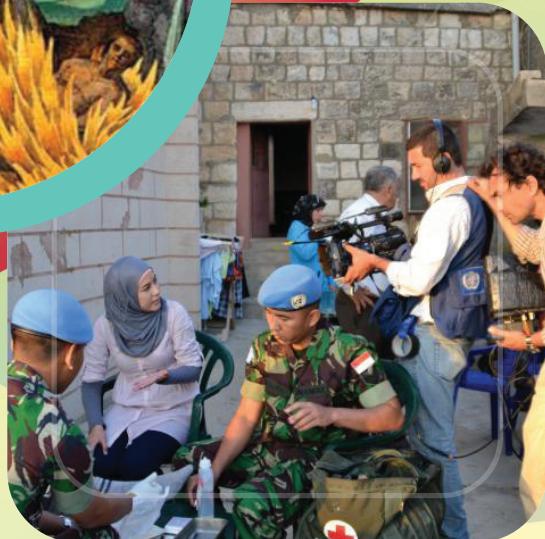


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2. Science and Technology

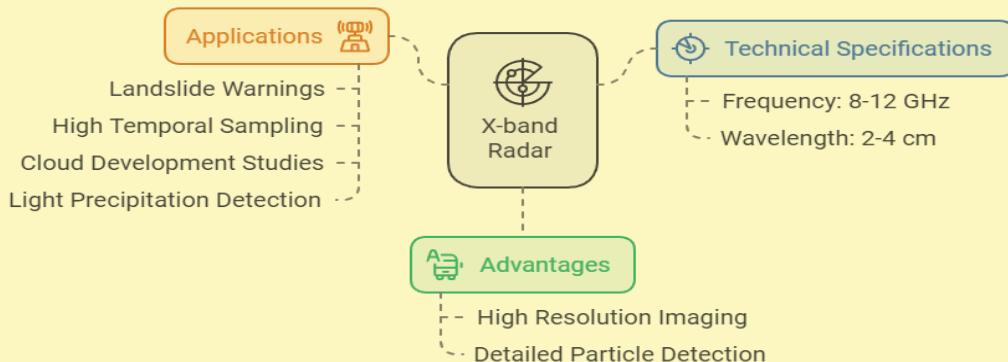
Wayanad new X band radar

Why in news?

After recent devastating floods and landslides in Kerala's Wayanad district, the Union Ministry of Earth Sciences approved an X-band radar to be installed in the district.

Key Facts

- Higher resolution images are produced due to the **shorter wavelengths** in the X-band.
- Attenuation increases with frequency, meaning the higher the frequency, the faster the radar signal is weakened or absorbed by the atmosphere or objects



Radar

- Radar** (radio detection and ranging) uses **radio waves** to measure **distance, velocity, and physical properties** of objects.
- A **transmitter** sends a signal, and the **receiver** analyzes the **reflected signal** from the object.
- Doppler radar** is used in meteorology to detect **weather patterns** using the **Doppler effect**, where wave frequency changes due to the object's motion.
- Doppler radars measure the **speed and direction** of clouds by analyzing changes in the reflected wave's frequency.
- Pulse-Doppler radars** assess the **intensity of precipitation** by emitting pulses and tracking the frequency of reflected signals.
- Doppler radars help **monitor weather**, predict **wind patterns**, and **anticipate storms**.

Previous Year Question

Consider the following activities:

- Identification of narcotics on passengers at airports or in aircraft
- Monitoring of precipitation
- Tracking the migration of animals

In how many of the above activities can the radars be used?

(a) Only one (b) Only two
 (c) All three (d) None

Answer: C

Dragon drones

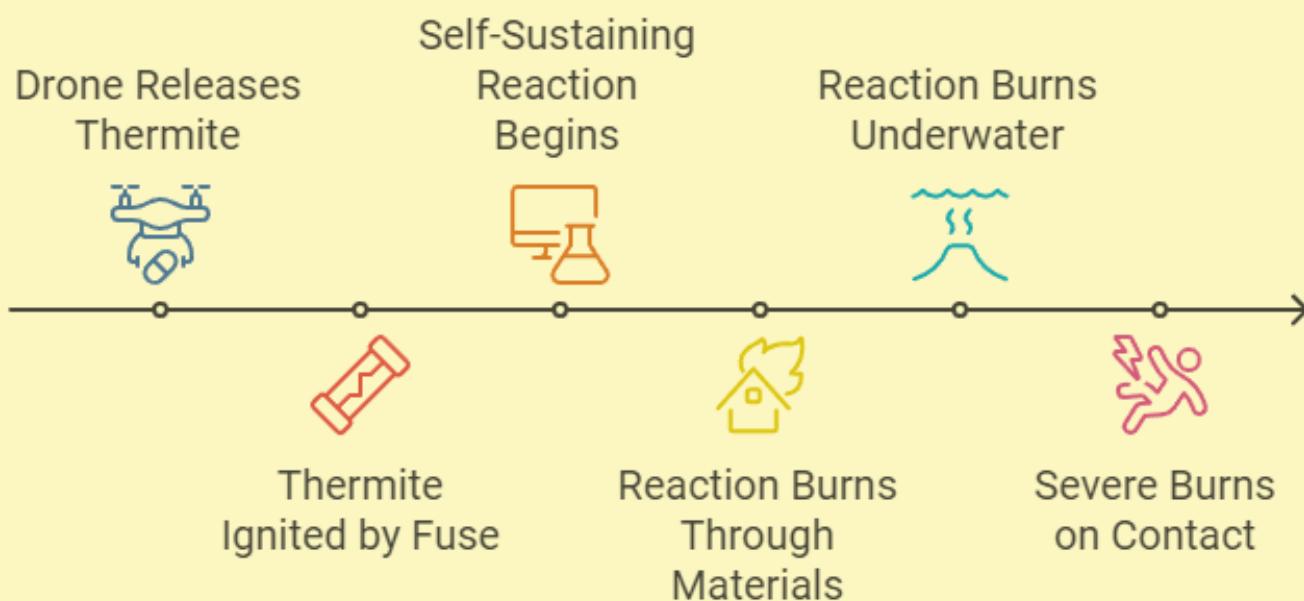
Why in news?

Dragon drones were recently deployed by both Russian and Ukrainian forces.

Key Facts

- Dragon drones release a substance known as **thermite**, a blend of **aluminum and iron oxide** that was originally developed over a century ago for **welding railroad tracks**.
- The use of thermite in warfare is **not banned by international law**.
- Targeting civilians with incendiary weapons like thermite is prohibited by the Convention on Certain Conventional Weapons (CCW).
- ✓ The CCW is a Cold War-era regulation established under the United Nations.

Thermite Reaction Sequence



Previous Year Question

What is "Terminal High Altitude Area Defense (THAAD)", sometimes seen in the news?

- An Israeli radar system
- India's indigenous anti-missile programme
- An American anti-missile system
- A defence collaboration between Japan and South Korea.

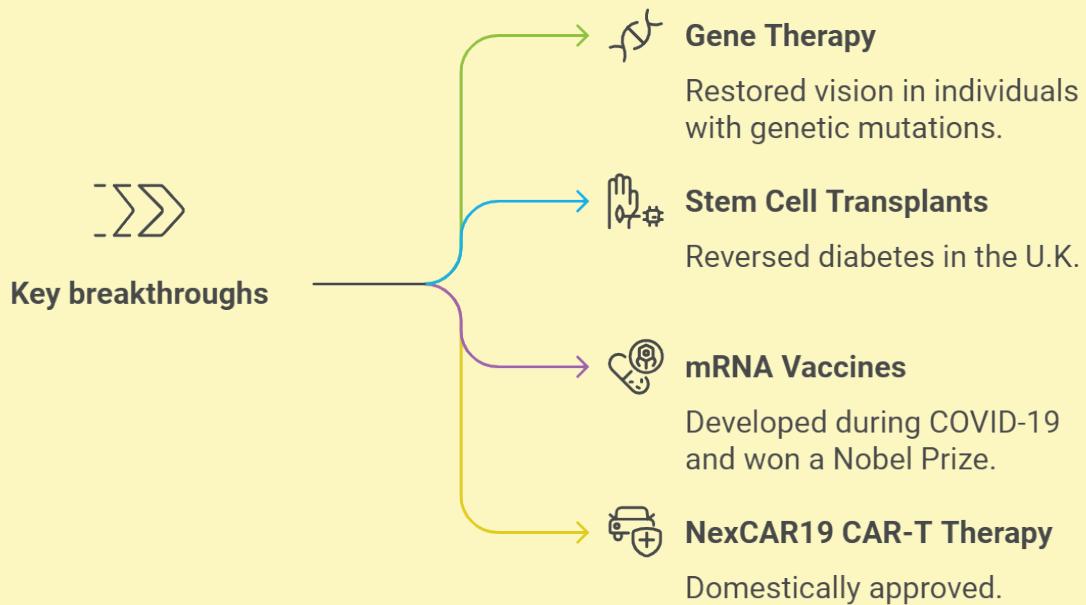
Answer: C

Precision Medicine and Biobanks

Why in news?

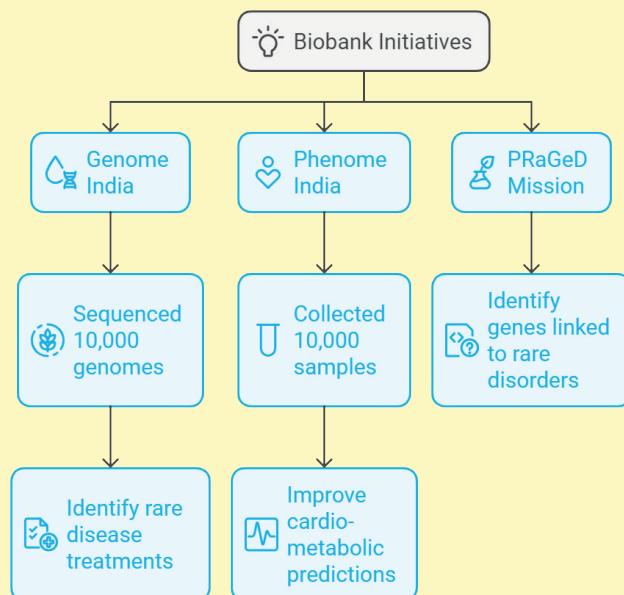
Key Facts

- Precision medicine offers personalized healthcare by leveraging genomic, gene-editing, and mRNA-based technologies.
- This method enables doctors and researchers to more accurately predict which treatment and prevention strategies will be effective for specific groups of people.

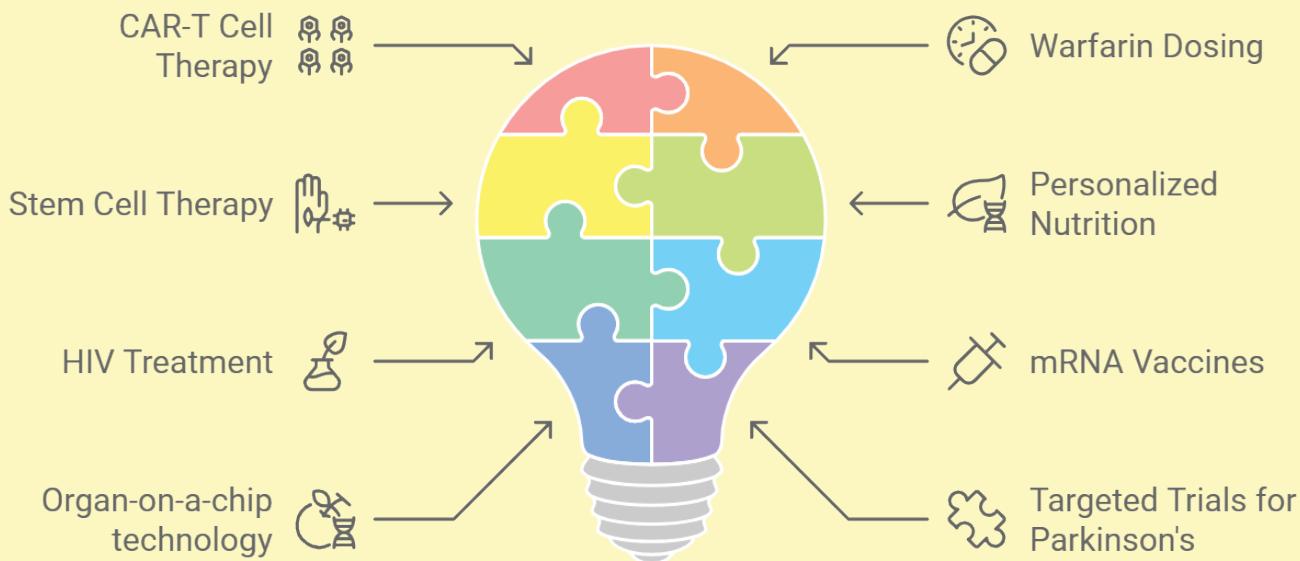


Biobanks

- Biobanks store biological samples (e.g., blood, DNA, tissues) along with genetic data for research purposes.
- Large and diverse biobanks are crucial for precision medicine.



Applications of Precision Medicine



Pharmacogenomics:

- Pharmacogenomics is a subfield of precision medicine.
- It studies how an individual's genes influence their response to drugs, ensuring medications are both effective and safe for people with different genetic makeups.
- It combines pharmacology (the study of drugs) and genomics (the study of genes) to help determine optimal drug types and dosages for each individual.

Previous Year Question

In the context of the developments in bioinformatics, the term transcriptome, sometimes seen in the news, refers to:

- A range of enzymes used in genome editing
- The full range of mRNA molecules expressed by an organism
- The description of the mechanism of gene expression
- A mechanism of genetic mutations taking place in cell

Answer: B

Ossification Test

Why in news?

Mumbai court ordered an ossification test to verify if a murder accused is a minor.

Key Facts

- Ossification is the Natural process of bone formation that continues until late adolescence.
- It helps determine the **approximate age of an individual**.
- It is not fully accurate due to individual variations in bone maturation.
- Ossification tests cannot override valid documentary evidence like Aadhaar or birth certificates.
- X-rays taken of specific bones (clavicle, sternum, pelvis) to assess skeletal development.

Previous Year Question

'Wolbachia method' is sometimes talked about with reference to which one of the following?

(2023)

- Controlling the viral diseases spread by mosquitoes
- Converting crop residues into packing material
- Producing biodegradable plastics
- Producing biochar from thermo-chemical conversion of biomass

Answer - A

2. Consider the following statements : (2022)

DNA Barcoding can be a tool to:

- assess the age of a plant or animal.
- distinguish among species that look alike.
- identify undesirable animal or plant materials in processed foods.

Which of the statements given above is/are correct?

- 1 only
- 3 only
- 1 and 2
- 2 and 3

Answer - D

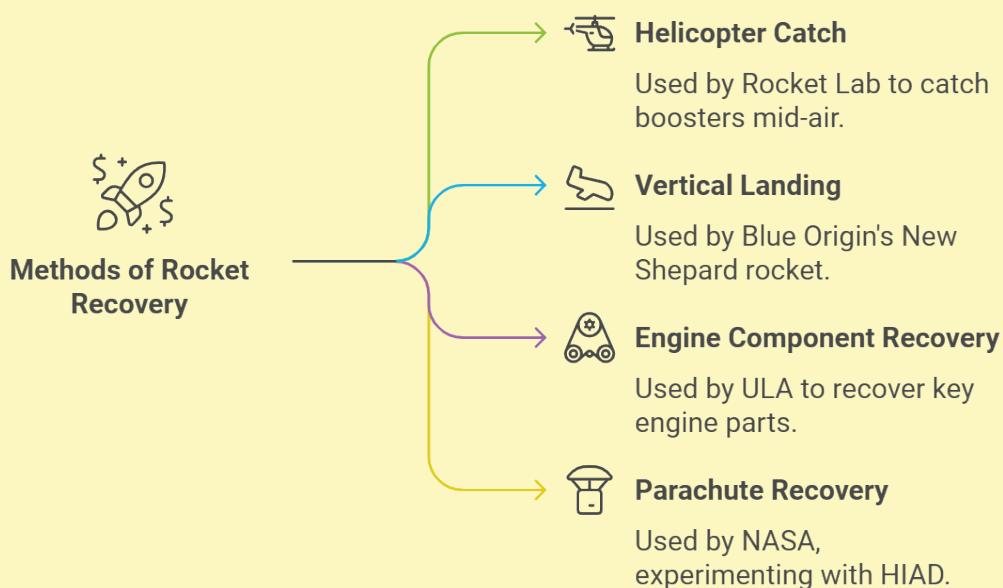
Mid-Air Booster Recovery

Why in news?

SpaceX used Mechazilla, a pair of giant robotic arms, to catch the Super Heavy booster mid-air after separation, improving reusability and reducing costs

Key Facts

- **Mechazilla** refers to a launch tower equipped with giant robotic arms designed to recover launch vehicle parts mid-air during descent.
- **Mechanism**
 - ✓ After separation, the booster uses grid fins to control its descent back to the launch site.
 - ✓ The robotic arms align with the tower and catch the booster using precision motors and actuators.
 - ✓ Mechazilla eliminates landing gear by catching the booster mid-air.
 - ✓ Enables rapid rocket reuse by avoiding ocean landings and parachute systems, cutting costs and turnaround time.



Previous Year Question

Which one of the following statements best reflects the idea behind the "Fractional Orbital Bombardment System" often talked about in media ?

- A hypersonic missile is launched into space to counter the asteroid approaching the Earth and explode it in space;
- A spacecraft lands on another planet after making several orbital motions.
- A missile is put into a stable orbit around the Earth and deorbits over a target on the Earth.
- A spacecraft moves along a comet with the same speed and places a probe on its surface.

Answer - C

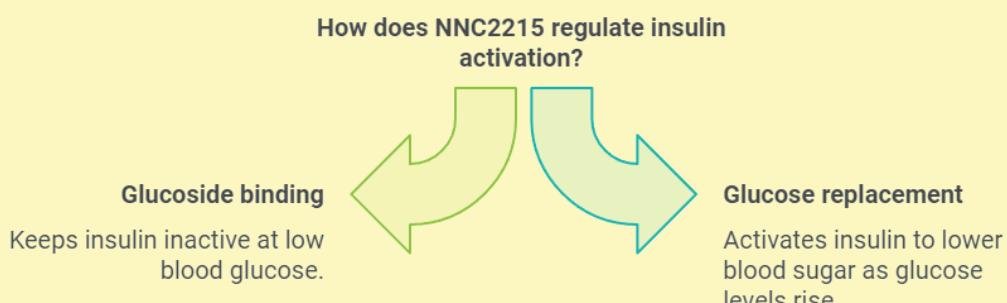
Smart Insulin

Why in news?

Scientists have achieved a significant breakthrough in creating a “smart” insulin that reacts in real time to changes in blood sugar levels.

Key Facts

- **NNC2215** has a ring-shaped structure with a glucoside molecule that binds when blood glucose is low, keeping insulin inactive.
- As glucose levels increase, **glucose replaces the glucoside**, activating insulin to lower blood sugar.

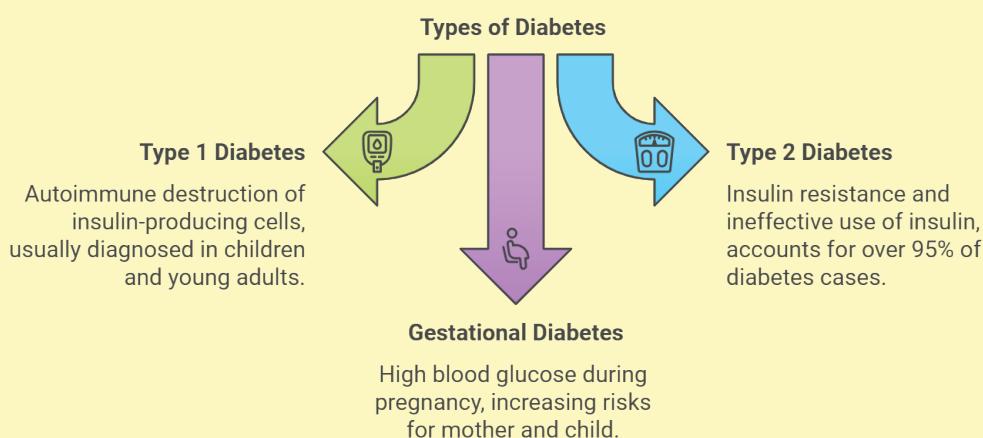


Insulin

- Synthesized by **beta cells in the pancreatic islets**.
- Regulates carbohydrate, fat, and protein metabolism; **promotes glucose absorption** in liver, fat, and muscle cells.
- First protein produced using recombinant DNA technology; listed in the WHO Model List of Essential Medicines.

Diabetes

- A chronic condition where the pancreas either **stops producing insulin or the body cannot use it effectively**, leading to prolonged **high glucose levels**.



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