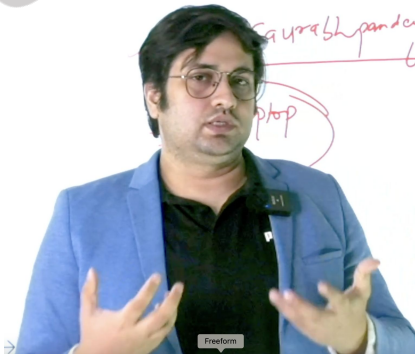
Topics - MINDS MAPS included

- CRISPR AND AGRICULTURE
- Van Allen radiation belts.
- Section 83 of the Patent Act
- Animation, Visual Effects, Gaming, and Comics Extended Reality (AVGC-XR) Policy
- Mapping - Palermo
- Mains



By saurabh Pandey

THE HINDU

Target Mains -2024/25 -

Q ‘’CRISPR Cas 9 technology will transform agriculture ‘’ Discuss

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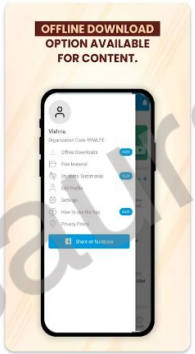

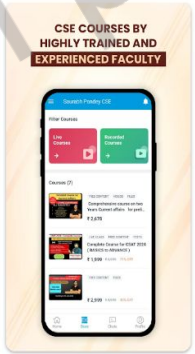

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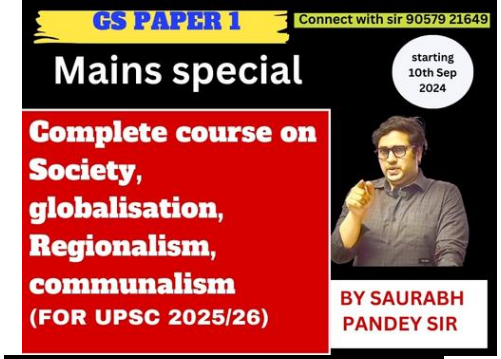

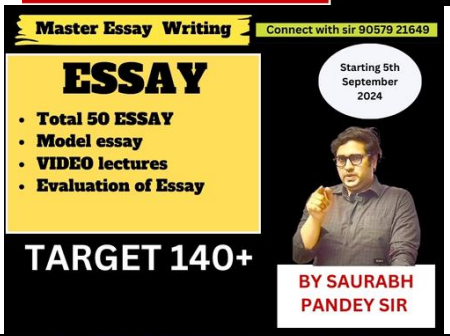

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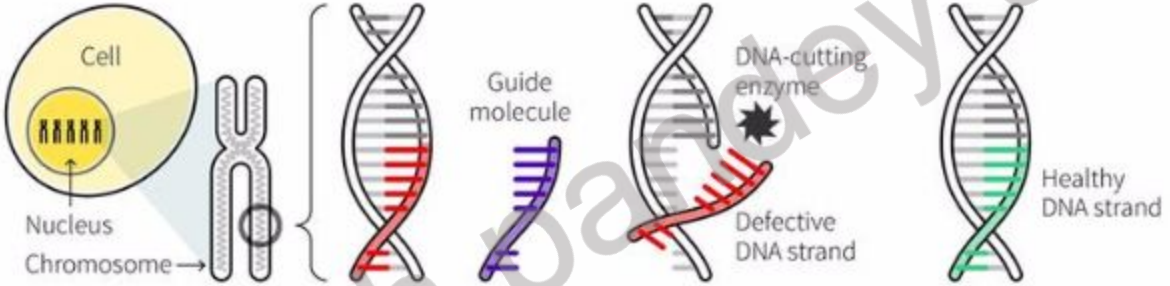
Topic- CRISPR AND AGRICULTURE

- CRISPR holds the potential to revolutionise agriculture in particular by allowing agricultural scientists to increase crop yields and improve resistance to disease and anomalous weather through gene-editing.
- a commonly used form of the CRISPR system is too big for plant genomes.
- This system uses one of two proteins, Cas9 or Cas12, to target specific parts of the DNA. But they are too bulky for plant cells to accommodate.
- plant genome editor consisting of a protein called ISDra2TnpB, derived from bacteria called *Deinococcus radiodurans* (famous for being able to survive extreme environmental conditions).
- ISDra2TnpB is less than half the size of Cas9 and Cas12

DNA editing

A DNA editing technique, called CRISPR/Cas9, works like a biological version of a word-processing programme's "find and replace" function.

HOW THE TECHNIQUE WORKS



A cell is transfected with an enzyme complex containing:
- Guide molecule
- Healthy DNA copy
- DNA-cutting enzyme

A specially designed synthetic guide molecule finds the target DNA strand.

An enzyme cuts off the target DNA strand.

The defective DNA strand is replaced with a healthy copy.

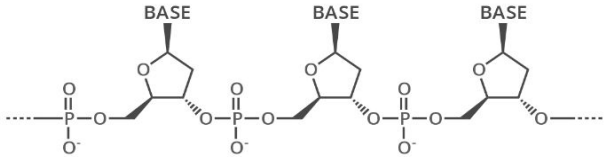
Sources: Reuters; Nature; Massachusetts Institute of Technology

- They reported developing a plant genome editor consisting of a protein called ISDra2TnpB, derived from bacteria called Deinococcus radiodurans (famous for being able to survive extreme environmental conditions). ISDra2TnpB is less than half the size of Cas9 and Cas12.
- “Currently, there are not many options available for plant genome editors, the improved TnpB certainly adds value.
- One should utilise the advantage of the size of TnpB in generating edited plants for various traits of interest,”.

TnpB's editing chops

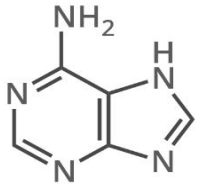
- TnpB is a protein made up of around 400 amino acid units (different combinations of the 20 amino acids make up all proteins). It belongs to a family of transposable elements, or transposons. Sometimes called "jumping genes", transposons are parts of a genome that can move from one location to another.
- The genome consists of two strands of DNA bonded to each other. Each strand is made up of building blocks called nucleotides.
- In turn, each nucleotide has three pieces; two are common to all of them whereas the identity of the third one can be one of four options: adenine (A), thymine (T), cytosine (C) or guanine (G).
- The DNA's 'sequence' refers to the order in which nucleotides containing these four compounds are arranged.

The sugar-phosphate backbone

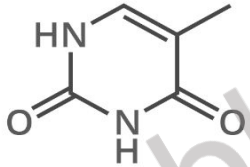


DNA is a polymer made up of units called nucleotides. The nucleotides are made of three different components: a sugar group, a phosphate group, and a base. There are four different bases: adenine, thymine, guanine and cytosine.

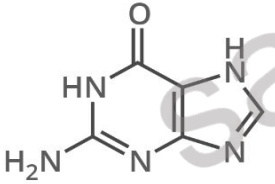
A Adenine



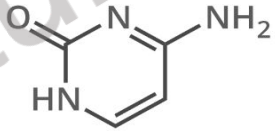
T Thymine



G Guanine

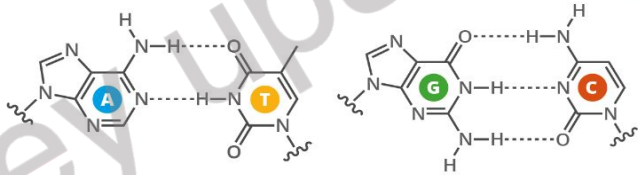


C Cytosine



What holds DNA strands together?

DNA strands are held together by hydrogen bonds between bases on adjacent strands. Adenine (A) always pairs with thymine (T), while guanine (G) always pairs with cytosine (C). Adenine pairs with uracil (U) in RNA.



From DNA to proteins

The bases on a single strand of DNA act as a code. The letters form three letter codons, which code for amino acids - the building blocks of proteins.

DNA → (Transcription) → RNA → (Translation) → Protein

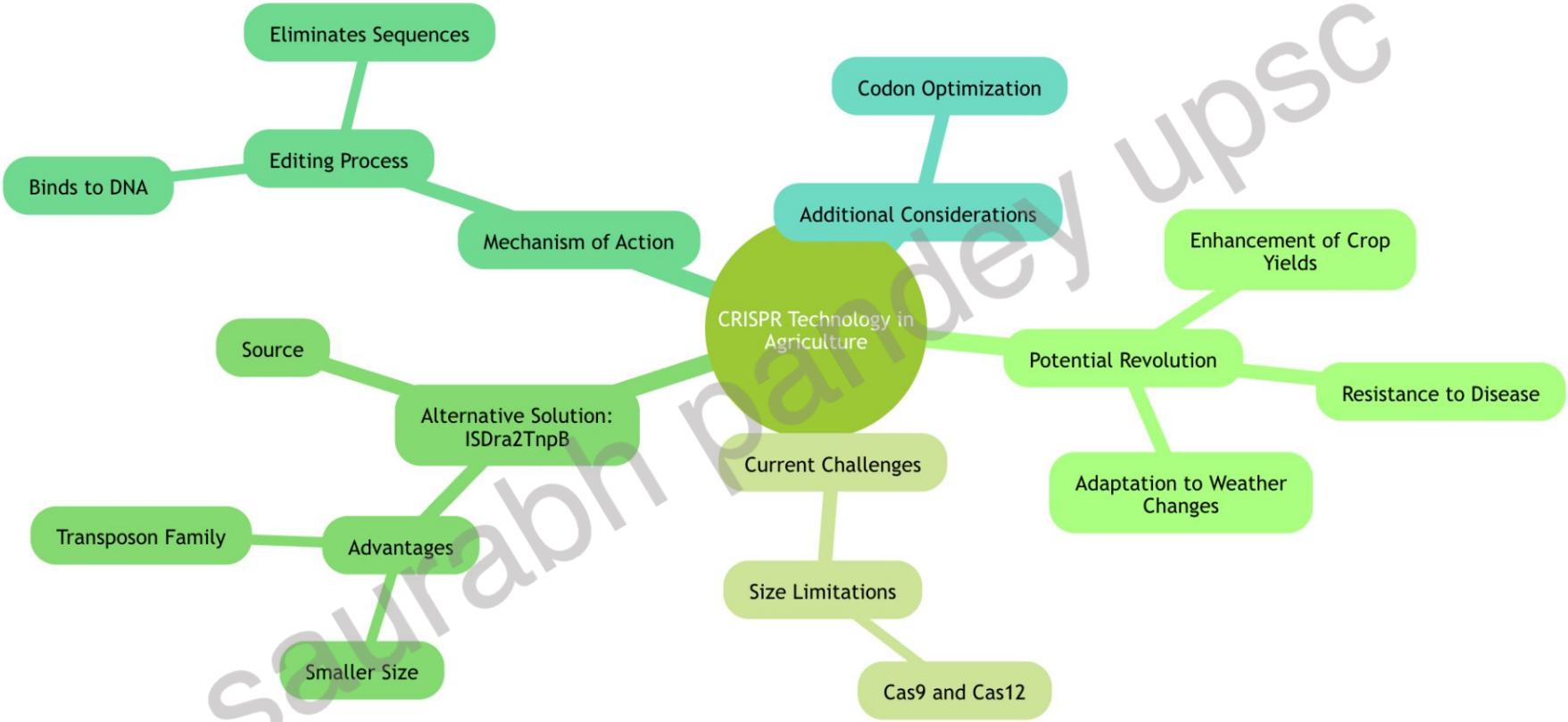
An enzyme, RNA polymerase, transcribes DNA into mRNA (messenger ribonucleic acid). It splits apart the two strands that form the double helix, then reads a strand and copies the sequence of nucleotides. The only difference between the RNA and the original DNA is that in the place of thymine (T), another base with a similar structure is used: uracil (U).

DNA sequence	T	T	C	C	T	G	A	A	C	C	C	G	T	T	A
mRNA sequence	U	U	C	C	U	G	A	A	C	C	C	G	U	U	A
Amino acid	Phenylalanine		Leucine			Asparagine			Proline			Leucine			

In multicellular organisms, the mRNA carries genetic code out of the cell nucleus, to the cytoplasm. Here, protein synthesis takes place. 'Translation' is the process of turning the mRNA's 'code' into proteins. Molecules called ribosomes carry out this process, building up proteins from the amino acids coded for.

- In the new system, TnpB hitches a ride on a piece of RNA that guides it to the target DNA sequence. Once there the TnpB binds with the sequence and eliminates it.
- The cell that houses this DNA repairs the cut by restoring the “correct” sequence.
- Thus, the genome is modified to replace an undesirable sequence with a desirable one.

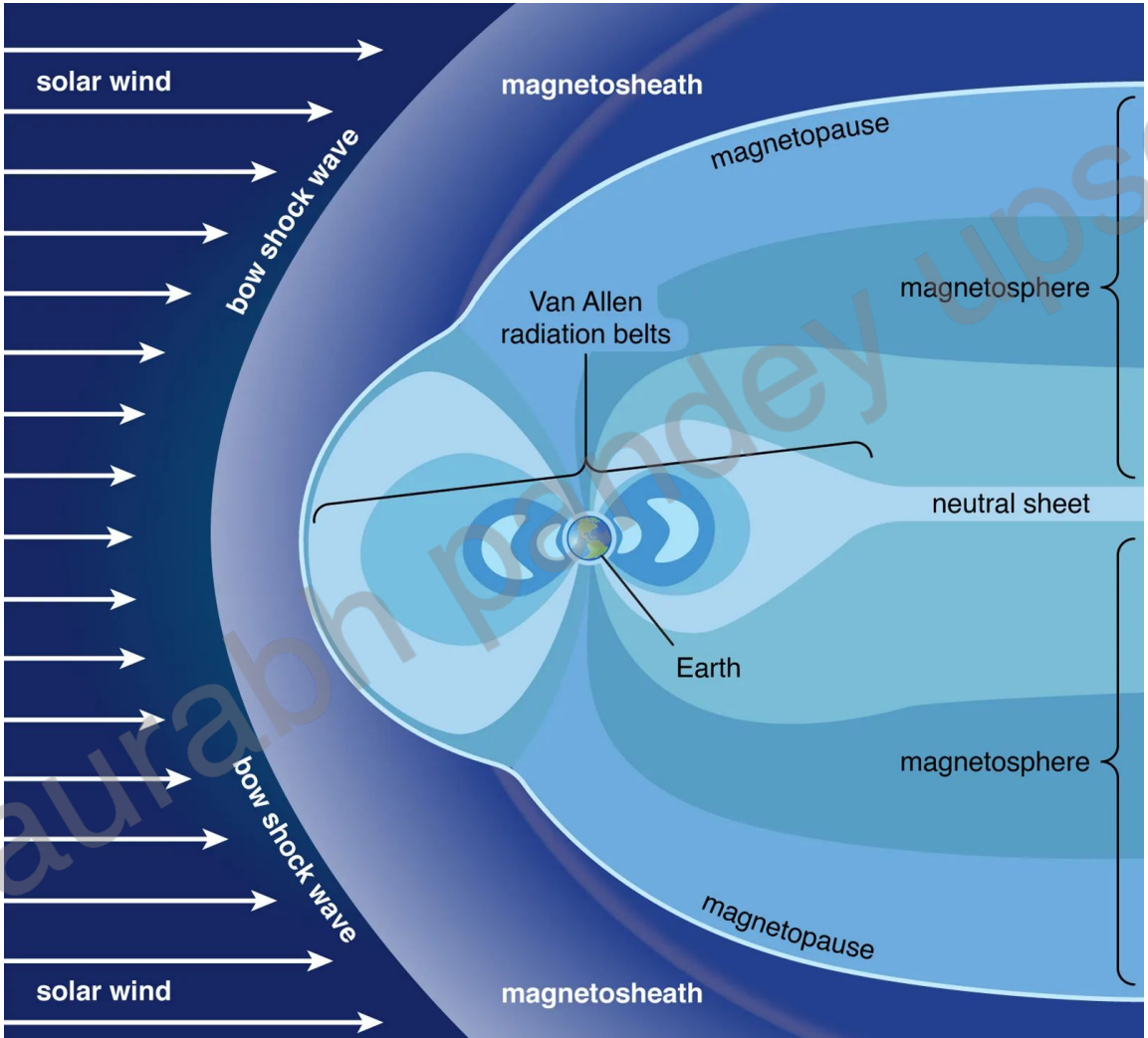
- First, they used a process called codon optimisation.
- For example, cells in the body make the amino acid lysine by following an instruction in the genome represented by a sequence of three nucleotides. Such sequences of three are called codons.
- The codon sequence that contains the recipe for lysine varies in different types of organisms. TnpB is a protein extracted from *D. radiodurans*, a prokaryotic bacteria, which has a different codon for lysine than do eukaryotes like plants



Topic- Van Allen radiation belts.

- The earth is surrounded by a bubble-shaped magnetic field that shields the planet from radiation from the Sun and other celestial objects. This field is called the earth's magnetosphere.
- During a solar storm, the Sun shoots out charged particles with more than usual energy through the space around it. Without the magnetosphere, these particles could have rendered life as we know it on earth impossible.
- But because the magnetosphere is there, these particles become trapped in it and zip around the earth rather than towards the ground in two large doughnut-shaped radiation belts in the upper atmosphere.
-

- **These are called the Van Allen radiation belts.**
- **The American astrophysicist James Van Allen discovered these belts in 1958 and studied them in detail**



- When lightning strikes, electrical energy flows in a path through the atmosphere that we see as a bolt.
- As it cuts through the air, the bolt releases its energy as electromagnetic waves with a range of frequencies.
- The earth's magnetic field can guide some of these waves up and into a layer of ionised gas above the atmosphere, where they travel along magnetic field lines — like a train moving on tracks — between the earth's northern and southern hemispheres.
- The higher the frequency of these waves, the faster they travel (even up to a tenth of the speed of light).
- The frequencies of these waves are often within the human hearing range (20–20,000 Hz) and can be heard as whistling noises through a receiver

- In a paper published in the journal *Science Advances* on August 16, scientists from the University of Alaska Fairbanks reported discovering a new type of whistler wave produced by a previously unknown wave generation mechanism.
- They found lightning energy injected into the ionosphere at low latitudes could get reflected like a light from a mirror into the magnetosphere.
- This contradicted previous claims that energy insertion at low latitudes can’t escape the ionosphere.

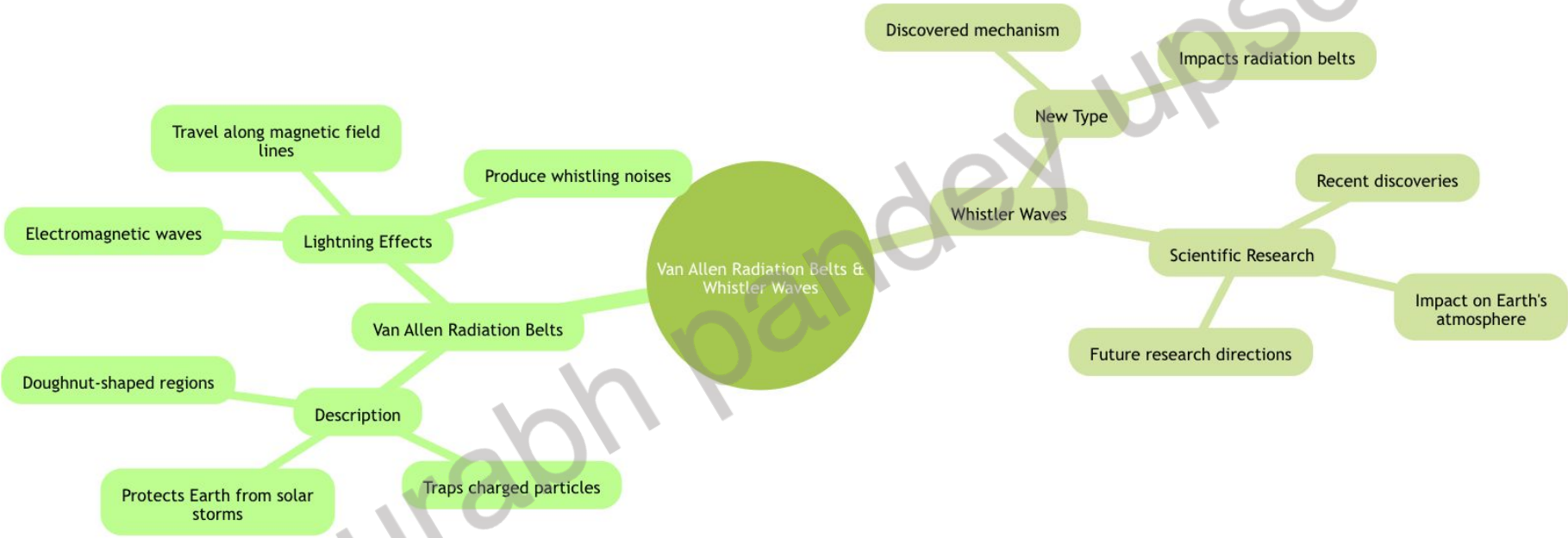


figure 1.2: table

Topic- Section 83 of the Patent Act

- Section 83 of the Patents Act states that “patents are granted to encourage inventions and to secure that the inventions are worked in India on a commercial scale and to the fullest extent that is reasonably practicable without undue delay” and that “they are not granted merely to enable patentees to enjoy a monopoly for the importation of the patented article”.
- It also states, “Patents are granted to make the benefit of the patented invention available at reasonably affordable prices to the public”.
- Substantive provisions enforce these key assertions, ensuring that while patent holders are guaranteed their rights under the Act, they cannot act in a manner that is prejudicial to the public interest.

- If a patented medicine is “not available to the public at a reasonably affordable price,” compulsory licences (CL) can be granted to any company willing to make the product in India. Issuing CL is the most effective remedy to ensure affordability of medicines but it was issued only once.
- This was when the originator company was charging nearly three lakh for a medicine. Using CL, an Indian company produced for ₹8,000.

- India’s Patents Act also permits the granting of government-use licences. Section 100 states, “patents granted do not in any way prohibit Central government in taking measures to protect public health”.
- Provisions under this section allow for the granting of government-use licences to enable domestic production of generic versions of patented medicines

Patent ACT 1970

Historical Background

- **Enactment of the Act: The Patents Act of 1970 was established to govern the patent system in India, replacing the Patents and Designs Act of 1911. It aimed to align India's patent laws with international standards and promote innovation and technological advancement.**
- **Objectives of the Act: The Act sought to encourage the development and protection of inventions, fostering economic growth and technological progress. It aimed to strike a balance between the interests of inventors, consumers, and the public at large.**
- **Scope and Applicability: The Act extends to the whole of India and applies to inventions in all fields of technology, providing a comprehensive legal framework for patent protection.**

Compulsory Licensing and Public Health

- **Access to Essential Medicines**: The Act incorporates provisions for compulsory licensing in cases of national emergency, extreme urgency, or public non-commercial use. It addresses public health concerns by ensuring access to affordable and essential medicines, particularly in situations of crisis.
- **Balancing Health and Innovation**: The Act strikes a balance between promoting innovation in the pharmaceutical sector and safeguarding public health interests. It provides flexibilities to address health emergencies while respecting the rights of patent holders.

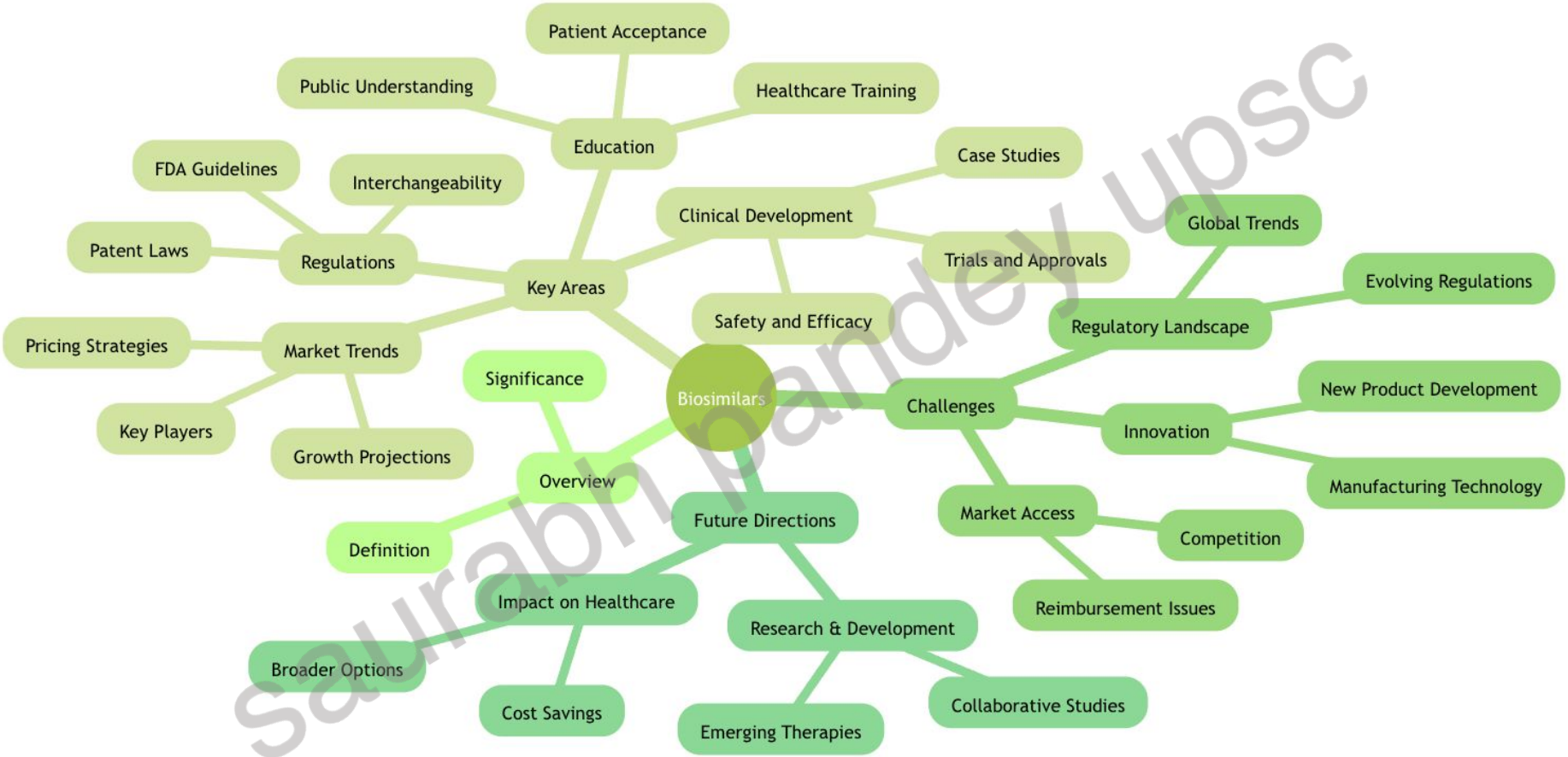
Biosimilar

Definition: (Biosimilars are biologic medical products highly similar to already approved reference products.)

Significance: (Lower costs, increased access to treatment.)

What are Biosimilars?

- **Definition and Characteristics**: Biosimilars are biological products that are highly similar to and have no clinically meaningful differences from an existing FDA-approved reference product. They are developed to be as safe and effective as the reference product, offering more affordable treatment options.
- **Regulatory Approval Process**: The approval of biosimilars involves rigorous testing to demonstrate similarity to the reference product in terms of structure, function, and clinical outcomes, ensuring patient safety and efficacy.
- **Patient Access and Affordability**: Biosimilars play a crucial role in expanding patient access to life-saving treatments by providing cost-effective alternatives to expensive biologic medication



Understanding Biologics

- **Biological Medicines**: Biologics are complex molecules derived from living cells or organisms, offering targeted and often life-changing treatments for various diseases, including cancer, autoimmune disorders, and chronic inflammatory conditions.

Topic-Animation, Visual Effects, Gaming, and Comics Extended Reality (AVGC-XR) Policy

Overview

The AVGC-XR policy aims to boost the animation, visual effects, gaming, and comics industries in India.

It focuses on enhancing the extended reality (XR) sector, integrating cutting-edge technologies and creative processes.

- Policy Implementation
- Economic Growth
- Technological Advancement
- Industry Collaboration

Key Components

Policy Goals

- **Boost industry growth** 📈
- **Create job opportunities** 👩‍🎨👨‍💻
- **Encourage innovation** 💡

Investment & Funding

- Government incentives 💰
- Support for startups 🚀
- Funding for research and development 🧪

Infrastructure Development

- Establishing industry hubs 🏢
- Improving technology access 💻
- Enhancing skill development programs 🎓

Stakeholder Engagement

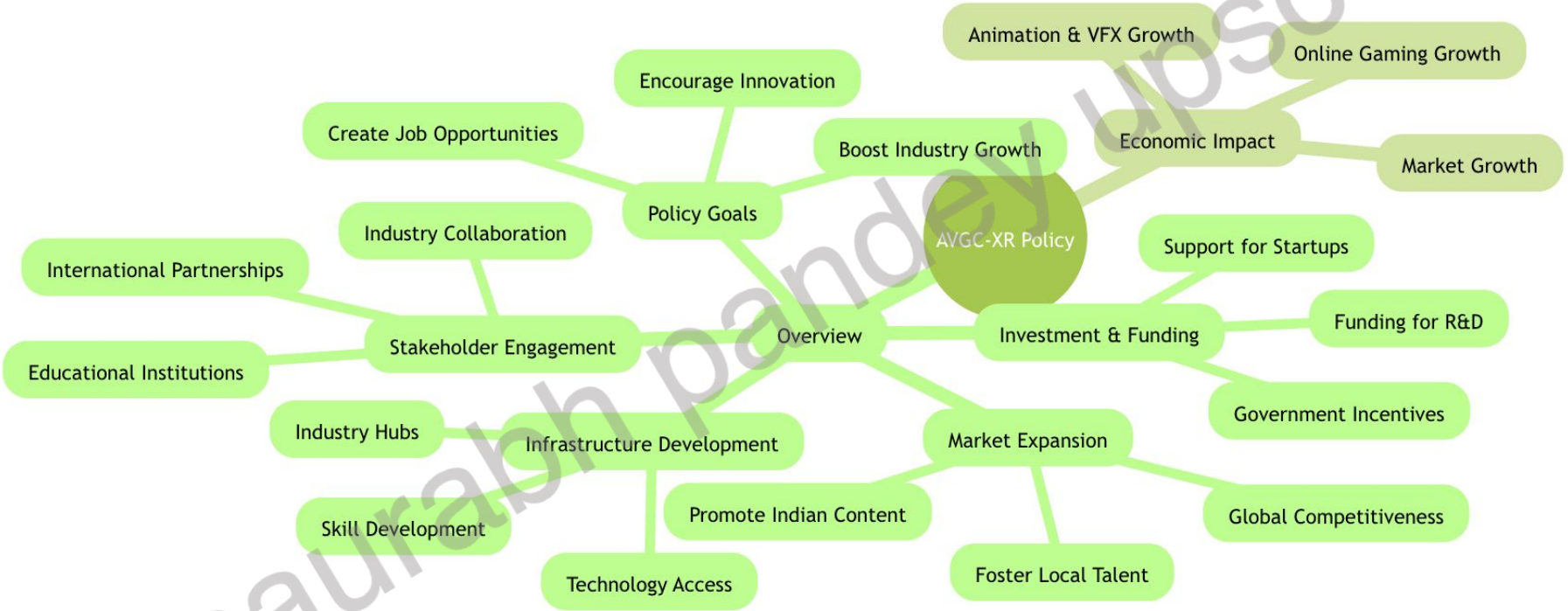
- Collaboration with industry leaders 🤝
- Involvement of educational institutions 📚
- Partnerships with international organizations 🌍

Market Expansion

- Increasing global competitiveness 🌐
- Promoting Indian content abroad 📺
- Fostering local talent 🌟

Economic Impact

Projected market growth to $26 billion by 2030 📊
Animation and VFX expected to reach $2.2 billion by 2026 💵
Online gaming market forecasted at $4.6 billion 🎮



Mapping

Overview of Palermo

Location: Southern Italy, capital of Sicily 🌍
Culture: Rich history, art, and architecture 🎨
Cuisine: Renowned for street food and local delicacies 🍕
Tourism: Popular tourist destination with historical sites and beaches 🏖️

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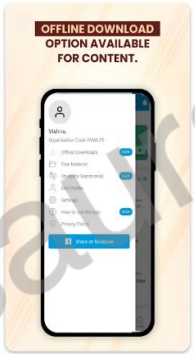

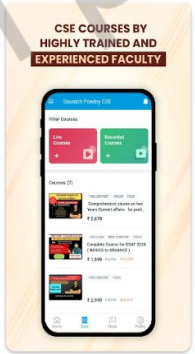

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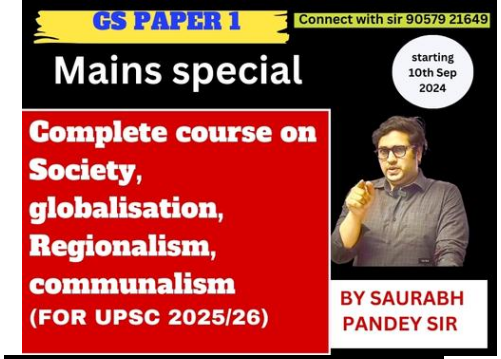

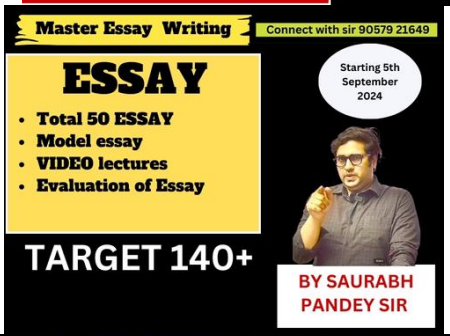

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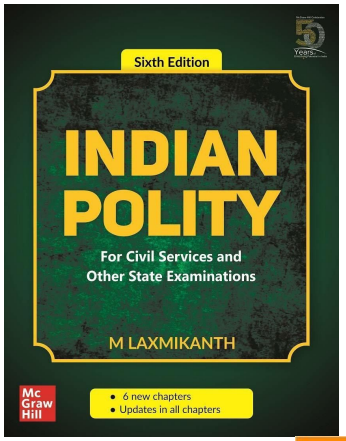

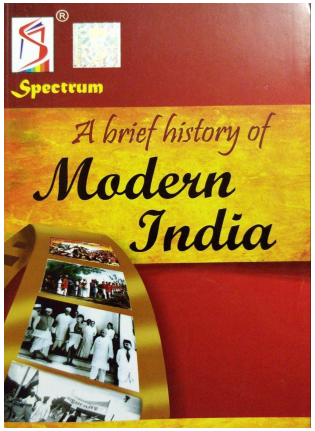

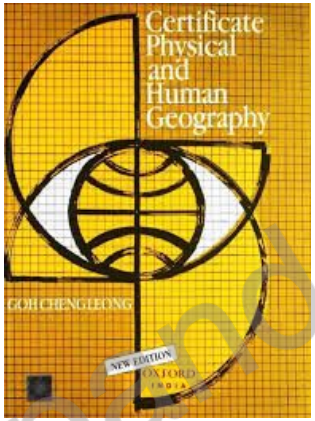

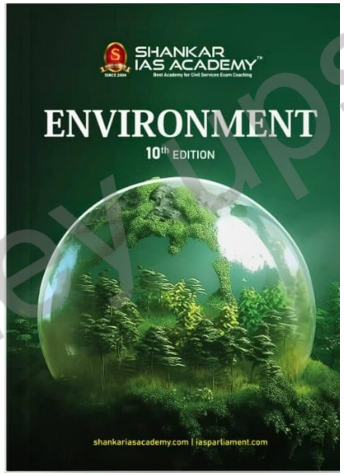

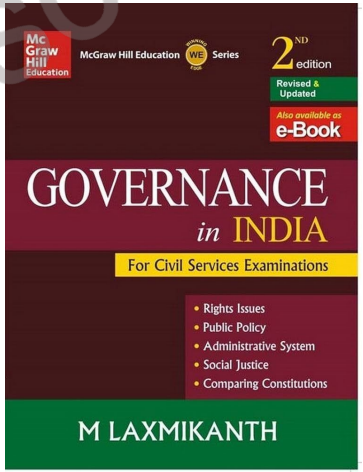

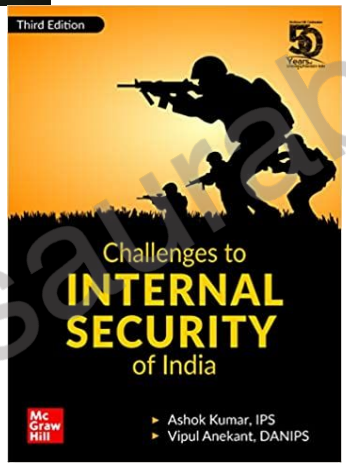

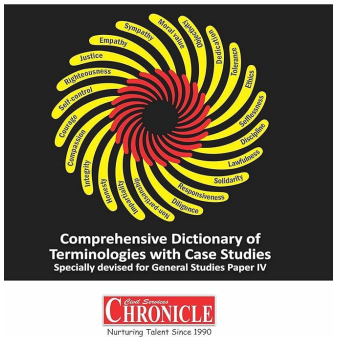

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