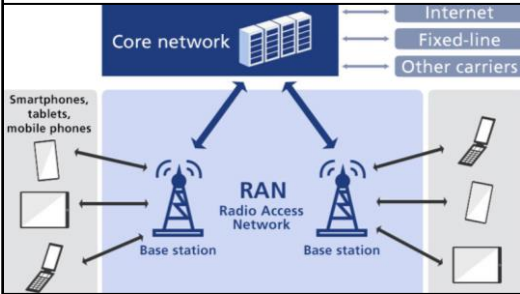


5G

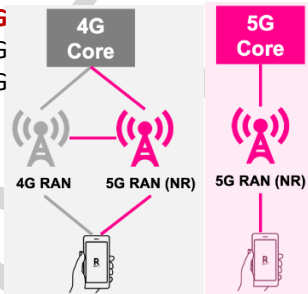
Radio Access Network

- RAN connects users to core network
- Currently, all hardware and software of a Telecom company’s RAN are made by single vendor.
- If ‘Open RAN’ is implemented, telecom companies will be able to mix and match components from different vendors.



Non-Standalone 5G

Core is 4G
RAN is 5G

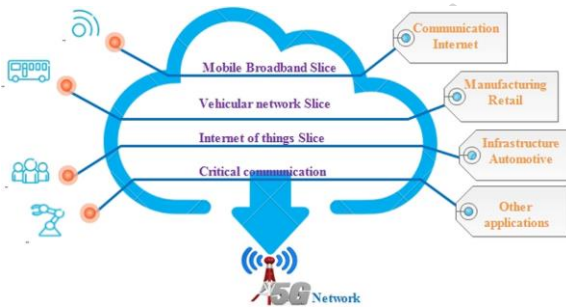


Standalone 5G

Core is 5G
RAN is 5G

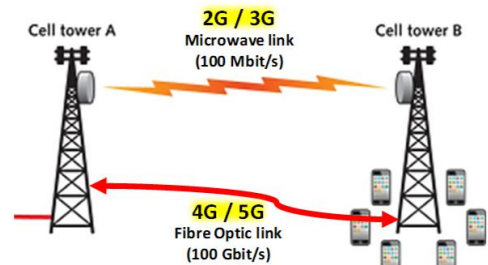
Network Slicing

Creating multiple virtual networks on the same physical network



Fiberization

Connecting mobile towers with each other by optical fibre cables



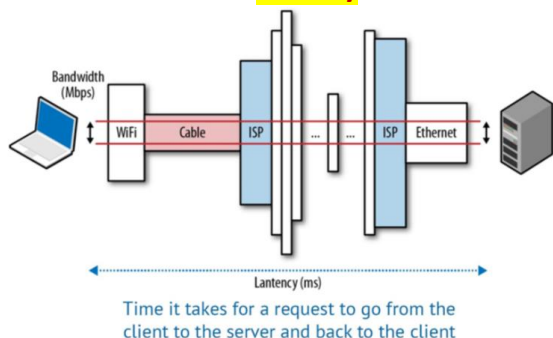
Indigenous 5G testbed

- Launched in 2022
- Funded by DoT.
- Stakeholders can test 5G in a small area to develop 5G technologies.

5G hackathon

- A competition organised by DoT in 2020, to develop uses of 5G in various fields like health, education, agritech, livestock, etc.

Latency



eSIM



Physical SIM

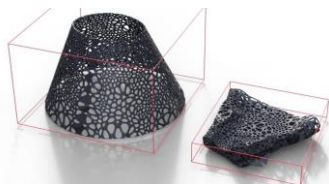
Embedded SIM

Subscriber Identity Module

Physical SIM	Embedded SIM
It can be removed	It cannot be removed
It can use only one operator	It can use multiple carriers/telcos
To change operator, buy new sim	Operator can be changed online

Jio, Airtel, Vi offers eSIM

4D printing



It is a 3D printed object which changes its shape in response to change in environment (light, temperature, moisture, pressure, electricity, pH, etc)

Crypto

- Blockchain platforms (Bitcoin, Ethereum, etc) use a consensus mechanism to verify transactions
- Proof of Work and Proof of Stake are two types of consensus mechanisms

Proof of work

- Validators solve complex problem, which consumes lot of energy.
- Rewards are give for mining and validating, in the form of bitcoins.
- [Bitcoin](#) uses Proof of Work

Proof of stake

- Validators put their crypto as collateral to validate a transaction. Consumes much less energy.
- It does not offer coin rewards. Therefore validators take some transaction fees
- [Ethereum](#) started using Proof of Stake in 2022

Extended Reality

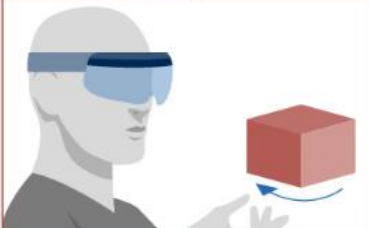
single term for AR, MR, VR

(Augmented Reality)



Real objects/surroundings are augmented by virtual images

(Mixed Reality)



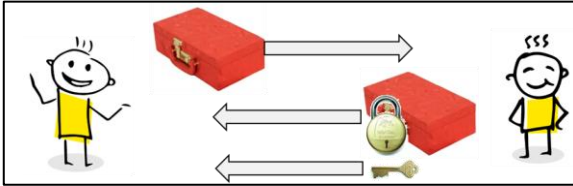
User interacts with virtual elements integrated into real environment

(Virtual Reality)



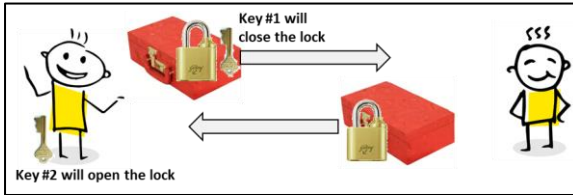
Digital environment is created, separate from real world

Encryption



Symmetric encryption

- There is a single key to close and open the lock
- "B" will close the lock.
- "B" will send the key to "A"



Asymmetric encryption

- There are two different keys
- Key #1 closes the lock. It's called as Public key
- Key #2 opens the lock. It's called Private key

Cryptojacking

hacking a computer to mine cryptocurrencies against user's will



Cyber security

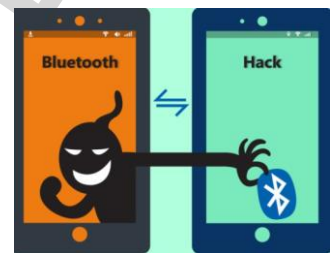
Juice jacking



Blue jacking

Blue snarfing

Blue bugging



Artificial Intelligence

ChatGPT by OpenAI

'Chat' → chatbot

'GPT' → Generative Pre-trained Transformer (a type of large language model)

Bard by Google

It is based on LaMDA

Language Model for Dialogue Applications

Turing test

- Proposed by Alan Turing in 1950
- It is a test of a machine's ability to show intelligent behaviour like a human being

Chatbot

- It uses AI and natural language processing (NLP) to understand customer questions and automatically give responses to them
- Google Assistant, Amazon Alexa, Apple's Siri

India Stack

India stack was started in 2023? No

- 2009 Aadhaar
- 2013 DBT
- and so on...

BIRTH OF 'INDIA STACK'

TRIGGER

Aadhaar, India's unique identification programme

BY-PRODUCTS

Direct benefit transfer (DBT): Aadhaar-enabled payment services

eKYC: Paperless know-your-customer process

eSign: Open API-based electronic signature service

Digilocker: For storing digital documents electronically

UPI: Digital money transfer using mobile phones

Data Empowerment and

Payment Infrastructure (DEPA): Sharing of data with adequate control

WORK IN PROGRESS

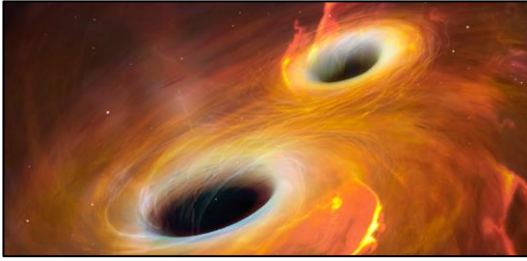
OCEN or Open Credit Enablement Network: For instant loan approval

Digital Health Mission: Creating framework for Electronic Health Record

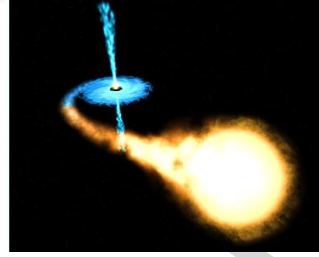
- It is a set of open APIs and digital public goods
- Its components are owned and maintained by different agencies. For example:
 - Aadhaar products such as e-auth and e-KYC are owned by UIDAI
 - eSign is maintained by Ministry of Communications and Information Technology.
 - Digilocker is owned by the Ministry of Electronics and Information Technology.
 - Account Aggregator framework is regulated by RBI
 - UPI is owned by NPCI

Binary Black Hole

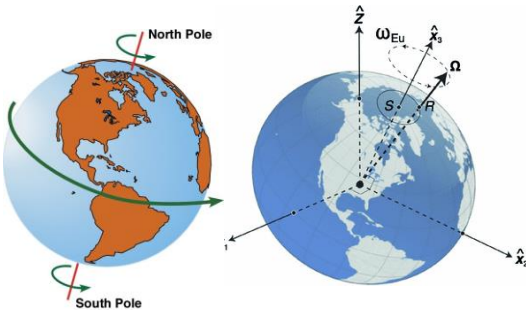
Two black holes in close orbit around each other



Tidal disruption event



- It happens when a star comes close to a black hole
- Black hole's tidal force (gravity) pulls apart the star
- The star experiences spaghettification (stretching)

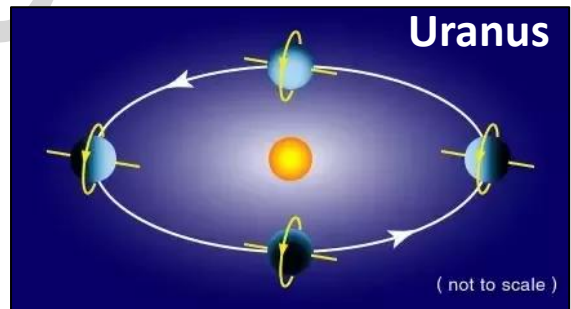
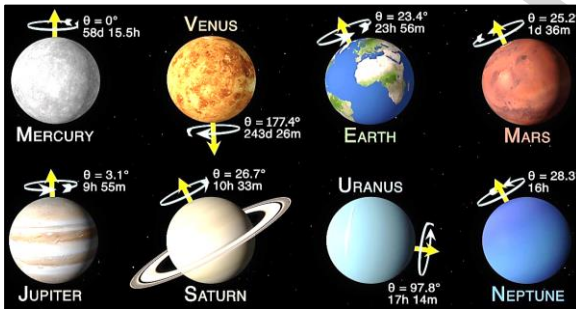


Chandler Wobble

Chandler Wobble

- It is a small deviation in a planet's axis of rotation
- It is the repeated movement of poles away from axis of rotation.
- Imbalance happens because planets don't have perfect spherical shape.

Tilt of Planets



Miscellaneous

2Africa Pearls

- **subsea cable** which connects Africa, Europe, and Asia

Global Lighthouse Network

- It is an initiative of WEF with McKinsey
- It is a community of companies showing leadership in **4th Industrial revolution technologies**

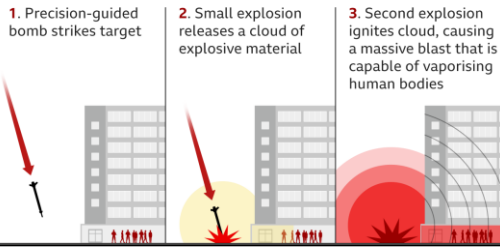
iNCOVACC

- World's first **intranasal** COVID-19 vaccine developed by Bharat Biotech

I read I forget, I see I remember | See explanation of this PDF on [YouTube](https://www.youtube.com/c/allinclusiveias) www.youtube.com/c/allinclusiveias

Thermobaric Bomb

How thermobaric weapons work



Thermobaric bomb

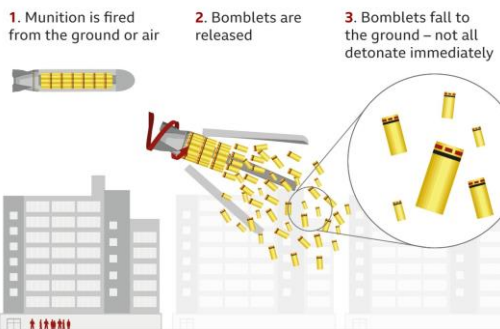
- aka aerosol bomb / vacuum bomb
- It uses oxygen from surrounding air to generate a high-temperature explosion.
- It is almost 100% fuel. Hence it has more energy than conventional explosives of equal weight.

Example:

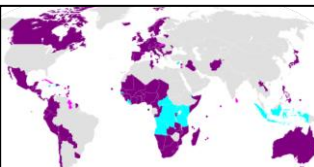
- Russia's 'Father of All Bombs'
- USA's Massive Ordnance Air Blast (Mother Of All Bombs)
- They are probably the most powerful conventional (non-nuclear) weapon in the world

Cluster Bomb

How cluster bombs work



- It spreads numerous small bombs over a large area
- It is banned under Convention on Cluster Munitions



Convention on Cluster Munitions

- 2008 : signed in Dublin, Ireland
- 2010 : It became binding international law on ratifying states
- India, China, Russia, USA, etc have not joined it
- 123 states have joined it

Cluster bombing aka saturation bombing

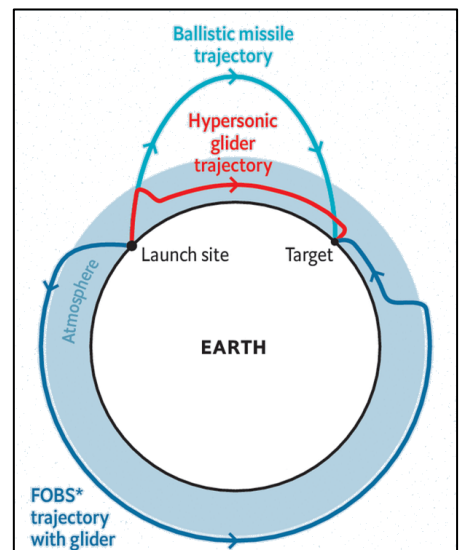
- It means bombing in every part of a selected area
- Cluster bombs makes it easy to do carpet bombing



FOBS

Fractional Orbital Bombardment System

- It is a warhead delivery system that uses a low earth orbit
- Just before reaching the target, it deorbits into the atmosphere
- It can carry both nuclear and conventional warheads
- It has unlimited range





MIRV

Multiple independently targetable re-entry vehicle

- It is an exo-atmospheric ballistic missile payload
- It has several warheads, each of which can be aimed to hit a different target.
- It is generally designed to deliver multiple nuclear warheads using a single intercontinental ballistic missile
- Only US, UK, France, Russia, China and India currently have deployed MIRV missile systems.
- India has it in Agni-P (confirmed) and Agni-V (suspected)

Jupiter ICy moons Explorer

- It is not NASA mission
- It is a mission of European Space Agency (ESA)
- It was launched in April 2023 from French Guiana
- It will explore Jupiter and three of its icy moons (Ganymede, Callisto, Europa)
- It will reach Jupiter in 2031 after four gravity assists (gravitational slingshot)

Juice mission







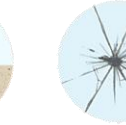



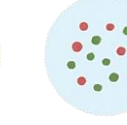











SOFIA



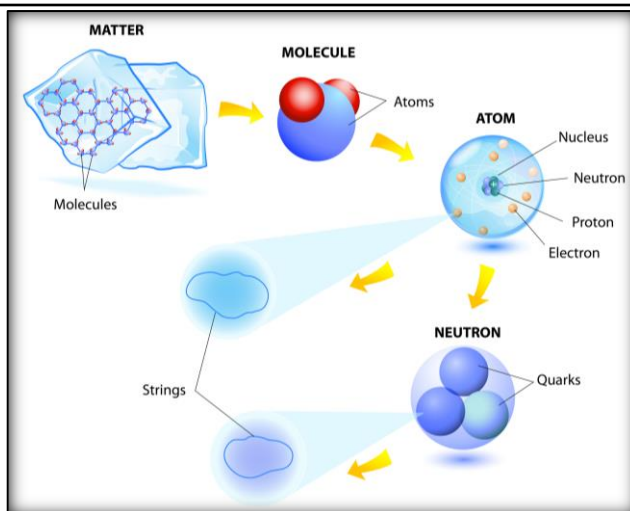
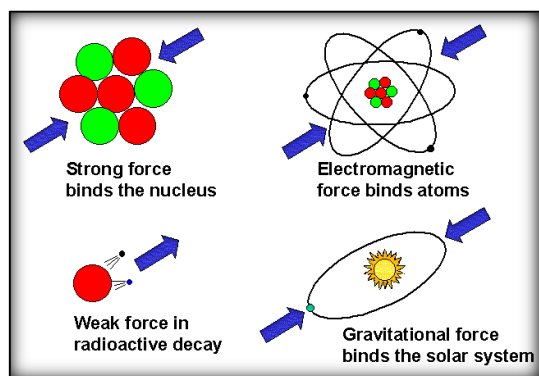
Stratospheric Observatory For Infrared Astronomy

- ❑ It was successor of Kuiper Airborne Observatory
- ❑ 2.7-meter reflecting telescope was fitted in Boeing 747
- ❑ It flew at 12-13 km altitude, i.e. in stratosphere
- ❑ By doing so, it avoided 99% of water vapour (because water vapour absorbs infrared)
- ❑ It was a NASA-Germany project (2010-2022) to observe infrared universe

Physical vs Chemical change

 Crushing a can	 Melting an ice cube	 Boiling water	 Mixing sand with water	 Breaking glass
Physical change				
 Dissolving sugar in water	 Shredding paper	 Chopping wood	 Mixing green and red marbles	 Sublimation of dry ice
 Iron Rusting	 Burning Wood	 Metabolism	 Cooking an Egg	 Baking a Cake
Chemical change				
 Electroplating	 Rotting Banana	 Vinegar and Baking Soda Mixture	 Fireworks	 Chemical Battery

Fundamental Forces

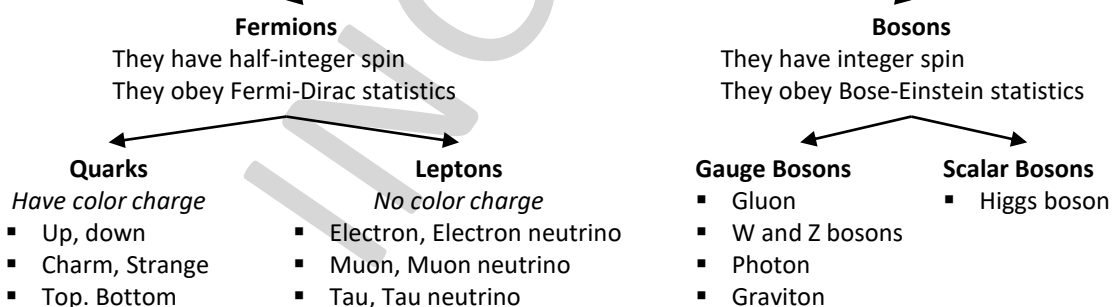


	Strong force	Weak force	Electromagnetic force	Gravitational force
Importance	It binds nucleus	It causes radioactivity	It binds atoms	It binds universe
Range	short	short	infinite	Infinite
Strength	#1 (Strongest)	#3	#2	#4 (Weakest)
Experienced by	Quarks & gluons	Quarks & Leptons	all particles with charge	all particles with mass
Force carrier	Gluon	W and Z Bosons	Photon	Graviton (unconfirmed)

Elementary particle / fundamental particle

- It is a subatomic particle that is not composed of other particles.
- All elementary particles are either bosons or fermions.

Elementary particles



Standard Model of particle physics

- It does
 - Classify all known elementary particles
 - Describe 3 of 4 fundamental forces (excluding gravity)
- It does not
 - fully explain baryon asymmetry
 - incorporate the full theory of gravitation as described by general relativity
 - account for universe's accelerating expansion as possibly described by dark energy

I read I forget, I see I remember | See explanation of this PDF on [YouTube](https://www.youtube.com/c/allinclusiveias) www.youtube.com/c/allinclusiveias

String theory

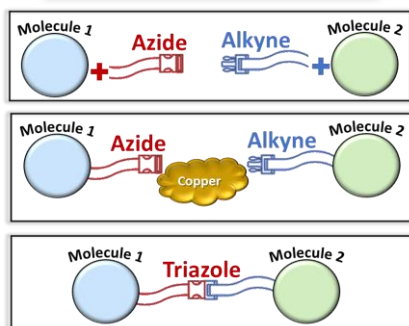
- It replaces particles of particle physics by one-dimensional objects called strings
- It is a theory of quantum gravity (It describes gravity as per quantum mechanics)
- It explains graviton

Muons

<https://indianexpress.com/article/explained/explained-sci-tech/scientists-outer-space-particles-xian-city-fortress-muons-8423710/>

- They are subatomic particles raining from space.
- They are created when particles in Earth's atmosphere collide with cosmic rays.
- They resemble electrons but are 207 times as massive. Hence aka "fat electrons".
- Muon tomography or muography: It is used to scan large structures
- Muons can penetrate hundreds of metres of stone surfaces

Click Chemistry



Nobel Prize in Chemistry 2022 was awarded jointly to

- Carolyn R. Bertozzi, Morten Meldal, K. Barry Sharpless
- for development of click chemistry and bio-orthogonal chemistry

Click Chemistry

- Reactions occur quickly and unwanted by-products are avoided.
- It can be used to bond molecules which normally do not bond

Bio-orthogonal chemistry

- Chemical reaction that can occur inside living organisms without interfering with native biochemical processes
- It is like applying the concept of click chemistry to living organisms



Anti-freeze

- It is an additive which **lowers the freezing point** of a water-based liquid.
- It is used in some automobile engines (Internal combustion engines), and also in some Air conditioners and solar water heaters.
- Most famous example: ethylene glycol

Prelims 1997

Which one of the following is used as an anti-freeze for the automobile engines ?

- (a) Propyl alcohol (b) Ethanol (c) Methanol (d) **Ethylene glycol**

bl.

bl. PREMIUM

European Commission
brings ethylene oxide under
pesticide residue
classification

Updated - April 13, 2023 at 10:05 PM.

Ethylene oxide

- It is a colourless and flammable gas with a sweet odour.
- It is carcinogen
- Uses: as pesticide in agriculture, disinfection of food products, sterilize medical tools, make anti-freeze, etc.

Genetic Engineering

GEAC Genetic Engineering Appraisal Committee

- functions under [MoEFCC](#)
- statutory body under [EPA 1986](#)
- Its clearance is mandatory for environmental release of GM crops.
- [Chaired](#) by Special/Additional Secretary of [MoEFCC](#)
- [Co-chaired](#) by a representative from [Dept of Biotech](#) (Ministry of Science)

FINANCIAL EXPRESS
Read to Lead

Illegal variety occupies about a fifth of GM cotton seed market

Since its introduction two decades ago, Bt cotton has led to a dramatic rise in India's cotton yield and thereby, production (see chart), but over the last two-three years, the yield has come down marginally.

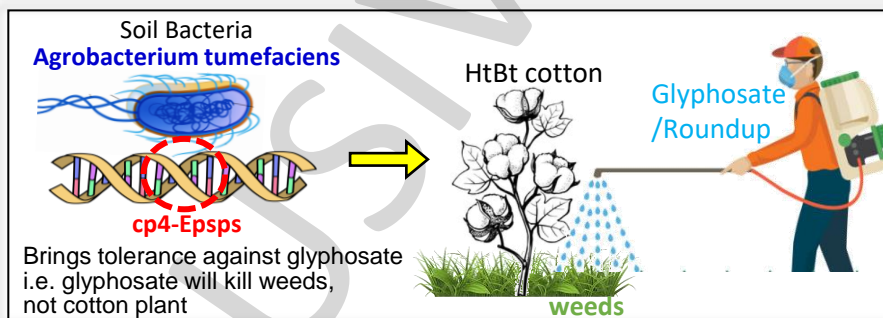
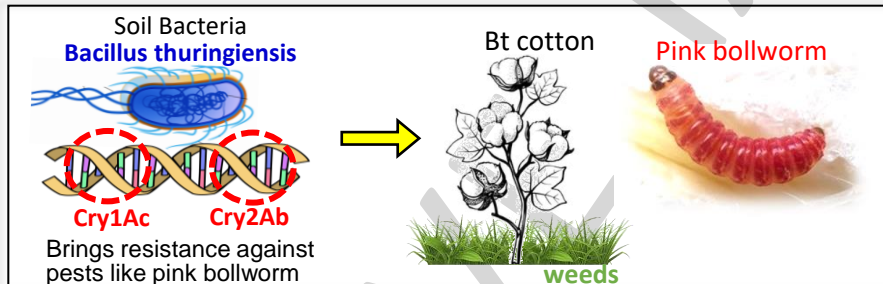
Written by Sandip Das
June 1, 2022 6:00:00 am

Between 2002-2014, yield rose 167%, but fell in last few years.

Bayer (Monsanto) has also developed herbicide tolerant version.

GEAC has not approved it.

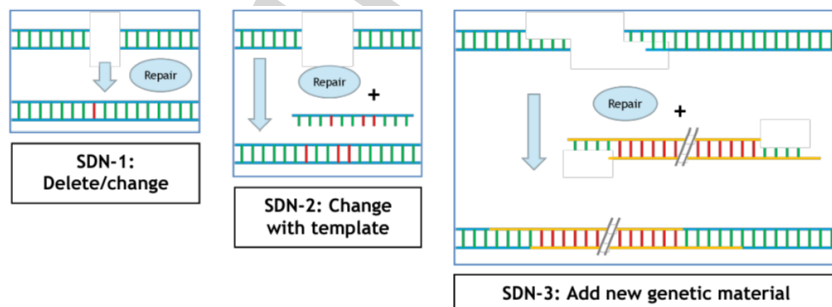
Farmers are illegally using it, to reduce costs.



Important Terms

Gene silencing	reduce expression of the gene in genome
Gene knockout	complete elimination of the gene from genome
Nucleic acid	DNA, RNA
Nuclease	Enzymes that degrades nucleic acid
SDN	Site Directed Nuclease

Students are advised to see PT365 2021 and 2022 science classes for more info on Genome / DNA / RNA



Three SDN technologies

- ❑ Meganucleases
- ❑ **Zinc-Finger Nucleases (ZFNs)**
- ❑ **Transcription Activator Like Effector Nucleases (TALENs)**

Three SDN techniques

SDN-1: create a break → cell naturally repairs itself

SDN-2: create a break → supply template → cell naturally repairs itself

SDN-3: create a break → supply foreign DNA → cell naturally repairs itself

Norms eased for genetically modified crop research

The guidelines circumvent challenges of using foreign genes to change crops profile

May 20, 2022 08:26 pm | Updated May 21, 2022 01:06 pm IST - NEW DELHI

SDN-1 & SDN-2:

Foreign DNA is not added
GEAC approval is not needed

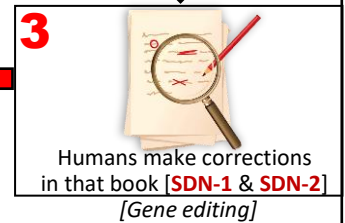
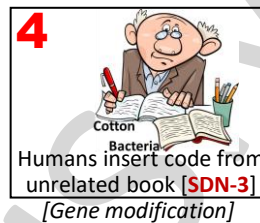
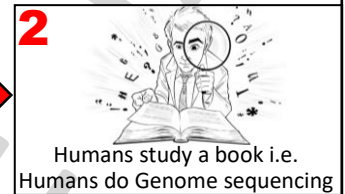
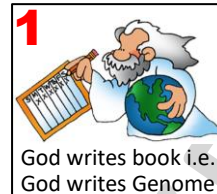
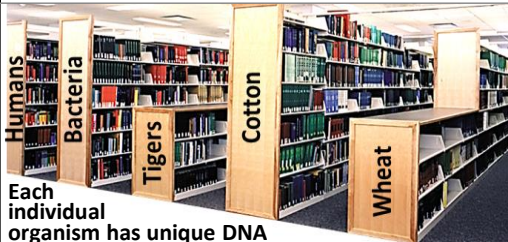
SDN-3:

Foreign DNA is added
GEAC approval is needed

Note:

Since SDN-1 & SDN-2 don't have exogenous (foreign) DNA, they are comparable to naturally occurring variants (or mutants obtainable through conventional mutagenesis).

Let's understand the concept



- ❑ Step-1 happens naturally
- ❑ Step-2 no harm as we are only studying
- ❑ Step-3 no harm as we are only correcting mistakes that God might have done while copying code from parents
- ❑ Step-4 risky as humans act like God and combine codes that God never did

Explained: What is genome editing technology and how is it different from GM technology?

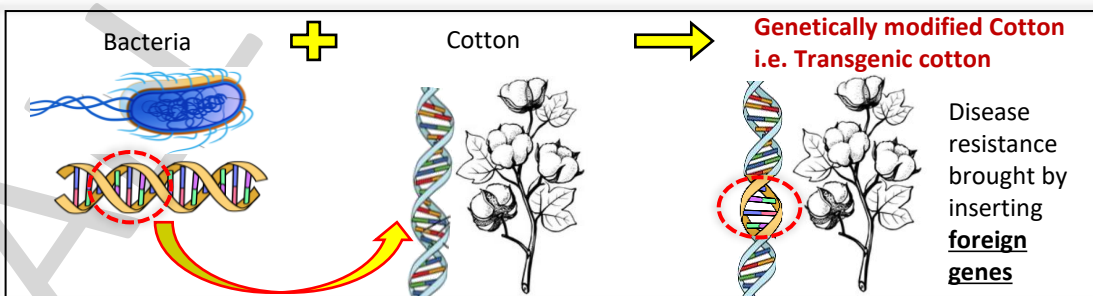
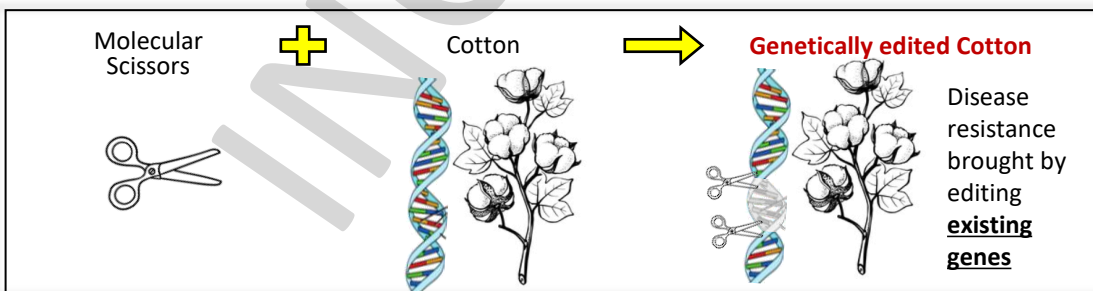
The Centre has paved the way for easy introduction of genome edited crops. What is genome editing and how is it different from genetically modified crops?

Genome editing: SDN-1, SDN-2

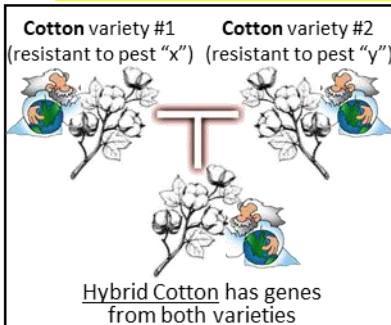
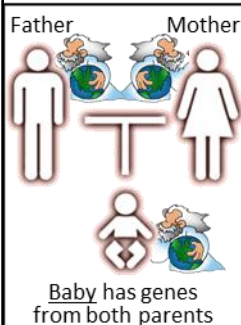
Genome modification: SDN-3

Advice: For exam purpose please consider, 'genome editing' and 'genome modification' same, unless the question specifically requires differentiation.

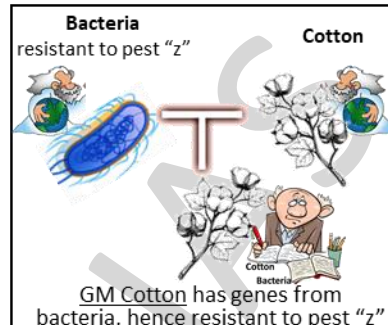
Both **Bt cotton** and **HtBt cotton** are genetically modified.
Genetically edited cotton is shown here just to explain the concept.



Why genetic engineering is needed



Hybridization can combine two varieties of cotton

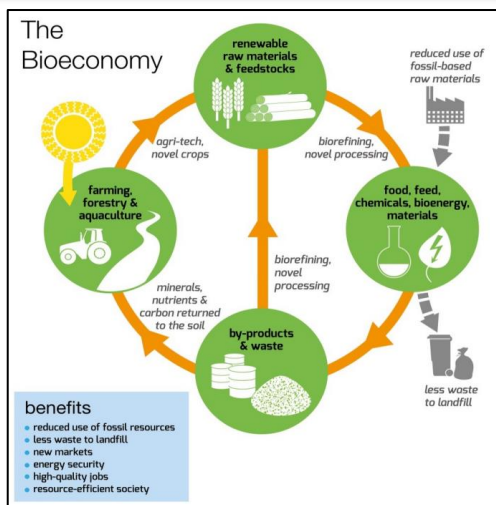


But to combine bacteria & cotton, Genetic engineering is needed.

Did you know? Sonalika, Kalyan Sona, Himgiri, Atlas 66, Karan Vandana are some hybrid wheats. Benefits:

Biofortified: High protein, iron, etc.

Disease Resistance: heat, yellow rust, wheat blast, etc.



Biobased economy

- aka bioeconomy or biotechnology
- use of biomass and biotechnology to produce goods and services

Vaccine

Misinformation



100 crore doses

1st China (19-06-2021)

2nd India (21-10-2021)

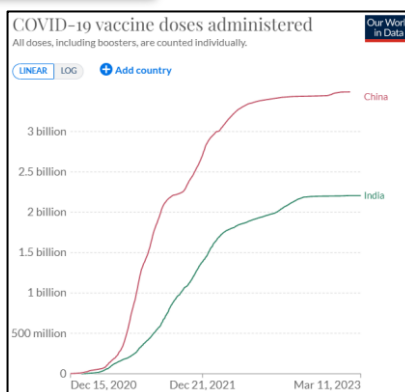
200 crore doses

1st China (28-08-2021)

2nd India (19-07-2022)

300 crore doses

1st China (05-02-2022)



<https://www.thehindu.com/news/webqoo-f/india-first-country-to-administer-one-billion-covid-vaccine-doses-fact-check#read-more>










Country rank by population (March 2023)

#1 - China 142 crore

#2 - India 141 crore

#3 - USA 34 crore

Some diseases

Tomato Virus		<ul style="list-style-type: none"> <input type="checkbox"/> Red rashes and fever, usually in children below 5 year age <input type="checkbox"/> Caused by virus
Human Papilloma Virus		<ul style="list-style-type: none"> <input type="checkbox"/> It causes cervical cancer in women <input type="checkbox"/> Cervical cancer is 2nd most prevalent cancers in India <input checked="" type="checkbox"/> Cervavac is India's first indigenously developed vaccine
Epstein-Barr Virus		<ul style="list-style-type: none"> <input type="checkbox"/> It is a type of herpes virus <input type="checkbox"/> It spreads mainly through saliva <input type="checkbox"/> It remains latent (inactive) in body <input type="checkbox"/> It is very common, and usually causes no symptoms
Zombie Virus		<ul style="list-style-type: none"> <input type="checkbox"/> Informal name given to ancient viruses released due to melting of ice in polar areas
Mpox Virus		<ul style="list-style-type: none"> <input type="checkbox"/> Mpox (earlier known as monkeypox) <input type="checkbox"/> Its symptoms are similar to smallpox, but less severe. <input type="checkbox"/> While smallpox was eradicated in 1980, mpox continues. <input type="checkbox"/> It is a zoonotic disease (spreads from animals to humans) <input type="checkbox"/> It also spreads from human to human through respiratory droplets, body fluids, lesions on the skin, etc.
African Swine Virus		<ul style="list-style-type: none"> <input type="checkbox"/> Recently reported in India <input type="checkbox"/> Almost 100% fatality <input type="checkbox"/> It is not zoonotic
Capripox virus / Neethling virus / Poxviridae		<ul style="list-style-type: none"> <input type="checkbox"/> It causes sheeppox, goatpox, lumpy skin disease <input type="checkbox"/> Lumpi-ProVac is the vaccine developed by ICAR <input type="checkbox"/> It is not a zoonotic disease
Canine Distemper Virus		<ul style="list-style-type: none"> <input type="checkbox"/> It affects dogs, fox, lions, etc. <input type="checkbox"/> Vaccine exists, but there is no treatment <input type="checkbox"/> In 2013, SC ordered relocation to Kuno NP in MP. Not done. <input type="checkbox"/> In 2018-20, more than 100 lions died due to Canine distemper virus
White spot syndrome virus		<ul style="list-style-type: none"> <input type="checkbox"/> It impacts crustaceans (crab, lobster, shrimp, krill, copepod, etc) <input type="checkbox"/> It has high fatality rate, sometimes wiping out entire shrimp farms



Shigellosis

- It is caused by Shigella bacteria (related to E. coli)
- it is a major cause of **diarrhea**, especially in children in Asia and Africa



Encephalitis

- It is inflammation of brain.
- Reason can be virus, bacteria, fungi, parasites, autoimmune diseases, certain medications, etc.

PEN-PLUS Strategy

- Package of Essential Noncommunicable
- It is a WHO strategy against non-communicable diseases
- It addresses severe Non-Communicable Diseases at First-Level Referral Health Facilities.
- Noncommunicable diseases (NCDs), including heart disease, stroke, cancer, diabetes and chronic lung disease, are collectively responsible for 74% of all deaths worldwide



Cardiovascular Diseases



Chronic Respiratory Diseases

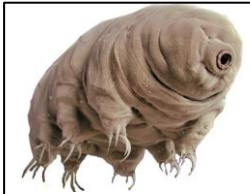


Diabetes



Cancer

Animal dormancy



Less than 1 mm long !

Cryptobiosis / Anabiosis

- State of extreme inactivity due to adverse environment
- All measurable metabolic processes stop
- Tardigrades (water bear) can remain like this for even 30 years
- They have even survived in outer space



Hibernation

- state of minimal activity, mostly during winter
- Metabolism slows down (breathing, heart-rate, temperature)
- Bears, snakes, frogs, rodents, bats, etc

Aestivation

- similar to hibernation, but it happens in summer
- snails, earthworms, frogs, crocodiles, etc

Cold & Warm blooded



Cold blooded animals don't have internal mechanism to regulate body temperature



Warm blooded animals have internal mechanism to regulate body temperature

Rice Fortification

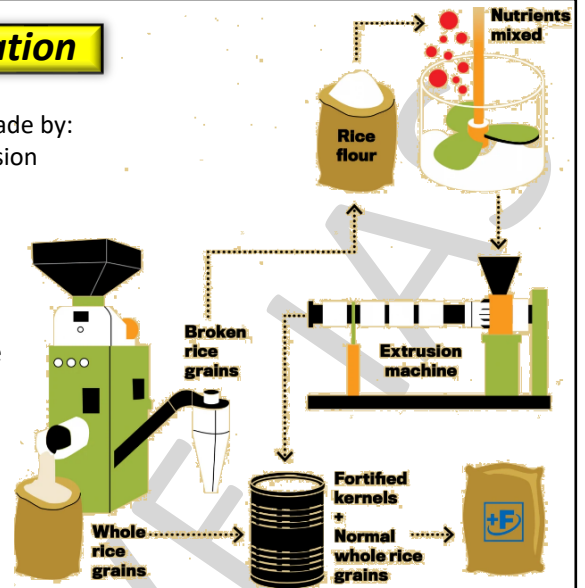
Fortified rice can be made by: coating, dusting, extrusion

Extrusion:

- Rice **grains** are ground to make rice **flour**
- Rice flour is mixed with **micronutrients** and water
- Extruder machine **creates** Fortified rice kernels (**FRKs**)
- FRKs are **blended with regular rice** to create fortified rice

As per ministry guidelines:

- length and breadth of FRK should be **5 mm** and **2.2 mm** respectively.
- **10 g** of FRK must be blended with **1 kg** of regular rice.
- Fortified rice will be packed with logo '+F' and the line "Fortified with Iron, Folic Acid, and Vitamin B12".



Parboiled Rice

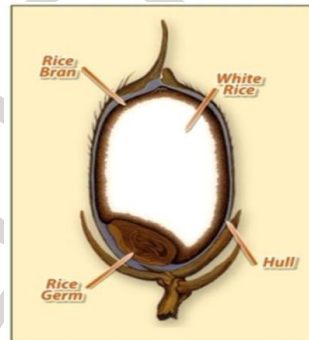
Parboiled rice / converted rice / easy-cook rice

Rice that has been partially boiled in the husk.

Benefits:

- Rice becomes easier to process by hand
- Rice becomes resistant to weevils (pests)
- Rice becomes more nutritious

Nutrients (like thiamine) move from bran to the endosperm



- **Hull or Husk** – tough protective outer coat
- **Bran** – 2nd outer layer, contains fiber and minerals
- **Endosperm (white rice)** – mostly starch, food for embryo
- **Germ** – embryo, contains oils, vitamins and minerals

Nixtamalization



Nixtamalization

- Maize is soaked and cooked in an alkaline solution, usually limewater
- It increases nutritional and reduces mycotoxins (e.g. aflatoxins)
- It was first done in Mesoamerica (central America) in 1500 BC



Mycotoxins

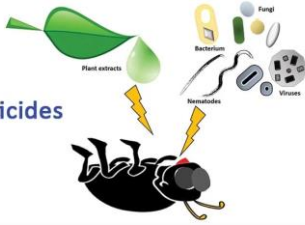
- Maize may develop Mycotoxins
- Mycotoxins are naturally occurring toxins
- They are produced by certain moulds (fungi) in food
- Moulds grow on cereals, nuts, spices, etc in hot and humid conditions



Chlorosis

- Maize may get Chlorosis due to Zinc deficiency
- Chlorosis happens due to lack of chlorophyll
- Green leaves become yellow or white

Biopesticides



Bio-pesticides

Biopesticides

- pesticides derived from natural materials like plant, animal, virus, bacteria, fungi, protozoan, certain minerals.
- e.g. *Bacillus thuringiensis*, canola oil, baking soda

Bio-fertilizers

- micro organisms which help plants to absorb more nutrients
- They usually colonise the rhizosphere or interior of the plant

Some types of bio-fertilizer

- Bacterial Biofertilizers:** e.g. *Rhizobium*, *Azospirillum*, *Azotobacter*, *Phosphobacteria*
- Algal Biofertilizers:** e.g. Blue Green Algae (BGA) and *Azolla*
- Actinomycetes Biofertilizer:** e.g. *Frankia*
- Fungal Biofertilizers:** e.g. *Mycorrhiza*

Prelims 2013 Consider the following:

1. *Agaricus* 2. *Nostoc* 3. *Spirogyra*

Which of the above are used as bio-fertilizer?

- (a) 1 and 2 only **(b) 2 only** (c) 2 and 3 only (d) 3 only



Agaricus

- genus of mushrooms containing both edible and poisonous species



Nostoc (star jelly)

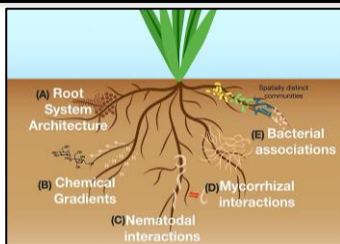
- It is a type of Cyanobacteria (blue-green algae)
- It grows symbiotically within the tissues of plants, giving nitrogen to the plant



Spirogyra (water silk)

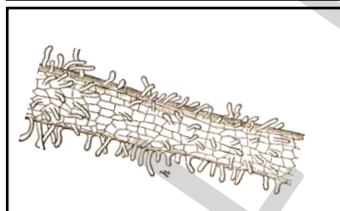
- It is a type of green algae
- It is commonly found in freshwater

Rhizosphere



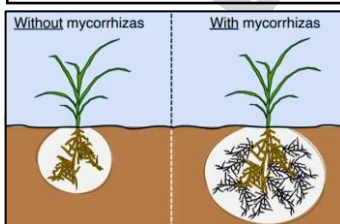
Rhizosphere

- It is a zone of soil surrounding the roots
- It is directly influenced by roots and microorganisms



Root hair

- They improve water absorption by increasing surface area
- They improve nutrient absorption as they are the main interface between plant and mycorrhizal fungi
- If they are damaged (by digging, transplantation, etc), plant growth will be affected.



Mycorrhiza

- symbiotic association between fungus and plant.
- Plant makes organic molecules (such as sugar) by photosynthesis and gives them to fungus
- Fungus takes water and nutrients (such as phosphorus) from soil and gives it them to plant

I read I forget, I see I remember

See explanation of this PDF on www.youtube.com/c/allinclusiveias

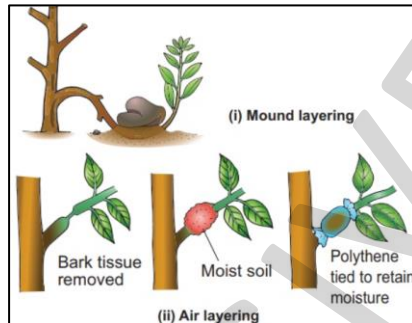
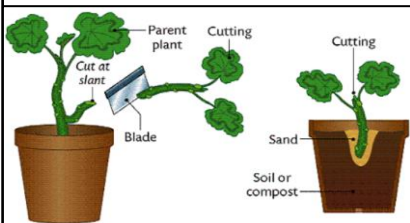
Vegetative propagation

Asexual reproduction: offspring is genetically identical to parent (provided that there is no mutation)

Sexual reproduction: offspring is genetically different from other offspring and parents

Vegetative reproduction

- It is a type of asexual reproduction.
- Offspring is clone of parent.
- It inherits parent's traits, disease, etc
- Generally, it can be done in all seasons.



Stem cutting

- A piece of stem is placed in moist soil.
- It will grow into a new plant.
- Used for sugarcane, grapes, cocoa.

Layering

- Stem, when still attached to the plant, will form roots, on coming in contact with a rooting medium.
- Air layering is aka Gootee
- Used for strawberry, raspberry, jasmine.

Grafting

- Tissues of plants are joined.
- Upper part is called scion
- Lower part is called root-stock
- Vascular tissues must grow together (inosculation)
- Used for Orange

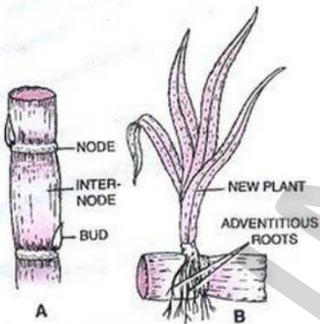


Fig. 1.21. A, a portion of sugarcane stem having buds. B, a bud growing into new plant.

Prelims 2020

With reference to the current trends in the cultivation of sugarcane in India, consider the following statements:

1. A substantial saving in seed material is made when 'bud chip settlings' are raised in a nursery and transplanted in the main field.
2. When direct planting of seeds is done, the germination percentage is better with single-budded setts as compared to setts with many buds.
3. If bad weather conditions prevail when seeds are directly planted, single-budded seeds have better survival as compared to large setts.
4. Sugarcane can be cultivated using settlings prepared from tissue culture.

Which of the statements given above is/are correct?

- (a) 1 and 2 only (b) 3 only **(c) 1 and 4 only** (d) 2, 3 and 4 only