percent** of children under 5 are **underweight**.
- Around 50-70% of these birth defects are preventable, caused due to deficiency of **Folic Acid**.

Food Safety and Standards (Fortification of Foods) Regulations, 2018.

- It has **prescribed standards** for fortification of various food products such as All fortified foods must not fall below the



	<p>minimum level of micro-nutrients.</p> <ul style="list-style-type: none">• Quality assurance: o Every manufacturer and packer of fortified food shall give an undertaking on quality assurance random testing of fortificants and fortified food• Every package of fortified food shall carry name of the fortificant and the logo to indicate. FSSAI has recently introduced +F logo for fortified staple food products.• The Food Authority shall take steps to encourage the production, manufacture, distribution, sale, and consumption
Proton therapy	<p>Vice President of India inaugurated India's first proton therapy centre in Chennai for the treatment of Cancer. The name of the centre is Apollo Proton Cancer Centre (APCC) and is launched by Apollo Hospitals Group. It is South Asia's first such centre.</p> <p>With this India becomes 16th country in the world to offer the therapy.</p> <p>About Proton Therapy</p> <ul style="list-style-type: none">• It is a type of radiation therapy which uses protons rather than x-rays to treat cancer.• It is considered as one of the most advanced forms of external beam radiation therapy for cancer treatment in the world. It is also known as Proton Beam Therapy and offers high levels of precision as compared to other treatment options.• It is particularly effective for paediatric cancers and tumours affecting the brain, eye, colon, breast, gastrointestinal area, pelvis, and prostate and those close to the spinal cord, brain stem and other vital organs. <p>Advantages over standard radiation therapy</p> <ul style="list-style-type: none">• Standard radiation therapy utilises x-rays, which deposits the majority of the radiation dose immediately upon entering the body.• While X-ray beams are effective in controlling many cancers, they also deliver an 'exit dose' along the path beam. This exposes not just the targeted tumour to the radiation, but also the nearby healthy tissues.• This exit dose is a cause of concern as the damage to the normal tissue or organs can affect the patient's quality of life post-treatment.• In comparison, protons slowly deposit their energy as they travel towards the cancerous tumour and then due to a unique physical characteristic called the Bragg Peak, deposit the majority of the radiation dose directly in the tumor. o Bragg Curve describes energy loss of ionizing radiation during travel through matter.• Proton beams target the tumour with sub-millimetre accuracy, leaving the nearby tissues and organs unharmed.• Also there is no 'exit dose' in case of proton beam. Protons stop after depositing the radiation dose in the tumor. <p>Challenges with Proton Therapy</p> <ul style="list-style-type: none">• Proton Therapy is highly specialised and expensive treatment.• It is not applicable to all type of cancers.



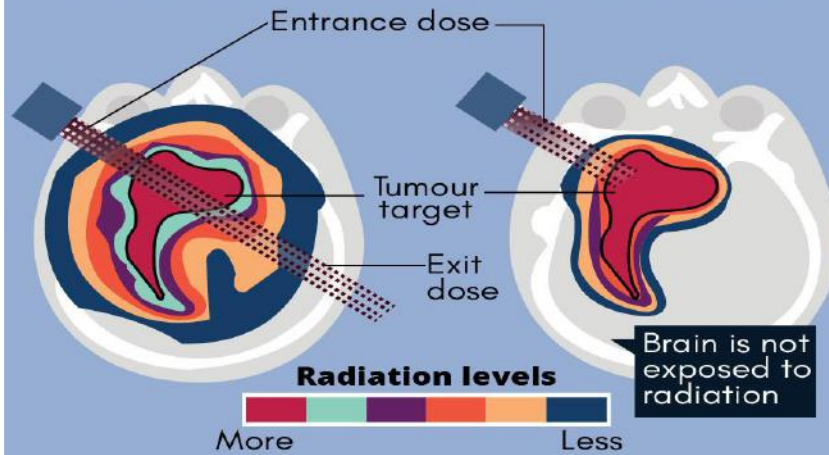
- More **research and clinical trials are needed** to make this treatment more affordable and applicable to all types of cancers.

Proton

- Atoms are the basic units of matter and the defining structure of elements. Atoms are made up of three particles: protons, neutrons and electrons
- The **proton** has a positive electrical charge, equal and opposite to that of the electron.
- The number of protons in an atom determines the chemical behaviour of the element.

CLINICAL BENEFITS

Beams of protons can be more tightly focused than beams of X-rays, killing cancer cells while sparing more of the surrounding tissue. This is beneficial for isolated tumours near sensitive parts of the body, such as the spinal cord and brain

**CONVENTIONAL RADIATION THERAPY**

Beam passes through the patient, resulting in healthy cells being damaged by the beam.

PROTON THERAPY

Protons can be tuned to stop at the depth of the tumour and release their energy. Fewer healthy cells are exposed.

Parthenogenesis

- Recently, female anaconda has given a birth through the phenomenon of Parthenogenesis.
- Parthenogenesis is a **reproductive strategy** that involves **development of a female** (rarely a male) **gamete** (sex cell) **without fertilisation** or development of an embryo from an unfertilised egg cell.
- It is an **adaptive strategy** when sexual reproduction is not possible due to environmental conditions.
- It occurs commonly among lower plants, pests of agriculture and horticulture, invertebrate animals (particularly rotifers, aphids, ants, wasps and bees) and rarely among higher vertebrates.
- Offspring from parthenogenesis **tends to be clones of the parent** because there has been no exchange and rearrangement of genetic information with another individual.

Rna and colour of

A team from the National Centre for Biological Sciences (NCBS),

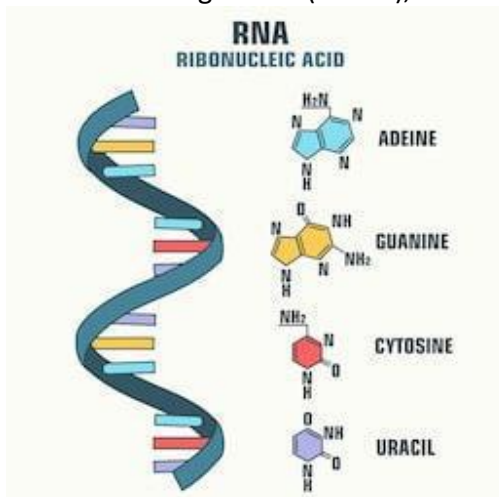


fruits, leaves

Bengaluru, has found that the rich colour in fruits and leaves of plants are indirectly controlled by specific micro RNAs — miR828 and miR858.

What is RNA?

- Ribonucleic acid, or RNA is one of the three major biological macromolecules that are essential for all known forms of life (along with DNA and proteins).
- Each RNA nucleotide consists of a nitrogenous base, a ribose sugar, and a phosphate.
- Each RNA molecule typically is a single strand, consisting of a relatively short chain of nucleotides.
- RNA can be shaped like a single helix, a straight molecule, or may be bent or twisted upon itself.
- In RNA, the base adenine binds to uracil.
- There are several types of RNA, including transfer RNA (tRNA), messenger RNA (mRNA), and ribosomal RNA (rRNA).



What are miRNAs?

- miRNAs are a class of endogenous small non-coding RNAs (ncRNAs).
- They are approximately 21 to 24 nucleotides in length found .
- They are found in plants and animals including humans.
- MiRNAs have recently emerged as key regulators in many biological pathways.
- MiRNAs function in the post-transcriptional regulation of gene expression.
- miRNA have been shown to regulate their target messenger RNA (mRNA) bydestabilizing mRNA molecules and translational repression.

What is transgenesis?

Transgenesis is the process of introducing an exogenous gene called a transgene into a living organism so that the organism will exhibit a new property and transmit that property to its offspring.

Quantum dot and cancer diagnosis

A team of scientists in Assam has developed a chemical process that turns =dirty' coal into a biomedical 'dot' to help detect cancer cells.



	<p>What is a Quantum Dot?</p> <ul style="list-style-type: none">• Any material at the nanoscale is a nanoparticle.• A quantum dot is a nanoparticle made of any semiconductor material such as silicon, cadmium selenide, cadmium sulfide, or indium arsenide. <p>How quantum dot revolutionise medicine?</p> <ul style="list-style-type: none">• Quantum dots enable researchers to study cell processes at the level of a single molecule.• This may significantly improve the diagnosis and treatment of diseases such as cancers.• QDs used as active sensor elements in high-resolution cellular imaging, where the fluorescence properties of the quantum dots are changed upon reaction with the analyte.• Also used in passive label probes where selective receptor molecules such as antibodies have been conjugated to the surface of the dots.
<p>Rice blast resistance</p>	<p>By characterising over 150 rice varieties from in the country scientists identified new markers associated with rice blast resistance.</p> <p>What is Rice blast disease?</p> <ul style="list-style-type: none">• Rice blast is caused by a fungus Magnaportheorzyae.• It is one of the major diseases of the rice crop. <p>What are genetic markers?</p> <ul style="list-style-type: none">• Genetic markers are used to identify different features in DNA sequence.• The features can be used to differentiate between individuals in a population, or to classify individuals between different varieties or cultivars within a species. <p>What are the uses of genetic markers?</p> <ul style="list-style-type: none">• The different features in the sequence can be used to identify if that particular region was inherited from the female or male parent.• By using this information, we can build up a more complete picture of each individuals genotype at each marker.• This allows us to track the inheritance of different regions of the genome. <p>What are types of molecular genetic marker? There are many, but some of the commonly used ones are:</p> <ul style="list-style-type: none">• RFLP – Restriction Fragment Length Polymorphism• SSR – Simple Sequence Repeat, or Microsatellite• AFLP – Amplified Fragment length Polymorphism• CAPS – Cleaved Amplified Polymorphic Sequence• dCAPS – derived Cleaved Amplified Polymorphic Sequence• STS – Sequence Tagged Site• RAPD – Randomly Amplified Polymorphic DNA• SNP – Single Nucleotide Polymorphism - technology to screen



	<p>thousands in one go</p> <ul style="list-style-type: none">• Also, Phenotypic markers
Implants from egg shell	<p>Researchers develop process to get bone implant material from eggshells</p> <p>What are implants?</p> <ul style="list-style-type: none">• Medical implants are devices or tissues that are placed inside or on the surface of the body• Many implants are prosthetics, intended to replace missing body parts.• Other implants deliver medication, monitor body functions, or provide support to organs and tissues.• Some implants are made from skin, bone or other body tissues.• Others are made from metal, plastic, ceramic or other materials.• Implants can be placed permanently or they can be removed once they are no longer needed. <p>What is the difference between implant and transplant?</p> <ul style="list-style-type: none">• If a biological substance is used to replace tissues, it will be named as TRANSPLANT.• If a synthetic substance is used it will be named as IMPLANT. <p>What is plaster of paris?</p> <ul style="list-style-type: none">• Plaster of Paris is created by heating gypsum crystals.• It is a soft mineral made of calcium sulphate dihydrate, to turn them into a dry powder.• $\text{CaSO}_4 \cdot 2\text{H}_2\text{O} + \text{heat} \rightarrow \text{CaSO}_4 \cdot 0.5\text{H}_2\text{O} + 1.5\text{H}_2\text{O}$ (released as steam).• When it is mixed with water it reforms into a gypsum paste which is used as a building material for wall surfacing and fireproofing, or for creating sculptures and other art works.
Pink bollworm spotted	<p>The dreaded cotton crop pest, pink bollworm, has made its appearance in some fields in Telengana.</p> <p>What is Pink bollworm?</p> <ul style="list-style-type: none">• Pink bollworm is an insect known for being a pest in cotton farming.• The pink bollworm is native to Asia but has become an invasive species in most of the world's cotton-growing regions.• The female moth lays eggs in a cotton boll and when the larvae emerge from the eggs, they inflict damage through feeding.• They chew through the cotton lint to feed on the seeds. Since cotton is used for fiber and seed oil, the damage is twofold.• Their disruption of the protective tissue around the boll is a portal of entry for other insects and fungi. <p>What is Bt cotton?</p> <ul style="list-style-type: none">• Bt cotton is an insect-resistant transgenic crop designed to combat the bollworm.• Bt cotton was created by genetically altering the cotton genome to express a microbial protein from the bacterium <i>Bacillus thuringiensis</i>.



	<ul style="list-style-type: none">• In short, the transgene inserted into the plant's genome produces toxin crystals that the plant would not normally produce.• This toxin when ingested by a certain population of organisms, dissolves the gut lining, leading to the organism's death.
Bcg with enhanced efficacy at nanoscale	<p>A study carried out has found that curcumin in nanoparticle form has the potential to enhance the efficacy of BCG vaccine such that it confers protection against adult pulmonary TB.</p> <p>What Are Vaccines?</p> <ul style="list-style-type: none">• A vaccine is a biological substance designed to protect humans from infections caused by bacteria and viruses.• Vaccines are also called immunizations because they take advantage of our natural immune system's ability to prevent infectious illness. <p>What is BCG?</p> <ul style="list-style-type: none">• It is an effective immunization against tuberculosis.• BCG stands for Bacille Calmette Guerin.• BCG is a weakened (attenuated) version of a bacteria called Mycobacterium bovis which is closely related to Mycobacterium tuberculosis, the agent responsible for tuberculosis.• It is given to infants to protect them from tubercular meningitis and disseminated TB.• When to give – BCG vaccine is given at birth or as early as possible till 1year
New wheat from iari	<ul style="list-style-type: none">• Indian Agricultural Research Institute (IARI) has released a new variety- HD-3226 or Pusa Yashasvi, for planting in the upcoming rabi crop season.• Its yield is comparable to or higher than other wheat varieties, which currently together occupy roughly 40% of the country's total wheat area.• It also has higher content of protein and gluten (which contributes to strength and elasticity of the dough), apart from more zinc.• The variety has also high levels of resistance against all major rust fungi — yellow/stripe, brown/leaf and black/stem.• The new variety is also known for its amenability to "conservation agriculture". <p>Conservation Agriculture (CA) is a farming system that can prevent losses of arable land while regenerating degraded lands. It promotes maintenance of a permanent soil cover, minimum soil disturbance, and diversification of plant species.</p> <div style="border: 1px solid black; padding: 5px;"><p>Recent Crop/Horticulture Varieties From IARI</p><p>Pusa Basmati 1718: Rice variety resistant to bacterial leaf scorch.</p><p>PusaSambha 1850: A high yielding, non-basmati, medium slender grain, blast resistant rice variety.</p><p>Pusa Aditi: Grape hybrid released for its commercial cultivation in NCR region</p><p>Pusa Sona: Onion variety has been released apart from various other horticulture crops such as melons, cucumber, cauliflower etc.</p></div>



Denisovans	<p>Scientists have for the first time restructured Denisovans' skeletal features, using DNA methylation (chemical changes), to understand how the long-lost human relative looked like, as reported by The Nature.</p> <p>About Denisovans</p> <ul style="list-style-type: none">• Denisovans are an extinct species of hominid and a close relative to modern humans.• Scientists first identified Denisovan remains from Denisova cave located in the Altai mountains in Siberia in 2010.• Denisovans may have ranged from Siberia to Southeast Asia during the last Ice Age.• Denisovans share a common ancestor with both modern humans and Neanderthals. This common ancestor, called Homo heidelbergensis, most likely lived in Africa.
New technique to propagate plants	<p>Mettupalayam-based S Rajarathnam has developed a technique to propagate plants using leaves</p> <p>What is plant propagation?</p> <ul style="list-style-type: none">• Plant propagation is the process of creating new plants.• There are two types of propagation: sexual and asexual. <p>What is sexual propagation?</p> <ul style="list-style-type: none">• Sexual reproduction is the union of the pollen and egg, drawing from the genes of two parents to create a new, third individual.• Sexual propagation involves the floral parts of a plant.• The advantages of sexual propagation are that it may be cheaper and quicker than other methods• It may be the only way to obtain new varieties and hybrid vigor.• In certain species, it is the only viable method for propagation; and it is a way to avoid transmission of certain diseases. <p>What is asexual propagation?</p> <ul style="list-style-type: none">• Asexual propagation involves taking a part of one parent plant and causing it to regenerate itself into a new plant.• The resulting new plant is genetically identical its parent.• Asexual propagation involves the vegetative parts of a plant: stems, roots, or leaves.• Asexual propagation has advantages, too.• It may be easier and faster in some species; it may be the only way to perpetuate some cultivars;• It bypasses the juvenile characteristics of certain species.
A1 or a2?	<p>The latest conundrum in the dairy world is the choice between A1 and A2 milk.</p> <p>What do the terms mean?</p> <ul style="list-style-type: none">• Casein is the largest group of proteins in milk, making up about 80% of total protein content.• There are several types of casein in milk.• Beta-casein is the second most prevalent and exists in at least 13 different forms.• The two most common forms are:<ul style="list-style-type: none">➤ A1 beta-casein.➤ A2 beta-casein.



	<p>Originally, all cows would produce only A2 protein.</p> <ul style="list-style-type: none">• Over the millennia however, a genetic mutation made many of them start producing both A1 and A2 proteins, with some producing A1 only.• Some studies suggest that A1 beta-casein may be harmful and that A2 beta-casein is a safer choice.• Thus, there is some public and scientific debate over these two types of milk.• A2 milk is produced and marketed by the A2 Milk Company and contains no A1 beta-casein.• It is said that India's desi cow breeds like Tharparkar, Gir, and Sahiwal have a genetic make-up that yields milk high in A2.• All indigenous breeds, or <i>Bos indicus</i>, have a higher frequency of A2 protein.
<p>Dna forensic</p>	<p>DNA forensic used in settling a trans boundary poaching dispute</p> <p>What is DNA forensic?</p> <ul style="list-style-type: none">• The establishment of DNA analysis within the criminal justice system in the mid-1980s revolutionized the field of forensic science.• Because of the accuracy and reliability of forensic DNA analysis, this evidence has also become an invaluable tool for exonerating individuals who have been wrongfully convicted. <p>What are the principles behind DNA forensic?</p> <ul style="list-style-type: none">• DNA is sometimes referred to as a —genetic blueprint because it contains the instructions that govern the development of an organism.• Characteristics such as hair color, eye color, height and other physical features are all determined by genes that reside in just 2% of human DNA.• This portion is called the coding region because it provides the instructions for proteins to create these features.• The other 98% of human DNA is considered non-coding.• Forensic scientists, however, use this non-coding DNA in criminal investigations.• Inside this region of DNA are unique repeating patterns that can be used to differentiate one person from another. <p>These patterns, known as short-tandem repeats (STRs), can be measured to define the DNA profile of an individual.</p>

Important Schemes and Policies By Department of Biotechnology(DBT)

<p>GARBH-ini (interdisciplinary Group for Advanced Research in Birth outcomes- DBT India Initiative)</p>	<ul style="list-style-type: none">• A Mission to promote Maternal and Child Health and develop prediction tools for pre-term berth,• It aims to discover molecular risk-markers and generate a risk-prediction algorithm for preterm birth which will facilitate timely referral and care for at-risk mothers, thus saving children's lives and reducing morbidity.• This programme has established a unique pregnancy cohort
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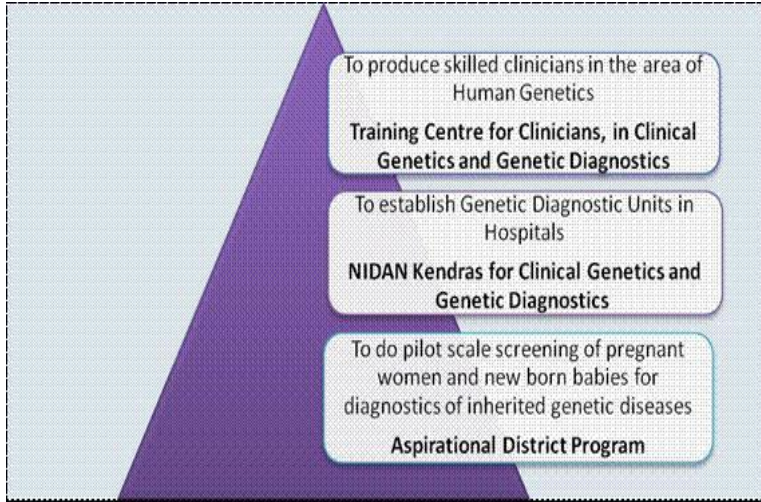


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<p>study</p>	<p>comprising more than 8000 women to study Pre Term Birth (PTB).</p> <ul style="list-style-type: none"> The GARBH-ini platform comprises a bio-repository (Rakshita) of well characterized clinical phenotypes.
<p>Indcepi</p>	<ul style="list-style-type: none"> A Mission to develop affordable vaccines for endemic diseases It is an India centric collaborative mission of DBT aligned to the global initiatives of CEPI (Coalition of Epidemic Preparedness Innovations). DBT is supporting the implementation of the Ind-CEPIs mission “Epidemic preparedness through rapid vaccine development. Support of Indian vaccine development is aligned with the global initiative of the Coalition for Epidemic Preparedness Innovations (CEPI)”, at BIRAC, PSU of DBT.
<p>Antimicrobial resistance (amr) mission</p>	<ul style="list-style-type: none"> It will focus on development of new antibiotics, alternatives to antibiotics and diagnostics. To address the rising threat of antimicrobial resistance (AMR) with a holistic and multi-sectoral (One Health) approach, “India’s One Health Initiative” to combat problems associated with AMR was launched.
<p>Unati mission</p>	<ul style="list-style-type: none"> Clean Technologies for Swachh Bharat: DBT has developed various technology platforms designed to convert different solid, liquid and gaseous wastes into renewable fuels, energy and useful products such as food, feed, polymers and chemicals. Under the UNATI Mission, 10 promising clean technologies have been identified for demonstration with DBT support at different sites across India, in collaboration with local stakeholders such as municipalities and other urban local bodies. The identified technologies include bio-methanation, constructed wetland, bio-toilets, chemical & membrane free water purification etc.
<p>Mission covid suraksha</p>	<ul style="list-style-type: none"> Mission COVID Suraksha is India’s targeted effort to enable the development of indigenous, affordable and accessible vaccines for the country and will complement the ongoing mission of Atmanirbhar Bharat.
<p>Partnerships for Accelerating Clinical Trials (PACT)</p>	<ul style="list-style-type: none"> The PACT (Partnerships for Accelerating Clinical Trials) programme has been launched for supporting COVID-19 vaccine development activities in partnering countries. The initiative is being implemented by Biotechnology Industry Research Assistance Council (BIRAC) and Clinical Development Services Agency (CDSA) under the aegis of the National Biopharma Mission and Ind-CEPI Mission of DBT.
<p>National biopharma mission</p>	<ul style="list-style-type: none"> It is the first ever Industry-Academia mission “Industry-Academia Collaboration National Biopharma mission. The mission aims for Accelerating Discovery Research to Early Development for Biopharmaceuticals. “Innovate in India (i3) Empowering biotech entrepreneurs & accelerating inclusive innovation “ to accelerate biopharmaceutical development in India.
<p>Pan india genome india</p>	<ul style="list-style-type: none"> Genome India was initiated for cataloguing the genetic variation in Indian population with a goal for whole genome sequencing and subsequent data analysis of 10,000 individuals representing the



	<p>country's diverse population to help build an exhaustive catalogue of genetic variations in Indian population, and to aid in the design of a genome wide association chip for Indian population.</p>
Lotus hr project	<ul style="list-style-type: none"> In collaboration with Netherlands, a toolbox of wastewater treatment technologies has been established on site at Barapullah drain to facilitate selection of treatment combinations for optimum treatment of wastewater.
Indian bioresource information network (ibin)	<ul style="list-style-type: none"> It was created to bring together all the available databases and information on the bio-resources and biodiversity of the country in one platform. The satellite telemetry tracking of Jacobin Cuckoo is a part of IBIN project in collaboration with Wildlife Institute of India to monitor the changes in Indian monsoon patterns and could help in planning the conservation and climate monitoring programmes.
Unique Methods of Management of Inherited Disorders (UMMID) Initiative	<ul style="list-style-type: none"> The Department launched the 'UMMID' initiative to tackle inherited genetic diseases in newborns. 
Indian biological data centre (ibdc)	<ul style="list-style-type: none"> It was established by DBT for deposition, storage, annotation and sharing of biological data generated in the country through extensive funding from various Government Organizations. The IBDC will enable life science researchers to deposit biological data in a central repository and thus safeguard data generated using public resources from loss. It will perform quality control, curation, and annotation of data. These efforts will help establish benchmarks for the quality of data deposited and thus improve the quality of experimental research conducted in the country.



<p>Genovault</p>	<ul style="list-style-type: none"> • GenoVault (Cloud based Genomics Repository) was launched in the Accelerating Biology 2020. • This cloud-based genomic repository enables quick archival and retrieval tools along with extremely powerful analytical engines. • GenoVault is a first India's Genomics Repository based on OpenStack cloud. This centralized repository would be of enormous importance for healthcare and would have great use in personalized medicine.
<p>Biotech-KISAN</p>	<ul style="list-style-type: none"> • Biotech-KISAN has created a platform in each of 15 agro-climatic zones of the country, which aims to connect farmers and scientists to promote Agriculture Innovation and take the new interventions to the farmers and farms
<p>Biotechnology industry research assistant council (birac)</p>	<ul style="list-style-type: none"> • BIRAC launched i4 (Intensifying the Impact of Industrial Innovation) to support biotechnological product/technology development by strengthening R&D capabilities of start-ups/companies/LLPs. • The programme provides impetus for pulling the translational ideas past PoC and taking them further along the innovation chain for validation, scale-up, demonstration and pre-commercialization of products and technologies.
<p>Wheat straw polysaccharide</p>	<ul style="list-style-type: none"> • DBT-National Agri-Food Biotechnology Institute (DBT-NABI) has developed a wheat straw polysaccharide derived novel edible coating formulation to prevent the post-harvest shelf-life of perishable fruit crops such as Apple, Peach and Banana. • In addition to that, antibody assisted graphene oxide coated gold nanoparticles for rapid bacterial detection and near infrared light enhanced antibacterial activity has been developed which detects food borne pathogens.
<p>Dbt-national brain research institute (dbt-nbrc) research</p>	<ul style="list-style-type: none"> • Japanese Encephalitis virus (JEV) infection was found to induce classical activation (M1) of microglia that drives the production of pro-inflammatory cytokines, while suppressing alternative activation (M2) that could serve to dampen the inflammatory response, thereby inducing inflammatory response, microglial activation, and neuronal apoptosis. • 'DALI' a tool in Indian languages for dyslexia assessment in children developed at NBRC remains in high demand and is being increasingly adopted countrywide. • BRAHMA and ANSH: NBRC scientists have developed specialized



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tools named BRAHMA and ANSH for integrating inputs from neuroimaging data and the clinical information to help in diagnosis of various brain diseases such as Alzheimer's and Parkinson's.

- The tool is standardized on a robust Indian brain template that is representative of the Indian population-specific brain anatomy.

RELATED NEWS

National gene bank

- Recently, the Union Minister for Agriculture and Farmers Welfare inaugurated the world's second-largest refurbished state-of-the-art National Gene Bank at the National Bureau of Plant Genetic Resources (NBPGR).
- Gene Banks are a type of biorepository which preserve genetic material. A collection of seed plants, tissue cultures etc.
- A gene is the basic physical and functional unit of heredity. Genes are made up of Deoxyribonucleic Acid (DNA).

National Bureau of Plant Genetic Resources (NBPGR)

- It is a nodal organisation for management of plant genetic resources in India and functions under the control of Indian Council of Agricultural Research (ICAR).
- It is conserving seed germplasm for long-term conservation (at -20°C) in its National Genebank (NGB).
- It plans, organizes, conducts and coordinates exploration and collection of indigenous and exotic plant genetic resources. It is headquartered in New Delhi and has 10 regional stations.

Key Points:

- The National Gene Bank was established in the year 1996 to preserve the seeds of Plant Genetic Resources (PGR) for future generations, and has the capacity to preserve about one million germplasm in the form of seeds.
- Germplasm is living tissue from which new plants can be grown.
- NBPGR is meeting the need of in-situ and ex-situ germplasm conservation through Delhi Headquarters and 10 regional stations in the country.
- In situ and ex situ conservation focuses on the maintenance of species diversity within or away from their natural habitats, respectively.

Significance:

- Presently, it is protecting 4.52 lakh accessions, of which 2.7 lakh are Indian germplasm and the rest have been imported from other countries.
- An accession is a single, collected variety or varieties of a wild plant, a landrace or a plant variety that has been produced by selective breeding, more commonly known as a cultivar.

Functioning:

- The NGB has four kinds of facilities, namely, Seed Genebank (-



	<p>18°C), Cryogenebank (-170°C to -196°C), In vitro Genebank (25°C) and Field Genebank, to cater to long-term as well as medium-term conservation.</p> <ul style="list-style-type: none">• It stores different crop groups such as cereals, millets, medicinal and aromatic plants and narcotics, etc. <p>Other Facilities:</p> <ul style="list-style-type: none">• The Svalbard Global Seed Vault in Norway houses the world's largest collection of seeds.• India's seed vault is at Chang La (Ladakh) in the Himalayas.• National Animal Gene Bank, established at the National Bureau of Animal Genetic Resources (NBAGR - Karnal, Haryana), has the objective of conserving the indigenous livestock biodiversity.• NBAGR is one of the Indian Council of Agricultural Research (ICAR) institutes.
<p>Indigau</p>	<ul style="list-style-type: none">• Recently, National Institute of Animal Biotechnology (NIAB), Hyderabad has launched a chip called IndiGau.• It is India's first Cattle Genomic Chip for the conservation of pure varieties of indigenous cattle breeds like Gir, Kankrej, Sahiwal, Ongole etc.• NIAB is an Indian autonomous research establishment of the Department of Biotechnology, Ministry of Science and Technology. <p>About IndiGau:</p> <ul style="list-style-type: none">• IndiGau is purely indigenous and the largest cattle chip of the world.• The Chip to achieve the goal of conservation of our own breeds with better characters and help towards doubling of farmers' income by 2022.• The manufacturing of this chip is in synergy with Rashtriya Gokul Mission and a great example of Atmanirbhar Bharat.• Further, the chip exemplifies the application of scientific knowledge and innovations for "Ease of Living" for all sections of society.• Importance of Indigenous Breeds:• Indigenous bovines are robust and resilient and are particularly suited to the climate and environment of their respective breeding tracts and productivity of indigenous breeds is less likely to be impacted by the adversities of climate change.• The milk of indigenous animals is high in fat and SNF content.• SNF content are the substances in milk other than butterfat and water in the form of casein, lactose, vitamins, and minerals which contribute significantly to the nutritive value of milk.
<p>Genome Mapping in Indian Ocean:</p>	<ul style="list-style-type: none">• National Institute of Oceanography (NIO) is going to launch the first-of-its-kind project of Genome Mapping in the Indian Ocean.• Indian Ocean is the third largest water body in the world, covering about 20% of the Earth's water surface. <p>Aim:</p> <ul style="list-style-type: none">• To gather samples for genome mapping of microorganisms in the Indian Ocean.• To understand the biochemistry and the response of the ocean to climate change, nutrient stress and increasing pollution.



Project Cost & Duration:

- Rs. 25 crore and will take three years to complete.
- A team of scientists and researchers from the NIO on board its research vessel Sindhu Sadhana will spend 90 days traversing the course of over 10,000 nautical miles in the Indian Ocean on the research project to reveal the internal working of the body of the ocean at a cellular level.
- They will course the Indian Ocean from India's east coast, Australia, Port Louis in Mauritius and up to the border of Pakistan, off India's west coast.

Genome Collection:

- The researchers will collect samples from various stretches of the ocean at an average depth of about 5 km.
- Just like gene mapping is carried out on blood samples collected from humans, the scientists will map these in the bacteria, microbes found in the ocean.
- The mapping of the Deoxyribose Nucleic Acid (DNA) and Ribonucleic Acid (RNA) will show the nutrients present in them, and also those lacking in different parts of the ocean.

Studying Trace Elements:

- Trace metals like cadmium or copper are supplied to oceans via continental run-offs, atmospheric deposition, hydrothermal activities and continental shelf interaction.
- They are essential for ocean productivity.
- It is important to understand the interactions of trace metals with marine biota "for having a holistic understanding about nutrient cycling and productivity of the oceans".
- Apart from their reactions on marine life, isotopic forms of trace metals can be utilised to track the movement of water masses responsible for ocean circulation and as tools to study the biological, geochemical and ecosystem processes and food web analyse.
- The NIO's project is expected to generate new information about trace metals from underexplored regions of the Indian Ocean.

Benefits:

- Understanding Ecosystem
- It will help scientists understand the internal working of the ecosystem of the Indian Ocean.
- **Understanding Factors Causing Change:**
- The research will enable scientists to identify the factors controlling the changes in RNA, DNA in the oceans, and various stressors impacting them.
- Identifying Mineral Concentration:
- The ocean has several micronutrients like nitrates, sulphates and silicates, minerals like iron ore and zinc, and trace metals like cadmium or copper.
- The genome mapping will show the presence of which these microbes have adapted to, in addition to their reaction to atmospheric carbon dioxide.
- This will help in identifying which part of the ocean has a greater



	<p>concentration of which mineral or element.</p> <ul style="list-style-type: none">• Scientists will then use these as tracers to tackle the causative factors for excess or lack of a certain mineral or element and suggest possible solutions for their mitigation. <p>Human Benefit:</p> <ul style="list-style-type: none">• The large pool of RNA, DNA library of the oceans will be utilised for using the Indian Ocean to human benefit in the future.• Increased Biotechnology Application:• Genome mapping will enable an increase in the growing number of commercial biotechnology applications, extending from multiple anticancer treatments to cosmetics and industrial enzymes, to antiviral molecules.
<p>First car-t cell therapy conducted:</p>	<ul style="list-style-type: none">• Clinical trials of Chimeric Antigen Receptor T-cell (CAR-T) therapy was conducted globally. Therapy has emerged as a breakthrough in cancer treatment. It has shown promising results on end stage patients, especially in patients of Acute Lymphocytic Leukemia. <p>Highlights</p> <ul style="list-style-type: none">• CAR-T technology has a remarkable therapeutic potential for cancer patients.• This technology is not available in India, currently. <p>Background</p> <ul style="list-style-type: none">• BIRAC and DBT have initiated and launched specialised calls and invitation to promote and support development of CAR-T cell technology against cancer and other diseases. <p>What are the challenges?</p> <ul style="list-style-type: none">• CAR-T cell therapy costs 3-4 crore for each patient. Thus, biggest challenge is to develop this technology in a cost-effective manner and make it available to patients. Manufacturing of this technology is complex which increases the cost. <p>First CAR-T cell Therapy</p> <ul style="list-style-type: none">• First CAR-T cell Therapy was done by IIT Bombay and cancer care in India at Bone Marrow Transplant unit of Tata Memorial Centre in Mumbai. CAR-T cells were designed and manufactured at the Bioscience and Bioengineering (BSBE) department, IIT Bombay. This was also supported by the BIRAC-PACE scheme. Now, this therapy will undergo Phase I and II trials of their CAR-T product through the National Biopharma Mission.
<p>RNA Interference and Antisense Technology</p>	<ul style="list-style-type: none">• RNAi is a gene silencing technology that inhibits protein synthesis in target cells using double-stranded RNA. Same result is achieved by Antisense technology through single-stranded RNA.• RNAi technologies are now known to formulate drugs capable of reducing cholesterol levels by half. The technology also finds immense importance in treating acute viral infections like acquired immunodeficiency syndrome (AIDS), because of the well-studied life cycle and pattern of gene expression of the human immunodeficiency virus (HIV).• Promising results have been shown by Antisense technology in producing a variety of tomato with increased shelf-life commonly known as Flavr Savr.• It can be said that, in the near future, antisense technology could



	<p>be used in targeting cancer.</p> <p>Two major challenges are faced by India which are hindrances in progress of RNAi and antisense technologies. They are:</p> <ul style="list-style-type: none">• Lack of efficient and targeted delivery vehicles for these potential RNA molecules.• The relatively minimal development of silencing reagents that ensure consistent, specific, significant and lasting knockdown of the gene targeted. <p>India, in order to deal with these constraints, needs to develop domestic facilities focusing on nanotechnology-based targeted RNA-delivery product development</p> <ul style="list-style-type: none">• There has to be active collaboration with research institutions in the Japan, Russia, the US and other early achievers in this space, in terms of the training and development of human resources at all the levels of government.
<p>Biotech-PRIDE</p>	<ul style="list-style-type: none">• Recently, Biotech-PRIDE (Promotion of Research and Innovation through Data Exchange) Guidelines was released by the Department of Biotechnology (DBT), Ministry of Science and Technology.• Further, a website of Indian Biological Data Centre (IBDC) was also launched. <p><u>Biotech-PRIDE Guidelines:</u></p> <ul style="list-style-type: none">• These guidelines envisage to bridge other existing biological datasets/data centers with the IBDC, which will be called Bio-Grid.• This Bio-Grid will be a National Repository for biological knowledge, information and data.• Also, Bio-Grid will be responsible for enabling its exchange, developing measures for safety, standards and quality for datasets and establishing detailed modalities for accessing data.• These guidelines will be implemented through Indian Biological Data Centre (IBDC).• Currently, India ranks number 4 amongst the top 20 countries contributing biological databases. <p><u>Need for Bio-Grid and its Advantages:</u></p> <ul style="list-style-type: none">• With a large population of over 135 crore and heterogeneous character of the country, India needs its own exclusive database for Indian research and solutions.• This indigenous database will have a huge enabling mechanism for exchange and adoption of data by young scientists and researchers for the benefit of Indian citizens.• Sharing a wide range of large scale data advances the understanding of the molecular and biological processes.• This will contribute to human health, agriculture, animal husbandry, fundamental research and thus will extend to societal benefits.• Advances in DNA sequencing with a steep drop in DNA sequencing cost have enabled government agencies to fund



	research towards generation of large volumes of biological data in various sectors of Biosciences.
E-cigarettes ban	<p>Health Minister Harsh Vardhan told the Lok Sabha that the Union government's move to ban the sale of electronic cigarettes was a —pre-emptive strike before the new form of intoxication spreads as the companies making them were looking at India as an attractive market.</p> <p>What are E-cigarettes?</p> <ul style="list-style-type: none">• An electronic cigarette is a battery-operated device.• It emits doses of vaporized nicotine, or non-nicotine solutions, for the user to inhale.• It aims to provide a similar sensation to inhaling tobacco smoke, without the smoke.• It is also known as e-cigarettes, e-cigs, electronic nicotine delivery systems, vaporizer cigarettes, and vape pens.• They are marketed as a way to stop or cut down on smoking. <p>What are the harmful effects of e-cigarettes reported?</p> <p>Use of e-cigarettes has documented adverse effects on humans which includes</p> <ul style="list-style-type: none">• DNA damage• Carcinogenesis• Cellular• Molecular and immunological toxicity• Respiratory, cardiovascular and neurological disorders and• Adverse impact on foetal development and pregnancy
Rare diseases	<ul style="list-style-type: none">• After withdrawing the National Policy for Treatment of Rare Diseases (NPTRD), the Minister of Health and Family Welfare has approved a proposal for adding a sub-component under the umbrella scheme of Rashtriya Arogya Nidhi (RAN) for provision of one-time financial assistance to those below threshold poverty line for specified rare diseases which require one-time treatment. <p>About Rare Diseases</p> <ul style="list-style-type: none">• There is no universally accepted definition of rare diseases and the definitions usually vary across different countries. However, generally rare diseases are defined as a health condition of low prevalence that affects a small number of people compared with other prevalent diseases in the general population.• WHO defines rare disease as often debilitating lifelong disease or disorder condition with a prevalence of 1 or less, per 1000 population.• 80% of rare diseases are genetic in origin and hence disproportionately impact children.• These are also called 'orphan diseases' because drug companies are not interested in adopting them to develop treatments due to low profitability.• The most common rare diseases include Haemophilia, Thalassemia, Sickle-cell Anaemia, auto-immune diseases, etc.



- They affect 6%- 8% of the total population in the country. So far about 450 rare diseases have been recorded in India.
- **Karnataka** is the first state to release a Rare Diseases and Orphan Drugs Policy.
- The Union Health Ministry termed the current policy “untenable” as the policy was to be implemented under the National Health Mission. (The ambit of the NHM is restricted to primary and secondary health care but **rare diseases come under tertiary care**).
- **One-time financial assistance** is being provided as an interim measure till a new policy is framed. A committee has been set up to frame a new policy.

Criticism of the move: Why India Needs a policy on rare disease?

- **Need for Continuous Treatment:** Most of the rare diseases for which treatment is available are progressive. They require continuous support and not just one-time assistance as an interim arrangement can never be a substitute for a policy.
- The withdrawn Policy highlighted the measures and steps, both in the short as well as in the long term, that need to be taken to deal comprehensively with rare diseases. The policy sought to strike a balance between access to treatment with health system sustainability.
- **Pushes Families in Poverty:** Its impact on families is often catastrophic in terms of emotional as well as financial burden. The exorbitant cost of treatment per patient, which ranges anywhere from ₹25 lakh and ₹4 crore per year, is out of reach even for middle-class families.
- **Significant Population Impacted:** While there is no registry of rare diseases patients in India (the policy provided for one), according to government’s own estimates there are between 70-90 million patients.
- **Difficulty in R&D:** Rare diseases are difficult to research upon as the patient pool is very small and it often results in inadequate clinical experience. The policy envisaged a R&D framework which cannot be attained through one-time financial support.

Not covered under Health Insurance: Private insurance companies treat genetic disorders as pre-existing conditions and, on that ground, exclude them from coverage. Since most rare diseases are genetic, patients are routinely denied insurance cover.

Rashtriya arogya nidhi

- The RAN was set up to provide **financial assistance to patients**, living below poverty line and who are suffering from **major life-threatening diseases**, to receive medical treatment at any of the super speciality Hospitals/Institutes or other Government hospitals.
- The financial assistance to such patients is released in the form of ‘**one-time grant**’, which is released to the Medical Superintendent of the Hospital in which the treatment has been/is being received.
- It has been set up as society registered under the Societies



Registration Act, 1860.

Way forward

- **Avoid shallow declarations:** India remains a long way away from **elimination at the state or district levels**, let alone eradication. It is necessary to learn lessons and avoid creating an environment of complacency.
- **Speedy implementation of the Health and Wellness Centres (HWC) initiative** in the true spirit of comprehensive primary healthcare approach.
- **Enhancing training of health-care providers:** in communication and behaviour change skills, and by improving the **patients' access to quality care and friendly services**.
- **Adherence to MDT:** can be improved by multiple initiatives that target the views and actions of patients, health-care workers, and society.
- **Removal of stigma:** Leprosy program managers should **design positive health messages and use innovative media to appeal** to and reach target groups to motivate leprosy patients to seek early treatment and the community to accept leprosy patients.
- **Creating Livelihood Opportunities:** Those who have been cured at an early stage and can work, should be given **opportunities to learn skills and trades** that would enable them to work.

National action plan for viral hepatitis control

Recently, Ministry of Health and Family Welfare launched National Action Plan for Viral Hepatitis.

About National Action Plan for Viral Hepatitis

- The Plan provides a strategic framework, based on which **National Viral Hepatitis Control Program** was launched in 2018 under National Health Mission.
- It is in line with the Government of India's deep commitment towards **elimination of viral hepatitis**.

About Hepatitis

It is an **inflammation of the liver** often **cause by virus** and other **infections, toxic substances** (e.g. alcohol, certain drugs).

There are **5 main hepatitis viruses**, referred to as types A, B, C, D and E.

- Viral **hepatitis types B and C** can cause **chronic hepatitis** and are responsible for 96% of overall hepatitis mortality while **Hepatitis A and E** usually cause **acute hepatitis**.
- **Hepatitis A and E** are typically caused by ingestion of **contaminated food or water**.
- **Hepatitis B, C and D** usually occur as a result of contact with **infected body fluids** such as during receiving blood, invasive medical procedures using contaminated equipment, transmission from mother to baby at birth, sexual contact etc.
- There are vaccines to prevent hepatitis A, B and E. However, **there is no vaccine for hepatitis C**.
- Also, **Hepatitis D virus (HDV)** infections occur **only** in those who are infected with **Hepatitis B Virus**.



	<p>The infections can progress to other health complications and liver cancers.</p> <p>The challenge in eliminating chronic viral hepatitis is due to the infected person being unaware of their chronic carrier status and to the potential for them to continue to infect others for decades.</p> <p>About National Viral Hepatitis Control Program</p> <ul style="list-style-type: none">• Its goal is ending viral hepatitis as a public health threat in the country by 2030.• It aims to reduce morbidity and mortality due to viral hepatitis. <p>The key strategies include:</p> <ul style="list-style-type: none">• Preventive and promotive interventions with focus on awareness generation, safe injection practices and socio-cultural practices, sanitation and hygiene, safe drinking water supply, infection control and immunization• Co-ordination and collaboration with different Ministries and departments• Promoting diagnosis and providing treatment support for patients of hepatitis B & C• Building capacities at national, state, district levels and sub-district level up to Primary Health Centres (PHC) and health and wellness centres such that the program can be scaled up till the lowest level of the healthcare facility in a phased manner.
<p>Protection of plant varieties and farmers' rights (ppv&fr)</p>	<p>Recently, PepsiCo has sued nine farmers in Gujarat for alleged rights infringement on the grounds that they illegally grew its registered FC-5 potato variety (or FL-2027) used to make Lays chips.</p> <p>More on News</p> <ul style="list-style-type: none">• PepsiCo has invoked Section 64 of the Protection of Plant Varieties and Farmers' Rights (PPV&FR) Act, 2001 to claim infringement of its rights, as company has patented FC-5 until January 2031 under the Act.• Farmers groups cite Section 39 of the PPV&FR Act, which specifically says that a farmer is allowed "to save, use, sow, resow, exchange, share or sell his farm produce including seed of a variety protected under this Act" so long as he does not sell "branded seed". <p>About the Protection of Plant Varieties and Farmers' Rights (PPV&FR) Act, 2001</p> <ul style="list-style-type: none">• India as a signatory to World Trade Organization in 1994, was obliged under Article 27(3) (b) of the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), either to adopt a sui genesis system for plant variety protection or join the Convention of the International Union for the Protection of New Varieties of Plants (UPOV).• The Protection of Plant Varieties and Farmers' Rights (PPV&FR) Act, 2001" was enacted by adopting sui generis system.• It's the world's only IPR legislation which grants intellectual



	<p>property rights not only to the plant breeders but also to the farmers by protecting new, extant and farmers' varieties.</p> <ul style="list-style-type: none">• Unlike UPOV, the Act facilitates protection of not only new, but even extant (existing) varieties. That includes those notified under the Seeds Act (1966), farmers' varieties and varieties of common knowledge.• Objective• To recognize and protect the rights of farmers in respect of their contributions made at any time in conserving, improving and making available plant genetic resources for the development of new plant varieties.• To accelerate agricultural development in the country, protect plant breeders' rights; stimulate investment for research and development both in public & private sector for the development new of plant varieties.• Facilitate the growth of seed industry in the country, to ensure the availability of high-quality seeds and planting material to the farmers.• The protection period is for 15 years, and 18 years in the case of trees and vines.• Establishes Plant Varieties Protection Appellate Tribunal (PVPAT): The decisions of the PVPAT can be challenged in High Court. The Tribunal shall dispose of the appeal within one year.
<p>Protection of plant varieties and farmers' rights authority (ppv&fr authority)</p>	<p>Established to implement the provisions of the Act by Department of Agriculture and Cooperation, Ministry of Agriculture.</p> <p>General Functions of the Authority:</p> <ul style="list-style-type: none">• Registration of new plant varieties and Maintenance of the National Register of Plant Varieties for registration of new plant varieties, essentially derived varieties (EDV) and extant varieties.• Facilitate development and commercialisation of new varieties through formal linkages with agricultural universities, research institutions and Krishi Vigyan Kendras.• Developing DUS (Distinctiveness, Uniformity and Stability) test guidelines for new plant species: DUS testing is a way of determining whether a newly bred variety differs from existing varieties within the same species (the Distinctness part), whether the characteristics used to establish Distinctness are expressed uniformly (the Uniformity part) and that these characteristics do not change over subsequent generations (the Stability part).• Maintenance of National Gene Bank to store the seed material including parental lines submitted by the breeders of the registered varieties• Establish National Gene Fund (2007): It supports and reward farming /tribal/rural communities who are engaged in conservation, improvement and preservation of genetic resources of economic plants and their wild relatives.• Institute Plant Genome Saviour Community Award, to community of farmers which is engaged in conservation,



improvement and preservation of genetic resources of economic plants and their wild relatives, particularly in areas identified as agro-biodiversity hotspots.

Rights under the Act

- **Breeders' Rights:** Breeders will have exclusive rights to produce, sell, market, distribute, import or export the protected variety. Breeder can appoint agent/ licensee and may exercise for civil remedy in case of infringement of rights.
- **Researchers' Rights:** Researcher can use any of the registered variety under the Act for conducting experiment or research. This includes the use of a variety as an initial source of variety for the purpose of developing another variety but repeated use needs prior permission of the registered breeder.
- **Farmers' Rights:** A farmer who has evolved or developed a new variety is entitled for registration and protection in like manner as a breeder of a variety.
- A farmer can save, use, sow, re-sow, exchange, share or sell his farm produce including seed of a variety protected under the PPV&FR Act, 2001 in the same manner as he was entitled before the coming into force of this Act provided farmer shall not be entitled to sell branded seed of a variety protected under the PPV&FR Act, 2001.
- There is also a provision for compensation to the farmers for non-performance of variety under Section 39 (2) of the Act, 2001; and
- Farmer shall not be liable to pay any fee in any proceeding before the Authority or Registrar or the Tribunal or the High Court under the Act. It will be paid through National Gene Fund.

International Union for the Protection of New Varieties of Plants-UPOV

Objective: It's an intergovernmental organization, to provide and promote an effective system of plant variety protection, with the aim of encouraging the development of new varieties of plants, for the benefit of society.

Protection to Framers: The UPOV Convention provides the basis for members to encourage plant breeding by granting breeders of new plant varieties an intellectual property right: the breeder's right.

Impact of Plant Variety Protection increased breeding activities, greater availability of improved varieties, diversification of types of breeders (private breeders, researchers), increased number of foreign new varieties, encouraging the development of a new industry competitiveness on foreign markets, and improved access to foreign plant varieties and enhanced domestic breeding programs.

Difference between Patent And PPV&FR Act:

- A patent deals with IPR over devices of Industrial applications whereas PPV & FR Act, 2001 confers IPR to plant breeders who have bred or developed plant varieties.
- A patent is a set of exclusive rights granted by a state (national



	<p>government) to an inventor or their assignee for a limited period of time in exchange for the public disclosure of an invention. The PPV&FR Act, give rights to farmers, breeders and researches besides giving protection to varieties of all crop species which are notified under the Act.</p> <ul style="list-style-type: none">• There is also provision for benefits sharing, compensation to the farmers, recognition and award to the farmers for supporting conservation and sustainable use of plant genetics resource.
Colistin ban	<p>The Ministry of Health and Family Welfare has issued an order prohibiting the manufacture, sale and distribution of colistin and its formulations in animal food industry.</p> <p>What is Colistin?</p> <ul style="list-style-type: none">• Colistin, also known as polymyxin E, is an antibiotic produced by certain strains of the bacteria <i>Paenibacillus polymyxa</i>.• Colistin is a mixture of the cyclic polypeptides colistin A and B and belongs to the class of polypeptide antibiotics known as polymyxins.• Colistin is effective against most Gram-negative bacilli. <p>What is multi drug resistance?</p> <ul style="list-style-type: none">• When a single bacterium is resistant to more than one antibiotic it is said to be multidrug-resistant.• This can occur in two distinct ways.<ol style="list-style-type: none">a) A bacterium can have several different resistance genes, each providing resistance to a particular antibiotic.b) The other possibility is that a single resistance mechanism gives resistance to more than one antibiotic.
Cordy gold nanoparticles (cor-aunps)	<p>Assam's Bodoland University is part of collaborative research on a fungus-powered biosynthesised nanogold particles that has received an international patent from Germany.</p> <ul style="list-style-type: none">• Cordy gold nanoparticles (Cor-AuNPs), the outcome of a collaborative experiment by scientists from four Indian institutions, has earned an international patent from Germany.• These nanoparticles, derived from the synthesis of the extracts of <i>Cordyceps militaris</i> and gold salts, could make drug delivery in the human body faster and surer.• <i>Cordyceps militaris</i> is a high value parasitic fungus, lab-grown at the Department of Biotechnology's Technology Incubation Centre (TIC) in Bodoland University.• <i>Cordyceps militaris</i>, called super mushroom because of its tremendous medicinal properties, adds bioactive components to the synthesis of gold nanoparticles for better penetration.• Biosynthesised nanogold particles indicate a new application of nanoparticles in the development of therapeutic drugs which can be delivered as ointments, tablets, capsules, and in other forms. <p>Cordyceps militaris</p>



	<ul style="list-style-type: none">• Cordyceps militaris is a species of fungus in the family Cordycipitaceae and the type species of the genus Cordyceps.• It was originally described by Carl Linnaeus in 1753 as Clavaria militaris.• Cordyceps militaris is an entomopathogenic fungus, meaning it parasitizes insects.• It is quite common, spread throughout the northern hemisphere and fruiting bodies appear in Europe from August to November.• militaris is a potential harbourer of bio-metabolites for herbal drugs and there is evidence from ancient times of its applications for the revitalization of various systems of the body.• In traditional Chinese medicine, this fungus can serve as a cheap substitute for Ophiocordyceps sinensis. Both contain cordycepin.
Use of antibiotics in animal food	<p>The health ministry has banned the manufacture, sale and distribution of the antibiotic colistin and its formulations for food producing animals and animal feed supplements.</p> <p>More in news</p> <ul style="list-style-type: none">• It is found that the misuse of colistin in the poultry industry is said to be a major reason for the increase in antibiotic resistance in India.• The ban has been imposed under provisions of the Drugs and Cosmetics Act, 1940.• The ban follows recommendations by the Drugs Technical Advisory Board, and the National Antimicrobial Resistance Action Plan committee.• The government also makes it mandatory for the manufacturers of antibiotic colistin to write clearly on the label that the drug is not to be used in food-producing animals, poultry, aqua farming and animal-feed supplement. <p>Background</p> <ul style="list-style-type: none">• India is one of the top consumers of agricultural antibiotics worldwide, accounting for 3 percent of global consumption. By 2030, this use is estimated to double.• Its use has been prohibited in Europe, the United States and China. <p>Reasons for use of Antibiotics in Animal food</p> <ul style="list-style-type: none">• For the treatment of animals that show clinical signs of an infectious disease.• As growth promoter to boost the weight of the animals.• Easy availability of antibiotics.• Currently, few laws in India govern antibiotic use in food animals, and most pertain only to animal products for export. <p>Steps to be taken to prevent its misuse</p> <ul style="list-style-type: none">• Track use of antibiotic: Track rates of veterinary antibiotic use, resistance, and residues through a nationwide surveillance and



	<p>monitoring system</p> <ul style="list-style-type: none">• Alternatives to antibiotics: Subsidies and alternatives to antibiotics are necessary to offer incentives for farmers to decrease antibiotic use without causing economic harm.• Promote antibiotic-free meat: Veterinarians, farmers, and consumers should be educated on appropriate use of antibiotics and the benefits of antibiotic-free meat.• Laws to reduce antibiotic use: Appropriate laws and regulation should be framed, along with the enforcement of current laws, to reduce antibiotic use in India. <p>About Colistin</p> <ul style="list-style-type: none">• Colistin or polymyxin E is an old antibiotic first introduced in 1952.• The drug has been used for treating infections caused by Gram-negative bacilli, which are responsible for various diseases such as plague, cholera and typhoid.• However, it was revealed that colistin has side effects of nephrotoxicity and neurotoxicity, prompting to restrict the use of the drug and replace it with other antibiotics which were considered safer at that time• According to the World Health Organisation (WHO), Colistin is a “reserve” antibiotic, which means it is supposed to be considered a “last-resort” option in treatment and used only in the most severe circumstances, when all other alternatives have failed.
<p>World anti-doping agency</p>	<ul style="list-style-type: none">• The World Anti-Doping Agency (WADA) has suspended the National Dope Testing Laboratory’s (NDTL) accreditation for a period of up to six months due to non-conformities with the International Standard for Laboratories.• WADA was set up as a foundation under the initiative of the International Olympic Committee in 1999.• It seeks to promote and coordinate the fight against doping in sport internationally.• It monitors the World Anti-Doping Code.• UNESCO’s International Convention against Doping in Sport helps in ensuring the effectiveness of the code. India is a signatory to the convention.• As the Code is a non-government document that applies only to members of sports organizations, the Convention provides the legal framework under which governments can address specific areas of the doping problem that are outside the domain of the sports movement.• It is an autonomous body under the Ministry of Youth Affairs and Sports.• The primary objectives are to implement anti-doping rules as per WADA code, regulate dope control programme, to promote education and research and creating awareness about doping and its ill effects.



	<p>At national level, National Anti-Doping Agency (NADA) was set up in 2005 as registered society under the Societies Registration Act of 1890. National Dope testing Laboratory is a body under Ministry of Youth Affairs and Sports responsible for analytical testing of samples and research in the field of dope analysis.</p>
Saans campaign	<p>Recently, Ministry for Health and Family Welfare launched 'SAANS'- Social Awareness and Action to Neutralise Pneumonia Successfully.</p> <p>It aims:</p> <ol style="list-style-type: none">To reduce child mortality due to pneumonia.To mobilise people to protect children from pneumonia,To train health personnel and other stakeholders to provide prioritised treatment to control the disease. <ul style="list-style-type: none">Under the campaign, a child suffering from pneumonia can be treated with pre-referral dose of anti-biotic amoxicillin by ASHA workers.Health and wellness centres can use pulse oximeter device to identify low oxygen levels in the blood of a child, and if required, treat him by use of oxygen cylinders.Pneumonia is a lung infection that is most commonly caused by viruses or bacteria. These infections are generally spread by direct contact with infected people.
Nano-pharmaceuticals	<ul style="list-style-type: none">Department of Biotechnology under Ministry of Science and Technology has prepared draft guidelines for evaluation of nano-pharmaceuticals in India.Nanoscience is the study of materials which are in nanoscale range. o Conversion of any material in nanoscale results in alteration of its physicochemical, biological, mechanical, optical, electronic, etc. properties which can be utilized for different useful activities.Nano-pharmaceutical is an emerging field that combines nanotechnology with pharmaceutical and biomedical science with the goal of targeted drug delivery which may improve efficacy and safety profile.There are no uniform internationally acceptable guidelines for nano-pharmaceuticals.The main challenges faced by regulatory institutions in India include: regulatory capacity, information asymmetry, Inter-agency coordination, overlapping roles and mandates etc.Possible adverse effects of nanotechnology on the environment and humans: For example, nanoparticles of sizes comparable to that of human cells can be deposited in lungs and may cause damage by acting directly at the site of deposition or by translocating to other organs or by being absorbed through the blood.Their use as undetectable weapon in warfare.Incorporation of nano-devices as performance enhancers in human beings.Ethical and social issues associated with nano pharmaceuticals.



- Need for orderly growth of the sector and commercialization of nano technology innovations.

Categorises nano pharmaceuticals:

According to degradability of nanomaterial:

- **Biodegradable nanoparticles** have been used frequently as drug delivery vehicles due to its improved bioavailability, better encapsulation, control release and reduction of toxic potential. Examples: albumin, chitosan, gelatin, polycaprolactone etc.
- **Nonbiodegradable nanoparticles** are relatively less used in pharmaceutical products (though these systems are more commonly used in cosmeceuticals). Almost all non-biodegradable nanoparticles have potential to toxic effects. Examples: titanium oxide, iron oxide, and metals such as gold, silver, platinum, etc.
- **According to nature of nanomaterial:** Nanomaterial may be organic or inorganic in nature. It may also be multicomponent nanoparticle.
- **Organic Nanoparticles:** are the nanomaterials or nanoparticles composed of organic compounds like lipids, proteins, carbohydrates. They have been primarily developed for drug delivery to reduce or overcome the risk of toxicity.
- **Inorganic Nanoparticles:** are **more stable** than organic nanostructures. They are **easier to prepare** with a defined size and a very narrow size distribution. However, most of the inorganic nanoparticles may **not be biodegradable**.
- **Multicomponent nanoparticles** are the nanoparticles composed of two or more different materials.

According to nanoform of the ingredient:

- A nanocarrier is a nanomaterial being used as a transport module for another substance like a drug.
- Some of the conventional/traditional drugs may be converted into nanocrystals, thereby increasing their potential for improved dissolution and bioavailability.

What is bioavailability?

- The degree and rate at which a substance (such as a drug) is absorbed into a living system or is made available at the site of physiological activity.

Benefits of nano-pharmaceuticals include:

- It overcomes the limitations of the conventional drug delivery systems and **precision targeting** via nano-pharmaceuticals reduces toxic systemic side effects, resulting in **better patient compliance**.
- They offer the **ability to detect diseases** at much earlier stages and the diagnostic applications could build upon conventional procedures using nanoparticles.
- Nano pharmaceutical **reduces the cost of drug discovery**, design



& development and enhances the drug delivery process.

Related information**Mission on Nano Science and Technology (Nano Mission)**

- Ministry of Science and Technology launched the Nano Mission in 2007 as an "umbrella capacity-building programme".
- The Mission's programmes will target all scientists, institutions and industry in the country.
- It will also strengthen activities in nano science and technology by promoting basic research, human resource development, research infrastructure development, international collaborations, orchestration of national dialogues and nano applications and technology development.
- It is steered by a Nano Mission Council chaired by an eminent scientist.

ROBOTICS

Robotics is an interdisciplinary sector of science and engineering dedicated to the design, construction and use of mechanical robots.

Robotics Technologies cater to the automated machines, which can take place of the humans in dangerous environments or manufacturing processes, or resemble humans in appearance, behavior and cognition.

The word robot comes from the Slavic word robota, which means slave/servant. In 1948, Norbert Wiener formulated the **principles of cybernetics, the basis of practical robotics.**

Fully autonomous robots only appeared in the second half of the 20th century.

The Three Laws of Robotics (often shortened to The Three Laws or known as Asimov's Laws) are a set of rules devised by the science fiction author **Isaac Asimov**. The rules were introduced in his 1942 short story "Runaround" (included in the 1950 collection I, Robot), although they had been foreshadowed in a few earlier stories. The Three Laws, quoted as being from the "Handbook of Robotics, 56th Edition, 2058 A.D.", are:

- First Law: A robot may not injure a human being or, through inaction, allow a human being to come to harm.
- Second Law: A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.
- Third Law: A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

Currently, robots perform a number of different jobs in numerous fields and the number of tasks delegated to robots is rising progressively. The best way to split robots into types is a partition by their application.

- **Industrial robots**– These robots bring into play in an industrialized manufacturing atmosphere. Typically, these are articulated arms particularly created for applications like-material handling, painting, welding and others. If we evaluate merely by application then this sort of robots can also consist of some automatically guided automobiles and other robots.
- **Domestic or household robots**– Robots which are used at home. This sort of robots consists of numerous different gears for example- robotic pool cleaners, robotic sweepers,



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robotic vacuum cleaners, robotic sewer cleaners and other robots that can perform different household tasks. Also, a number of scrutiny and tele-presence robots can also be considered as domestic robots if brought into play in that sort of environment.

Autonomous Robots

- **Medical robots**– Robots employed in medicine and medicinal institutes. First & foremost surgical treatment robots. Also, a number of robotic directed automobiles and perhaps lifting supporters.
- **Service robots**– Robots that cannot be classed into any other types by practice. These could be various data collecting robots, robots prepared to exhibit technologies, robots employed for research, etc.
- **Military robots**– Robots brought into play in military & armed forces. This sort of robots consists of bomb discarding robots, various shipping robots, exploration drones. Often robots at the start produced for military and armed forces purposes can be employed in law enforcement, exploration and salvage and other associated fields.
- **Entertainment robots**– These types of robots are employed for entertainment. This is an extremely wide-ranging category. It begins with model robots such as robosapien or the running photo frames and concludes with real heavy weights like articulated robot arms employed as movement simulators.
- **Space robots**–This type of robots would consist of the robots employed on Canadarm that was brought into play in space Shuttles, the International Space Station, together with Mars explorers and other robots employed in space exploration & other activities.
- **Hobby and competition robots**– Robots that is created by students. Sumo-bots, Line followers, robots prepared merely for learning, fun and robots prepared for contests.
- **Humanoid Robots**: Humanoid robots are robots that look like and/or mimic human behavior. These robots usually perform human-like activities (like running, jumping and carrying objects), and are sometimes designed to look like us, even having human faces and expressions. Two of the most prominent examples of humanoid robots are Hanson Robotics' Sophia and Boston Dynamics' Atlas.

What is Artificial Intelligence?

- Artificial intelligence (AI) is the simulation of human intelligence processes by machines, especially computer systems.
- These processes include learning (the acquisition of information and rules for using the information), reasoning (using rules to reach approximate or definite conclusions) and self-correction.

How Artificial Intelligence Works?


- AI works by combining large amounts of data with fast, iterative processing and intelligent algorithms, allowing the software to learn automatically from patterns or features in the data.
- AI is a broad field of study that includes many theories, methods and technologies, as well as the following major subfields:
- **Machine learning** automates analytical model building. It uses methods from neural networks, statistics, operations research and physics to find hidden insights in data without explicitly being programmed for where to look or what to conclude.
- **A neural network** is a type of machine learning that is made up of interconnected units (like neurons) that processes information by responding to external inputs, relaying information between each unit. The process requires multiple passes at the data to find connections and derive meaning from undefined data.



- **Deep learning** uses huge neural networks with many layers of processing units, taking advantage of advances in computing power and improved training techniques to learn complex patterns in large amounts of data. Common applications include image and speech recognition.
- **Cognitive computing** is a subfield of AI that strives for a natural, human-like interaction with machines. Using AI and cognitive computing, the ultimate goal is for a machine to simulate human processes through the ability to interpret images and speech – and then speak coherently in response.
- **Computer vision** relies on pattern recognition and deep learning to recognize what's in a picture or video. When machines can process, analyze and understand images, they can capture images or videos in real time and interpret their surroundings.
- **Natural language processing (NLP)** is the ability of computers to analyze, understand and generate human language, including speech. The next stage of NLP is natural language interaction, which allows humans to communicate with computers using normal, everyday language to perform tasks.

Cognitive Computing vs. AI

COGNITIVE COMPUTING		ARTIFICIAL INTELLIGENCE
Machine learning, natural language processing, neural networks, deep learning, sentiment analysis	TECHNOLOGIES	Machine learning, natural language processing, neural networks, deep learning
Simulate human thought processes to assist humans in finding solutions to complex problems	CAPABILITIES	Find patterns in big data to learn and either reveal hidden information or deliver solutions to complex problems
Augment human capabilities	PURPOSE	Automate processes
Customer service, healthcare, industrial sector	INDUSTRIES	Finance, security, healthcare, retail, manufacturing, government



Robotics in Pandemics

- **Disinfecting surfaces:** Large and small autonomous or remote-controlled robots could be developed to locate and constantly sterilize frequently touched surfaces with ultraviolet light.
- **Contract Tracing:** The roboticists say combining existing security systems with facial recognition software could allow authorities to retrace the steps of patients who tested positive for COVID-19 and contact others who might be at risk, which is known as contact tracing.
- **Testing for coronavirus** involves inserting a swab fairly deep into a patient's nasal cavity. There are parts of the process that puts humans at risk of contracting the virus, including collecting the sample, handling the sample, transferring the sample to the test location and the test itself. Automated or robot-assisted nasopharyngeal and oropharyngeal swabbing may speed up the process, reduce the risk of infection, and free up staff for other tasks.



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- **Delivery:** Autonomous drones and ground robots can be used to deliver medicine to patients who have the coronavirus. In the field hospital in Wuhan, China, CloudMinds robots were used to deliver food, drink and medicine to patients.
- **Social Simulations:** In the time of isolation and quarantine, social robots can help people provide social stimulation and interactions, in addition to providing reminders to follow treatment regimens (to the elderly).

Robotics and the World of Artificial Intelligence

- Artificial Intelligence (AI) is a general term that implies the use of a computer to model and replicate intelligent behavior. Research in AI focuses on the development and analysis of algorithms that learn and perform intelligent behavior with minimal human intervention.
- These techniques have been and continue to be applied to a broad range of problems that arise in robotics, e-commerce, medical diagnosis, gaming, mathematics, and military planning and logistics, to name a few.
- Several research groups fall under the general umbrella of AI in the department, but are disciplines in their own right, including, robotics, natural language processing (NLP), computer vision, computational biology, and e-commerce.

Artificial Intelligence in Pandemics

- **Predicting Outbreaks:** On December 30, an artificial-intelligence company called BlueDot, which uses machine learning to monitor outbreaks of infectious diseases around the world, alerted clients—including various governments, hospitals, and businesses—to an unusual bump in pneumonia cases in Wuhan, China.
 - An automated service called **HealthMap** at Boston Children's Hospital also caught those first signs. As did a model run by **Metabiota**, based in San Francisco. That AI could spot an outbreak on the other side of the world is significant, and early warnings save lives.
 - It would be another nine days before the World Health Organization officially flagged what we've all come to know as Covid-19.
 - In the near and distant future, technology like this may be used to predict zoonotic infection risk to humans considering variables such as climate change and human activity.
- **Health Profiling:** The combined analysis of personal, clinical, travel and social data including family history and lifestyle habits obtained from sources like social media would enable more accurate and precise predictions of individual risk profiles and healthcare results.
- **Protein Modelling & Drug Discovery:** Part of what has troubled the scientific community is the absence of a definitive cure for the virus.
 - AI can lead the charge for the development of antibodies and vaccines for the novel coronavirus, either entirely designed from scratch or through drug repurposing.
 - For instance, using its **AlphaFold** system, **Google's** AI company, **DeepMind**, is creating structure models of proteins that have been linked with the virus in a bid to aid the science world's comprehension of the virus.
 - Although the results have not been experimentally verified, it represents a step in the right direction.
- **Virtual healthcare assistants:** The number of COVID-19 cases has shown that healthcare systems and response measures can be overwhelmed.
 - AI has leveraged its natural language processing capabilities to build a multi-lingual virtual healthcare agent that can answer questions related to COVID-19, provide



reliable information and clear guidelines, recommend protection measures, check and monitor symptoms, and advise individuals whether they need hospital screening or self-isolation at their homes.

- Automated camera systems used in conjunction with thermal sensors and vision algorithms on autonomous or remotely operated robots could be used to monitor temperatures of patients in hospitals.
- **Intelligent drones and robots:** The public deployment of drones and robots has been accelerated due to the strict social distancing measures required to contain the virus' spread.
 - To ensure compliance, some drones are used to track individuals not using facemasks in public, while others are used to broadcast information to larger audiences and also disinfect public spaces.

XENOBOTS

Context: The scientists have used the stem cells of frogs to create a new living robot. These robots have been named Xenobots.

About Xenobots

- Xenobots are capable of healing themselves.
- They can record memories.
- Xenobots are made from frog cells. They have been named after the *Xenopus laevis* frog that supplied its cells to create the robot. *Xenopus laevis* is an African frog.
- These robots are to be used to detect diseases and deliver drugs to specific areas of the body.
- Xenobots are less than 1 milli metre long.
- They are comprised of 500-1000 living cells.
- Xenobots come in different basic shapes and can scoot themselves in linear or circular directions.
- They are capable of joining up together to act collectively.
- They can move small objects by harnessing their cellular energy for a maximum of ten days.

How were the Xenobots created?

- The Xenobots were created by microengineering amphibian eggs with RNA. The biologists later removed the egg membrane after 24 hours. They then harvested the stem cell tissue from the embryo. The tissues then formed into spheres with tiny hair like structure called cilia. The cilia moved to propel the bots across a surface creating a Xenobot.

How was the memory of the Xenobots created?

- The memory retaining capability of the Xenobots was propelled by a protein called EosFP. This protein normally glows green. However, it emits red colour when exposed to a light of 390 nm wavelength.
- The cells of frog embryos with messenger RNA coding enabled the Xenobots to record when exposed to blue light (at around 390 nm of wavelength).
- The scientists tested the above function on ten Xenobots that were swimming around a surface where one spot was illuminated by the light of 390 nm of wavelength. After two hours, three of the bots emitted red light and the rest remained green. This provides a memory of their travel experience.



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Opportunities, Challenges, and the Future of Robotics in India

Robots are quickly moving out of controlled environments into homes and public spaces. In fact, researchers are also developing artificial intelligence systems that will allow robots to make decisions autonomously.

With the advancement of science and technology in India, robotics is entering the industrial space rapidly. As entrepreneurship opportunities and employment are opening up for tech enthusiasts who desire to enter this growing and exciting field, future of robotics in India seems bright and promising. India, like the rest of the world, has understood that skill, speed, accuracy, and consistency of robots are unmatched by humans.

Opportunities:

- Robotic technologies are extensively used across a range of sectors such as atomic energy, space, metals, textiles, automotive, and manufacturing industries. Besides, health sector in India has also initiated the use of robotic technology widely in operation theatres and even in rehabilitation centers to augment the quality of life.
- Robotics has proved to be a growing field and many avenues have opened in recent past. Many experts believe that robotics is best suited for industrial automation which includes manufacturing, packaging, and assembling. In fact, robotics and automation have the potential to revolutionize the industrial scenario by promising to bring the same result as computer systems have brought in services and other sectors.
- Robotics in automation sector has proved to improve productivity, safety as well as the quality of the end product while allowing the human operators to take up more value-added roles. In fact, the effects of robots replacing jobs in large numbers are already felt.
- Over a period of three years, the Indian textile giant Raymond replaced nearly 10,000 jobs. In another instance, executives of Grey Orange, a home-grown warehouse robotics company, believe that the 'Butler' robots can pick up nearly 600 items an hour as against human worker who can manage to pick up to close to 100 items. Furthermore, the 'Sorter' robots manufactured by Grey Orange company can automatically scans and sort packages in the warehouses of e-commerce and logistics giants like Jabong, Flipkart, and DTDC.

Challenges:

- There are many challenges that India must overcome before it is considered as a go- to destination for robotics. One of the biggest challenges is cost and procurement of the required hardware and other electronic components to build a robot. Due to the extensive paperwork involved in importing hardware components into the country, not many commercial applications are ready to enter the market.
- Additionally, acquiring and retaining quality talent is one of the biggest challenges, as robotics is a multidisciplinary field. Another major challenge is that SME customers expect visible ROI prior to proactively adopting robotics.

Future:

- Robotics is mainly capturing industries like manufacturing, pharmaceutical, packaging, FMCG, and inspection. The other promising sectors include education and defense. There is no doubt that robotics technologies are all set to change the way things are done in the industries in which they are being implemented. Experts believe that in the near future it is inevitable that robotics will become an essential aspect of various sectors.
- Like other technologies, adoption of robotics technology world is usually slow. However, the rising demand for robotics technology in a wide array of industries indicate that there will be huge opportunities and hence a higher rate of adoption of robotics technology.



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- At the forefront of India's manufacturing process would be the companies with advanced and innovative automation technologies. The increasing emphasis on the new initiative, "Make in India", will shoot up the demand for robotics technology. The need for meeting global manufacturing standards and huge opportunities for foreign players will be definitely witnessed shortly by Indian robotics industry.

Recent Developments in world of Robotics

- The robot **Captain Arjun** was launched to intensify screening and surveillance at the railway stations. It was launched by the Railway Protection Force operating under Central Railways
 - The robot is equipped with PTZ camera, motion sensor and one Dome camera. The cameras installed in the robot uses Artificial Intelligence algorithms to track antisocial activities and suspicious activities.
- **Coro-bot:** India first in world to make internet-controlled Robot. It can independently dispense food, beverages, water, medicines. The robot also gives good advises to patients without the aid of nurses, staffs or other caregivers. The robot has a special option of controlling it through an application from any part of the world. This makes the bot unique. The robot becomes the first in world to use Internet of Things technology in the medical field.
- **FEDOR:** Russia launched life-size humanoid robot called Fedor to International Space Station (ISS). It is the first ever life-size humanoid robot sent into space by Russia. It was launched onboard of unmanned Soyuz MS-14 rocket from Baikonur cosmodrome in Kazakhstan.
 - Fedor stands for Final Experimental Demonstration Object Research. It is also known as Skybot F850. It will spend 10 days learning to assist astronauts on the ISS. Its main purpose is to be used in operations that are dangerous for humans onboard spacecraft and in outer space.
 - It can emulate human body movements. This key skill will allow it to remotely help astronauts or even people on Earth to carry out tasks while humans are strapped into exoskeleton.
 - Note: US space agency NASA had sent world's first humanoid robot Robonaut 2 (R2) to space in 2011 to work in hazardous environments.
- **AntBot** is the first walking robot to have navigational capabilities without GPS or mapping. It has been designed by French National Centre for Scientific Research (CNRS) and Aix-Marseille University researchers at ISM, on lines similar to desert ants who use polarised lights and UV radiation to navigate in space.
- **Bandicoot**, a drainage-cleaning robot, has been introduced in Chennai, Tamil Nadu. It is a semiautomatic robot can enter manholes for cleaning sewage lines with its robotic arm and is equipped with 5 night-vision cameras to relay the scenario underneath.
- Kerala Chief Minister, Pinarayi Vijayan, inaugurated India's first **Humanoid Police Robot named KP-BOT**, ranked as Sub-Inspector (SI), at the Police Headquarters in Thiruvananthapuram, Kerala
- Chinese news agency Xinhua unveiled the world's first female AI news anchor Xin Xiaomeng. She has been developed by Xinhua in collaboration with SogouInc, a search engine company. She was modelled after real-life Xinhua news **anchor Qu Meng**.
- **Aida** is the world's first ultra-realistic humanoid artist, able to draw creatively due to in-built artificial intelligence (AI) technology.
 - Ai-Da is named after Ada Lovelace, the English mathematician and writer often called the world's first computer coder.



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- In 2017, **social robot Sophia** was given citizenship of Saudi Arabia – the first robot to be given legal personhood anywhere in the world.
- Chennai Traffic Police introduced a **road safety robot named ROADEO**, to help in traffic management and assist citizens. With this, Chennai became the second city after Mumbai to induct robots in traffic management.
- **NASA's Astrobee Robot "Bumble"** became the first Astrobee robot to fly under its own power in space.
 - It will help researchers in examining the new technologies in zero gravity and assist astronauts to perform routine work in the International Space Station (ISS).
 - 'Bumble' and a second Astrobee named 'Honey' were launched to the space station in April 2019. 'Queen', a third robot, will be launched in July 2019.
- The Modern coach factory (MCF) in Uttar Pradesh's Raebareli started using 'Sona 1.5' humanoid robots in its factory for transporting documents from one place to another.
 - Sona 1.5 is a full-service robot made in India built by Club first technologies, Jaipur. It is the World's 1st robot with human-like spine technology due to which they are able to balance.
- Intel launched its latest processor named 'Spring Hill' or Nervana NNP (neural network processor) -I 1000. It is Intel's first artificial intelligence (AI) chip.
- **SAW (Single Actuator Wave-like Robot)**
 - Scientists have developed a tiny, ingestible 3D-printed snake-like robot called SAW (single actuator wave-like robot), that can navigate through the small intestines. The snake-like tiny robot was made from a set of interlocking 3D-printed "plastic" pieces that look like vertebrae.
 - The robot moves in a wave-like motion and can travel through the extremely squishy environment of the small intestine. The external shape of the robot is a 2D projection of a rotating helix that results in a continuously moving wave. Its direction can be reversed simply by reversing the direction of rotation of the motor. In tests, the robot was able to move incredibly fast and cross a wide array of terrains, from water to rough, rocky soil.
 - Potential application: It can be used to visualise the digestive system in real time, especially for colonoscopies.

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