11.PYQS

2023	
Q1	Which one of the following is a part of the Congo Basin? (a) Cameroon (b) Nigeria (c) South Sudan (d) Uganda
Q2	Consider the following pairs: Area of conflict mentioned in news: Country where it is located 1. Donbas: Syria 2. Kachin: Ethiopia 3. Tigray: North Yemen How many of the above pairs are correctly matched? (a) Only one (b) Only two (c) All three (d) None

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3	Consider the following countries: 1. Bulgaria 2. Czech Republic 3. Hungary 4. Latvia 5. Lithuania 6. Romania How many of the above-mentioned countries share a land border with Ukraine? (a) Only two (b) Only three (c) Only four (d) Only five
4	In the recent years Chad, Guinea, Mali and Sudan caught the international attention for which one of the following reasons common to all of them? (a) Discovery of rich deposits of rare earth elements (b) Establishment of Chinese Military bases (c) Southward expansion of Sahara Desert (d) Successful coups
5	Consider the following pairs: Regions often Reason for being in news 1. North Kivu and Ituri : War between Armenia and Azerbaijan 2. Nagorno-Karabakh : Insurgency in Mozambique 3. Kherson and Zaporizhzhia : Dispute between Israel and Lebanon How many of the above pairs are correctly matched? (a) Only one (b) Only Two (c) All three (d) None

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2022	
6	Which one of the following lakes of West Africa has become dry and turned into a desert? (a) Lake Victoria (b) Lake Faguibine (c) Lake Oguta (d) Lake Volta
7	The term "Levant" often heard in the news roughly corresponds to which of the following regions? (a) Region along the eastern Mediterranean shores (b) Region along North African shores stretching from Egypt to Morocco (c) Region along Persian Gulf and Horn of Africa (d) The entire coastal areas of Mediterranean Sea
8	Consider the following countries: 1. Azerbaijan 2. Kyrgyzstan 3. Tajikistan 4. Turkmenistan 5. Uzbekistan Which of the above have borders with Afghanistan? (a) 1, 2 and 5 only (b) 1, 2, 3 and 4 only (c) 3, 4 and 5 only (d) 1, 2, 3, 4 and 5
IB	Consider the following countries: 1. Armenia

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	2. Azerbaijan 3. Croatia 4. Romania 5. Uzbekistan Which of the above are members of the Organization of Turkic States? (a) 1, 2 and 4 (b) 1 and 3 (c) 2 and 5 (d) 3, 4 and 5
9	Which one of the following statements best reflects the issue with Senkaku Islands, sometimes mentioned in the news? (a) It is generally believed that they are artificial islands made by a country around South China Sea. (b) China and Japan engage in maritime disputes over these islands in East China Sea. (c) A permanent American military base has been set up there to help Taiwan to increase its defence capabilities. (d) Through International Court of Justice declared them as no man's land, some South-East Asian countries claim them.
10	Consider the following pairs: Region often mentioned in the news Country 1. Anatolia – Turkey 2. Amhara – Ethiopia 3. Cabo Delgado – Spain 4. Catalonia – Italy How many pairs given above are correctly matched? (a) Only one pair (b) Only two pairs (c) Only three pairs (d) All four pairs

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2020	
11	In which one of the following groups are all the four countries members of G20? (a) Argentina, Mexico, South Africa and Turkey (b) Australia, Canada, Malaysia and New Zealand (c) Brazil, Iran, Saudi Arabia and Vietnam (d) Indonesia, Japan, Singapore and South Korea
12	Consider the following pairs: River : Flows into 1. Mekong : Andaman Sea 2. Thames : Irish Sea 3. Volga : Caspian Sea 4. Zambezi : Indian Ocean Which of the pairs given above is/are correctly matched? (a) 1 and 2 only (b) 3 only (c) 3 and 4 only (d) 1, 2 and 4 only
2019	
13	Consider the following pairs: Sea : Bordering country 1. Adriatic Sea : Albania 2. Black Sea : Croatia 3. Caspian Sea : Kazakhstan 4. Mediterranean Sea : Morocco 5. Red Sea : Syria Which of the pairs given above are correctly matched? (a) 1, 2 and 4 only

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	(b) 1, 3 and 4 only (c) 2 and 5 only (d) 1, 2, 3, 4 and 5
14	Which of the following has/have shrunk immensely/dried up the recent past due to human activities? 1. Aral Sea 2. Black Sea 3. Lake Baikal Select the correct answer using the code given below: (a) 1 only (b) 2 and 3 (c) 2 only (d) 1 and 3
15	Consider the following pairs: Towns sometimes mentioned in news - Country 1. Aleppo - Syria 2. Kirkuk - Yemen 3. Mosul - Palestine 4. Mazar-i-sharif - Afghanistan Which of the pairs given above are correctly matched? (a) 1 and 2 (b) 1 and 4 (c) 2 and 3 (d) 3 and 4
16	Consider the following pairs: Regions sometimes mentioned in news - Country 1. Catalonia - Spain 2. Crimea - Hungary

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	3. Mindanao - Philippines 4. Oromia - Nigeria Which of the pair given above are correctly matched? (a) 1, 2 and 3 (b) 3 and 4 only (c) 1 and 3 only (d) 2 and 4 only
2017	
17	Mediterranean Sea is a border of which of the following countries? 1. Jordan 2. Iraq 3. Lebanon 4. Syria Select the correct answer using the code given below: (a) 1, 2 and 3 (b) 2 and 3 only (c) 3 and 4 only (d) 1, 3 and 4 only
18	Which of the following is geographically closest to Great Nicobar? (a) Sumatra (b) Borneo (c) Java (d) Sri Lanka
2015	
19	The area known as 'Golan Heights' sometimes appears in the news in the context of the events related to

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	(a) Central Asia (b) Middle East (c) South-East Asia (d) Central Africa
20	Which one of the following countries of South-West Asia does not open out to the Mediterranean Sea? (a) Syria (b) Jordan (c) Lebanon (d) Israel
2014	
21	Consider the following pairs: Region often in news: Country 1. Chechnya: Russian Federation 2. Darfur: Mali 3. Swat Valley: Iraq Which of the above pairs is/are correctly matched? (a) 1 only (b) 2 and 3 only (c) 1 and 3 only (d) 1, 2 and 3
22	Turkey is located between (a) Black Sea and Caspian Sea (b) Black Sea and Mediterranean Sea (c) Gulf of Suez and Mediterranean Sea (d) Gulf of Aqaba and Dead Sea

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23	What is the correct sequence of occurrence of the following cities in South-East Asia as one proceeds from south to north? 1. Bangkok 2. Hanoi 3. Jakarta 4. Singapore Select the correct answer using the code given below: (a) 4-2-1-3 (b) 3-2-4-1 (c) 3-4-1-2 (d) 4-3-2-1
2013	
24	Which one of the following pairs is correctly matched? Geographical Feature : Region (a) Abyssinian Plateau : Arabia (b) Atlas Mountains : North-Western Africa (c) Guiana Highlands : South-Western Africa (d) Okavango Basin : Patagonia
2010	
25	Which one of the following can one come across if one travels through the Strait of Malacca: a) Bali b) Brunei c) Java d) Singapore
2009	
26	Consider the following countries:

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	1. Australia 2. Namibia 3. Brazil 4. Chile Through which of the above does the Tropic of Capricorn pass? a) 1 only b) 2, 3 and 4 c) 1, 2 and 3 d) 1, 2, 3 and 4
2008	
27	Which one of the following cities is nearest to the equator? a) Colombo b) Jakarta c) Manila d) Singapore
28	Which one of the following straits is nearest to the International Date Line? a) Malacca Strait b) Bering Strait c) Strait of Florida d) Strait of Gibraltar
29	In which one of the following is Malta located? a) Baltic Sea b) Mediterranean c) Black Sea

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	d) North Sea
30	Which of the following countries share borders with Moldova? 1. Ukraine 2. Romania 3. Belarus Select the correct answer using the code given below: a) 1 and 2 only b) 2 and 3 only c) 1 and 3 only d) 1,2 and 3
31	Through which one of the following Straits, does a tunnel connect the United Kingdom and France? a) Davis Strait b) Denmark Strait c) Strait of dover d) Strait of Gibraltar
32	Which one of the following cities does not have the same clock time as that of the other three cities at any given instant? a) London (U.K) b) Lisbon (Portugal) c) Accra (Ghana) d) Addis Ababa (Ethiopia)
33	Other than India and China, which of the following groups of countries border Myanmar? a) Bangladesh, Thailand and Vietnam

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	b) Cambodia, Laos and Malaysia c) Thailand, Vietnam and Malaysia d) Thailand, Laos and Bangladesh
2006	
34	Through which one of the following groups of countries does the Equator pass? a) Brazil, Zambia and Malaysia b) Colombia, Kenya and Indonesia c) Brazil, Sudan and Malaysia d) Venezuela, Ethiopia and Indonesia
35	Huangpu River flows through which one of the following cities? a) Beijing b) Ho Chi Minh City c) Shanghai d) Manila
2005	
36	Which one of the following countries does not have border with Lithuania? a) Poland b) Ukraine c) Belarus d) Latvia
37	Which one of the following is the correct sequence of the given town of Pakistan while moving from the North towards the South? a) Islamabad-Gujranwala-Peshawar-Multan b) Peshawar-Gujranwala-Multan-Islamabad c) Peshawar-Islamabad-Gujranwala-Multan d) Islamabad-Multan-Peshawar-Gujranwala
2004	
38	Latvia does not share its borders with which one of the following countries? a) Russia b) Estonia c) Lithuania d) Poland

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39	Match List-I (Sea) with List- II (Country) and select the correct answer using the codes given below the Lists: List-I (Sea) List-II (Country) A. Black Sea 1. Bulgaria B. Red Sea 2. China C. Yellow Sea 3. Eritrea D. Caspian Sea 4. Kazakhstan Codes: A B C D a) 1 4 2 3 b) 2 3 1 4 c) 1 3 2 4 d) 2 4 1 3
40	Which one of the following does not border Panama? a) Costa Rica b) Pacific Ocean c) Colombia d) Venezuela
2003	
41	Which one of the following countries is land locked? a) Bolivia b) Peru c) Suriname d) Uruguay
42	Israel has common borders with: a) Lebanon, Syria. Jordan and Egypt b) Lebanon, Syria, Turkey and Jordan c) Cyprus, Turkey, Jordan and Egypt

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	d) Turkey, Syria, Iraq and Yemen
43	Which one of the following countries does NOT border the Caspian Sea? a) Armenia b) Azerbaijan c) Kazakhstan d) Turkmenistan
2002	
44	Consider the following countries: 1. Albania 2. Bosnia Herzegovina 3. Croatia 4. Macedonia Which of these countries has/have Adriatic Sea as a boundary? a) 1 and 2 b) 1, 2 and 3 c) 4 only d) 3 and 4
2001	
45	The given map shows four towns of the Central Asian region marked as 1, 2, 3, and 4. Identify these from the following list and select the correct answer using the codes given below:  Towns: A. Bishkek

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	B. Ashkhabad C. Tashkent D. Dushanbe Codes: a) A-3, B-1, C-2, D-4 b) A-3, B-1, C-4, D-2 c) A-1, B-3, C-2, D-4 d) A-1, B-3, C-4, D-2
46	Consider the following provinces of former Yugoslavia: I. Bosnia II. Croatia III. Slovenia IV. Yugoslavia The correct sequence of these provinces from the east to the west is a) IV, I, III, II b) IV, I, II, III c) I, IV, III, II d) I, IV, II, III
47	Which one of the following lakes forms an international boundary between Tanzania and Uganda? a) Chad b) Malawi c) Victoria d) Zambezi
1999	
48	Match the cities labelled as A, B, C and D in the given map with the names of cities and select the correct answer using the codes given below the names of cities: Names of Cities:

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	 1. Darwin 2. Kuala Lumpur 3. Lagos 4. Nairobi 5. Singapore Codes: a) A-1, B-2, C-4, D-3 b) A-2, B-1, C-4, D-3 c) A-1, B-4, C-5, D-2 d) A-4, B-3, C-5, D-2
49	The physical regions marked as 1, 2, 3 and 4 on the given map are respectively:  a) Andes, Brazilian Shield, Guyana Highlands and Amazon Basin

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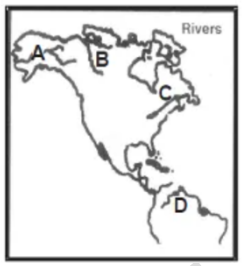
	b) Andes, Guyana Highlands, Brazilian Shield and Amazon Basin c) Amazon Basin, Guyana Highlands, Brazilian Shield and Andes d) Guyana Highlands, Brazilian Shield, Andes and Amazon Basin
1998	
50	Match rivers labelled A, B, C and D on the given map with their names given in the list and select the correct answer using the codes given below the list: 1. St. Lawrence 2. Orinoco 3. Mackenzie 4. Amazon 5. Yukon List-I  a) A-4, B-3, C-2, D-1 b) A-5, B-3, C-1, D-2 c) A-5, B-4, C-1, D-3 d) A-3, B-1, C-4, D-2
1997	
51	Consider the geographical details given in the following figure:

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	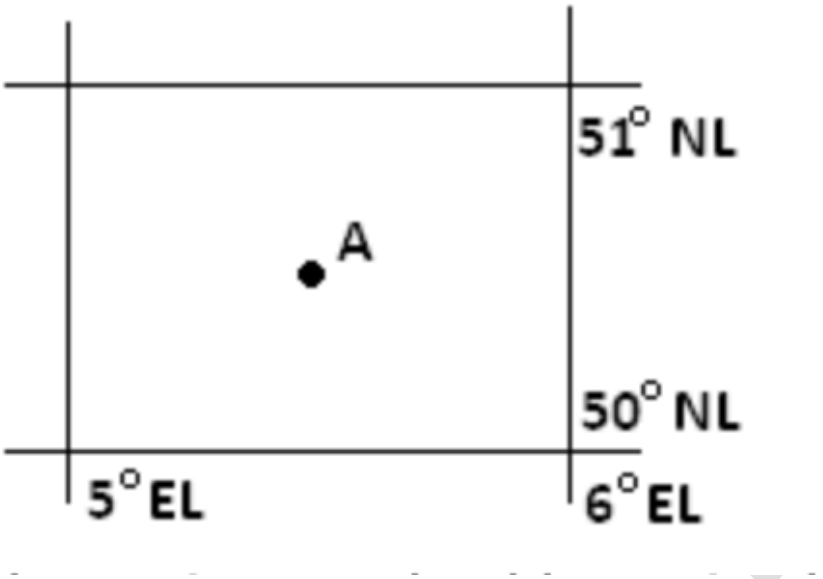 The point marked by A in the above figure indicates a country in: a) North America b) South America c) Europe d) Asia
52	One will NOT have to pass through the Suez Canal while going from Mumbai to: a) Alexandria b) Suez c) Port Said d) Benghazi
53	During a flight from Delhi to Tokyo the following are the landing airports: I. Hong Kong II. Hanoi III. Taipei IV Bangkok The correct sequence of the landing at these airports during an onward journey is a) I, II, III, IV b) IV, II, I, III c) III, IV, I, II d) IV, I, II, III

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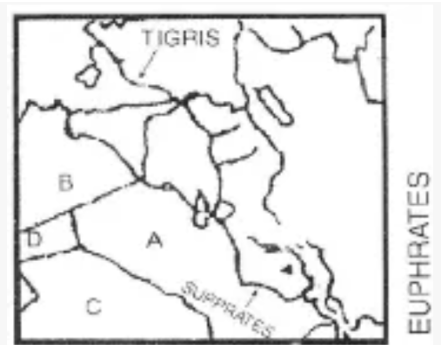
1996	
54	The rough outline map shows a portion of the Middle East. The countries labelled A, B, C and D are respectively:  a) Syria, Iraq, Jordan and Saudi Arabia b) Syria, Iraq, Saudi Arabia and Jordan c) Iraq, Syria, Saudi Arabia and Jordan d) Iraq, Syria, Jordan and Saudi Arabia
1995	
55	Consider the map given below indicating four places frequently figuring in the news:  Which one of them is Chechenya? Choose the correct answer from the codes given below:

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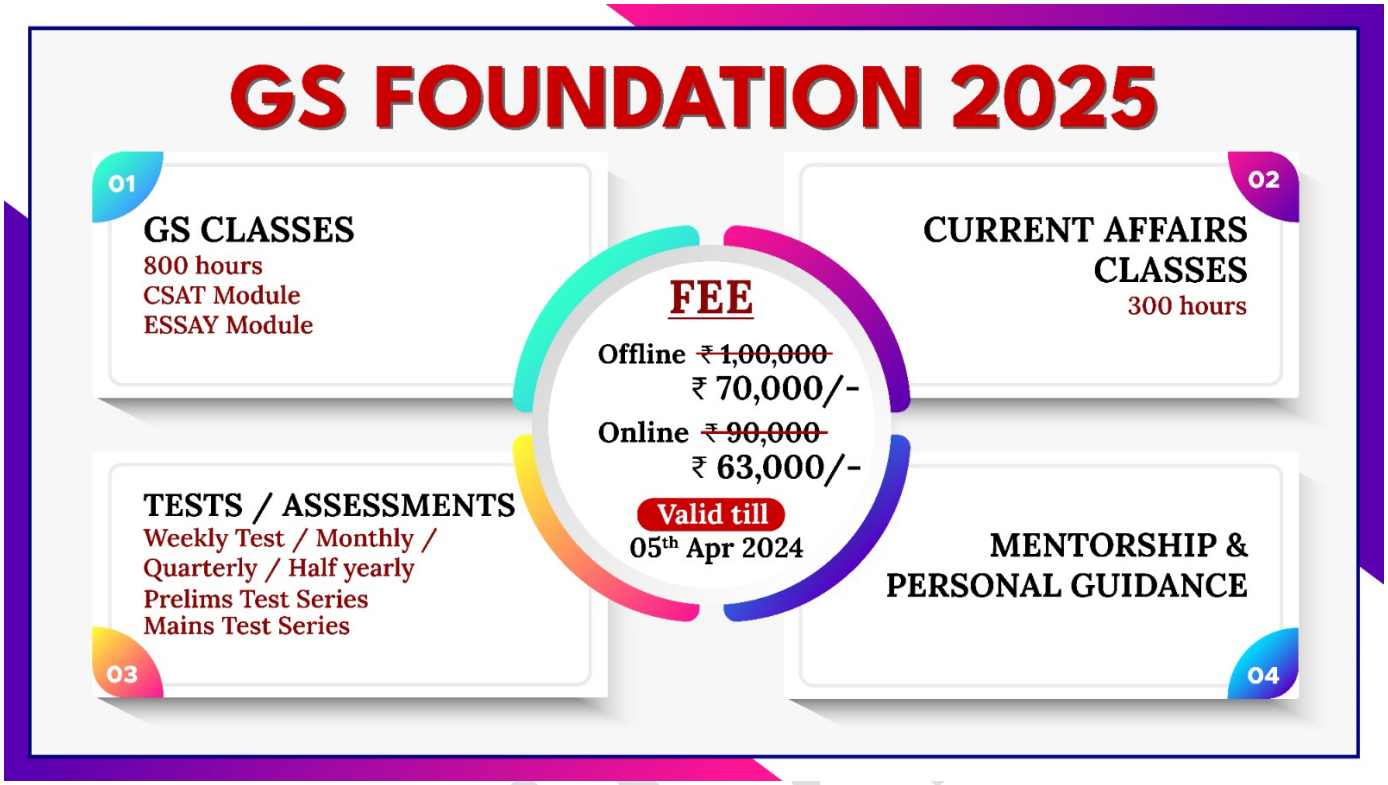
	a) 1 b) 2 c) 3 d) 4



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TARGET PRELIMS 2024
BOOKLET-37; S&T-11
BIOLOGY BASICS-2
CLASSIFICATION OF LIFE

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2. DIVERSITY IN LIVING ORGANISMS

1) INTRODUCTION

- Attempts at classifying living things into groups have been made since time immemorial.
  - Greek thinker **Aristotle** classified animals according to whether they lived on land, in water or in the air. This was a simple way of looking at life but misleading too.

- **Classification and Evolution**
  - Classification of life forms is closely related to the evolution. The living organisms which have evolved from same ancestor would tend to fall in the same group during classification.

2) THE HIERARCHY OF CLASSIFICATION GROUPS

- Various biologists have tried to classify all living organisms into broad categories, called the **Kingdoms**.
  - The classification **Robert Whittaker** (1969) proposed is widely used and has **five kingdoms**
    - Monera
    - Protista
    - Fungi
    - Plantae
    - Animalia

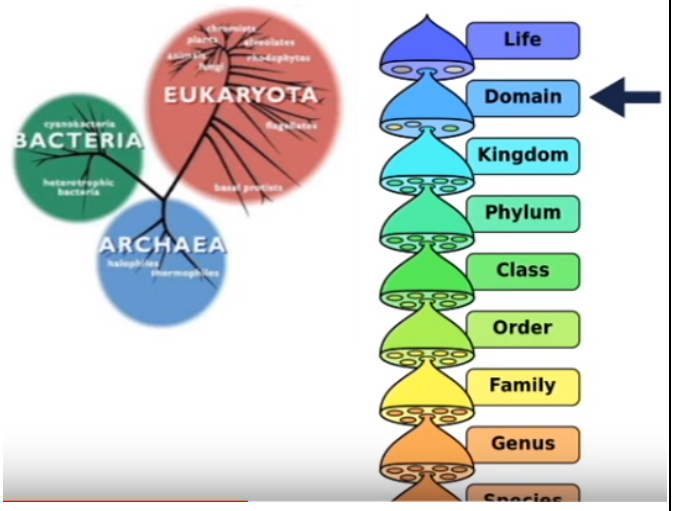
  - The number of Kingdoms were **expanded to 7** in **2015 by Ruggerio**. These are Monera, **Archaea**, Protozoa, **Chromista**, Fungi, Plants and Animals.

    - This classification also has **two super kingdoms (**Prokaryota and Eukaryota**)**

  - In 1990, a **three-domain system** (Archaea, Bacteria and Eukaryota) of biological classification was introduced by Carl Woese.

  - **More About Archaea** (or archaea bacteria)
    - Almost 10% of the life is found in the form of archaea. They are found almost everywhere (human gut, gut of a cow, extreme environment etc.)

    - **Key features**
      - They are prokaryotes (no nucleus or cell organelles)
      - **Cell wall present** (like bacteria)
      - **Membranes**



- **Metabolism** -> Phototrophs (e.g. halobacterium), Lithotroph (e.g. methanogen), Organotrophs (e.g. sulfolobus)

- **Many of these Archaea** are **extremophiles** (organisms that can thrive in extreme environments where most other forms of life can't live). This include glaciers, acid mine drainage and deep sea hydrothermal vents. Some categories of extremophiles are thermophiles, Psyhcrophiles, radio-resistant microbes, halophiles etc.

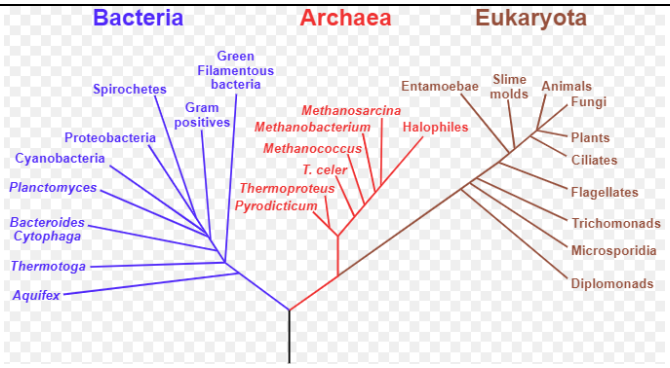
- The above groups have been formed based on the cell structure, mode and source of nutrition and body organization.

- **Further classification is done by naming the sub-groups at various levels** as given in the following scheme:
  - **Kingdom**
    - **Phylum (**For animals) / **Division** (for plants)
      - **Class**
        - **Order**
          - **Family**
            - **Genus**
              - **Species**

  - Humans
    - Kingdom: Animalia
    - Phylum: Chordata
    - Class: Mammalia
    - Order: Primates
    - Family: Hominidae
    - Genus: Homo
    - Species: Homo Sapiens

  - Thus, by separating organisms on the basis of a hierarchy of characteristics into smaller and smaller groups, we arrive at a basic unit of classification, which is a **species**.
    - Broadly, **a species** includes all organisms that are similar enough to breed and perpetuate.

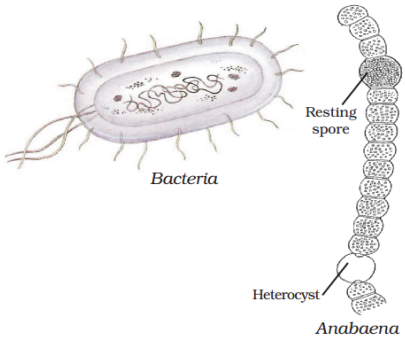
In some recent classification mechanism **Domain is considered the** highest classification of life. The concept of domain was only introduced in 1990s, before which Kingdom held the highest rank of classification.
Need of this classification:
- Earlier all living organisms were divided into Prokaryotes (bacteria) and Eukaryotes (everything else).
- But, later it was found that some of the organisms which were earlier classified as bacteria, were from a completely different lineage. Though they were prokaryotes, they were not bacteria.
- This led to creation of three domains: **Eukarya, Bacteria and Archaea**.
- The domains highlight the enormous evolutionary differences among organisms. It was **Carol Woese** who separated Monera into bacteria and archaea and proposed a **three domain system**.
-



1) MONERA (MONERA AND ARCHAEA)

- **All Prokaryotes** are found in this Kingdom. Don't have a defined nucleus or organelles. Don't show multicellular body design.

- **Note**: All Kingdoms except Monera have Eukaryotes
- Show **diversity based on other characteristics**
  - Cells walls - some have some not.
  - Autotrophic or heterotrophic



- E.g.: **bacteria**, blue green algae or cyanobacteria (it is considered a bacterium, and the term algae is reserved for Eukaryotic organisms only, it is autotrophic), mycoplasma (lacks a cell wall around their cell membrane), Anabaena (a genus of filamentous cyanobacteria, that exists as plankton)

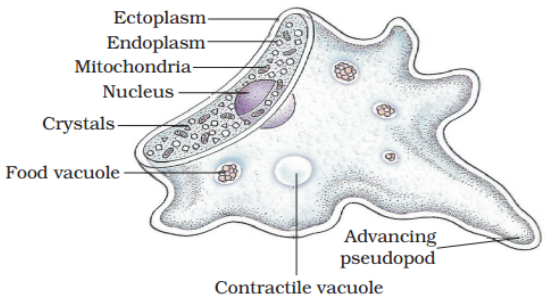
- **Spirulina**: **A wonder Food Supplement**
  - Spirulina is a blue green alga (family: Monera) that was earlier classified as a plant (algae) because of its richness in plant pigments as well as its ability to photosynthesize.
  - New understanding of its genetics, physiology and biochemical properties caused scientists to move it to the Bacteria Kingdom and the Cyanobacterium Phylum.
  - It is a free floating filamentous micro-algae that grow generally in oceans and salty lakes in subtropical climate.
  - It is cultivated worldwide and has been consumed for centuries for its high nutritional content and health benefits.
  - The nutritional value of Spirulina is well-recognized with its unusual high protein content (60-70% by dry weight) and its richness in vitamins (particularly B12) minerals, essential fatty acids, and other nutrients.
  - It is consumed in the form of capsules, tablets, flakes, syrups, or powder.
  - However, there is still not enough evidence to determine if spirulina supplements are safe. Medical studies are currently underway to verify spirulina as a dietary supplement and its potential health effects.
  - **Composition of Spirulina**

Protein	60-70%

Carbohydrate	16-20%
Lipid	5-7%
Mineral	6-9%
Moisture	2.5%-6%

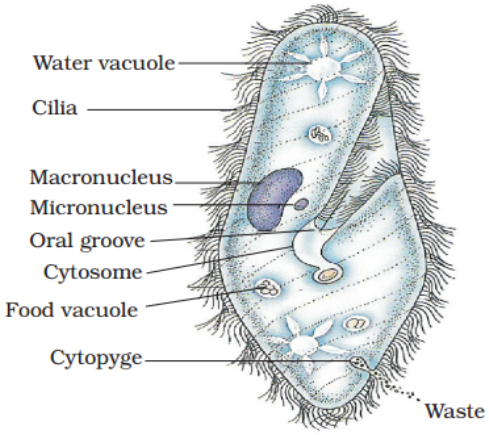
2) PROTISTA (OR PROTOZOA)

- Protista is a diverse group of Eukaryotic organisms that are not plants, animals, or fungi (It's a **hodgepodge category**, and eukaryotes that don't fit in plants, animals, and fungi are included in this category)
- They can be unicellular, multicellular or colonial. They can also be found in almost every habitat on earth.
- They can be autotrophic, heterotrophic, or mixotrophic and can produce both sexually and asexually.



Amoeba

- There are **several major groups of Protists** including:
  i. **Algae:** Photosynthetic protists that range from single celled organisms to large multi-cellular seaweeds (it lacks cellular characteristics of plants and hence not classified as plants). They can be found in freshwater or marine ecosystems and are very important primary producers of aquatic ecosystem.
  ii. **Protozoa**: They are heterotrophic protists and are typically unicellular and motile. They can be free living or parasitic. They play a significant role in nutrient cycling and as prey for other organisms. Some protozoa can cause diseases in humans and animals such as Malaria (Plasmodium falciparum) and sleeping sickness.



Paramecium

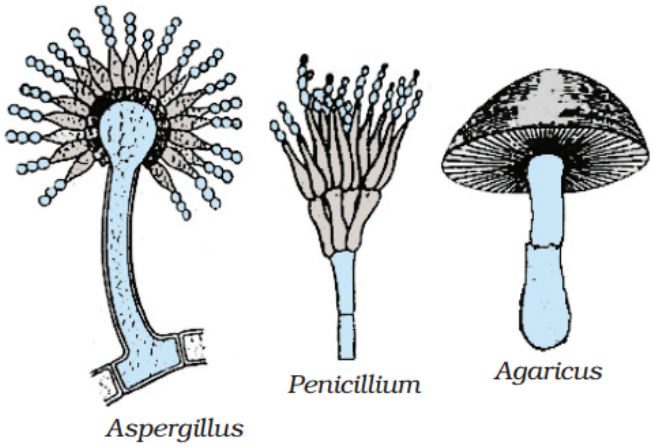
  iii. **Slime Molds:** Protists that can exist as single cells or as large, multicellular aggregates. They are important decomposers in forest ecosystem.

  iv. **Water Molds**: They are mostly parasitic and can cause diseases in plants and animals.

- They have significant economic and ecological importance (for e.g. algae are used as food sources for animals and humans. Others play significant role in health and biotechnology sector.
  Some of these organisms use appendage, such as hair like cilia or whip like flagella for moving around.

3) FUNGI

- These are **heterotrophic**, **Eukaryotic** organisms.
- They **use decaying organic material** as food and are therefore called **saprophytes**.
- Many of them have the capacity to become multicellular organism at some stage of life.
- They have **cell walls** made of tough complex sugar called **chitin**.
- **E.g.**
  i. Yeast, Mushrooms, molds etc.



- Some fungal species live in permanent mutually dependent relationship with blue-green algae (or cyanobacteria). Such relationships are called Symbiotic. These symbiosis life forms are called **lichens**.
  i. We have all seen lichens as slow-growing dark coloured patches on the bark of trees.

- **Recent Development**
  i. **Kirajadi / Yarsagambu / Yartsa gunbu**
    - Scientific Name: Ophiocordyceps Sinesis (O. Sinesis)
    - It is classified as medicinal mushroom.
    - It is an entomopathogenic fungus (a fungus that grows on insects) found in mountainous regions of India, Nepal and Tibet
    - It parasites larva of ghost moths and produces a fruiting body which is valued as an herbal remedy.
    - The fungus germinates in the living larva, and kills and mummifies it, and then a dark brown stalk-like fruiting body which is a few centimetres long emerges from the corpse and stands upright.


Caterpillars with emerging *Ophiocordyceps sinensis*

    - **Uses**
      - Used in traditional Asian medicines in countries such as Nepal, China, Bhutan etc.
      - In 2012, BBC magazine reported how it is transforming local economies in Himalayas.
    - **Endangered** in China
      - Overharvesting and overexploitation has led to the classification of the specie as endangered in China.
    - **Other names**
      - Caterpillar fungus, Yartsa Gunbu, etc.

4) PLANTAE

- **Autotrophic, Eukaryotic, mostly Multicellular with cell walls**.
  - They use chlorophyll for **photosynthesis**.

- Thus, all plants are included in this group.
- They all have **cell walls** made of **cellulose**.
- **Note:** Algae are classified under Protista, but some biologists classify multi-cellular algae under Plantae
- **Note:** Three of the five kingdoms have cell walls.
    1. **The Plant Kingdom**: All Plants have cell walls made up of cellulose.
    2. **The Fungi Kingdom**: Most fungi have cell walls made of Chitin, a complex carbohydrate that provides structural support and protection
    3. **The Monera Kingdom**: Bacteria and Cyanobacterium (also known as blue green algae) in Monera kingdom have cell walls made of peptidoglycan, a polymer made of sugars and amino acids that provides support and protection.

5) ANIMALIA

- Organisms which are multicellular eukaryotes without cell walls.
- They are all Heterotrophic.

Note: Viruses are not classified in any kingdom yet because they are not really alive. They only show signs of life

2) ANIMAL KINGDOM: ANIMALIA

- These are organisms which are **Eukaryotic, multicellular, and heterotrophic**.
  The **Animal Kingdom is classified into several phyla**, each with distinct characteristics and traits. The following are the major phyla of the Animal Kingdom:

1. **Porifera (Sponges)**
2. **Cnidaria**
3. **Platyhelminthes (Flatworms):** These are bilaterally symmetrical animals with flattened bodies and primitive nervous systems.
4. **Nematoda (Roundworms):** These are unsegmented, cylindrical animals with a complete digestive system.
5. **Annelida (Segmented Worms):** These are bilaterally symmetrical animals with a segmented body and a closed circulatory system.
6. **Mollusca (Snails, clams, octopuses):** These are soft-bodied animals with a muscular foot and a mantle that secretes a shell in some species.
7. **Arthropoda (Insects, spiders, crustaceans):** These are segmented animals with jointed legs and an exoskeleton made of chitin.
8. **Echinodermata (Starfish, sea urchins):** These are radially symmetrical animals with a spiny exoskeleton and a water vascular system.

9. **Chordata:** These are animals with a **notochord, a dorsal nerve cord, and pharyngeal gill slits** at some point in their development. Chordates include vertebrates and non-vertebrates like tunicates and

lancelets. **Chordates are divided into three subphyla**: **Urochordata or Tunicata, Cephalochordata** and **Vertebrata**.

Chordata:

Chordates are a major phylum within the Animal Kingdom that includes animals that have a number of shared characteristics, including:

1) **Notochord**: It is a flexible rod-like structure that runs along the dorsal (back) side of the body, providing support and allowing for movement.
   - In vertebrate subgroup of chordates, the notochord develops into **spine**, and in wholly aquatic species this helps the animal swim by flexing its tail.
2) **Dorsal Nerve Chord:** A nerve cord that runs along the back of the body, and in some cases develops into **spinal cord** in vertebrates.
3) **Phryngeal Gill Slits:** Pouches in the pharynx region of the body that are used for respiration in aquatic species and may be modified for other functions in terrestrial species.
4) **Post-Anal Tail:** A tail that extends beyond the anus, present at some point in the life cycle of many chordates.
   - **Note:** In humans and apes, the tail is reduced to a tiny tailbone called 'Coccyx'.

- They can be broadly classified as **Vertebrates and Invertebrates.**

- **Vertebrates** are animals with backbones and spinal columns i.e. these animals have **a true vertebral column and internal skeleton**, allowing for a completely different distribution of muscle attachment points to be used for movement.
  - Vertebrates are bilaterally symmetrical, triploblastic (derived from three embryonic cell layers – ectoderm, mesoderm and endoderm), coelomic and segmented, with complex differentiation of body tissues and organs.

  - All chordates (Phylum) possess the following features
    1. Have a notochord
    2. Have a dorsal nerve cord
    3. Are triploblastic
    4. Have paired gill pouches
    5. Are coelomate

  - Vertebrates are the most advanced organisms on Earth. Although they represent a very small percentage of all animals, their size and mobility often allow them to dominate their environment. Vertebrates can further be classified into following **5 groups**
    - Fishes
    - Amphibians
    - Reptiles
    - Birds
    - Mammals

2) IN-VERTEBRATES

- Invertebrates **are animals without backbones**. More than **98% animal species** in the world are invertebrates. Invertebrates **don't have internal skeleton made of bone**.
  - Many invertebrates have a **fluid-filled, hydrostatic skeleton**, like the jelly fish or worm.
  - Others have a **hard-outer shell, like insects and crustaceans**.

- **Invertebrates can be classified as:**

PORIFERA:

- The word porifera **means organisms with holes**.
- These are non-motile animals attached to some solid support.
- There are **holes or pores all over the body**. These lead to **canal system** that **helps in circulating water throughout the body** to bring food and oxygen.
- These animals are covered with hard outside layers or skeleton.
- **The body design** involves very minimal differentiation and division into tissues. They are commonly called sponges and are mainly found in marine habitats.
- They are considered one of the simplest forms of multicellular animals and are found in both fresh water and marine environments.

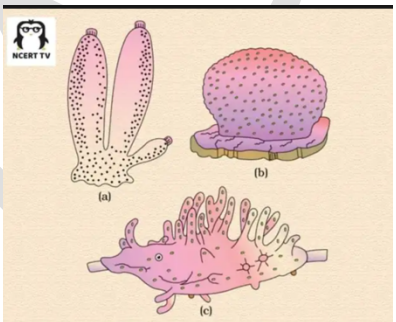
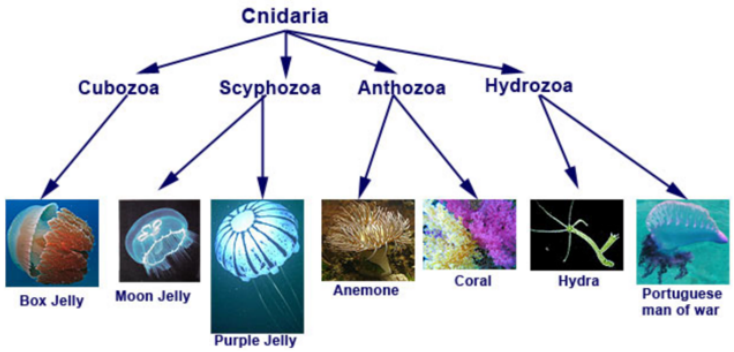


Figure 4.5 Examples of Porifera : (a) Sycon (b) Euspongia (c) Spongilla

- They are **important aquatic animals** – They provide habitat for other organisms and help filter water. They are also used in various industrial applications such as cleaning and polishing.

B) COELENTERATE (CNIDARIA)

- It is the phylum of organisms that include corals, **anemones**, hydroids and **jelly fish**.
- They were the first animals to move, sense and hunt.
  - They are characterized by tentacles. These tentacles allow organisms to move around and sense the surrounding environment. The cells on tentacles are called Cnidocytes. They are used to inject venom and paralyze the prey. It is due to the presence of Cnidocytes that the phylum is called Cnidaria.

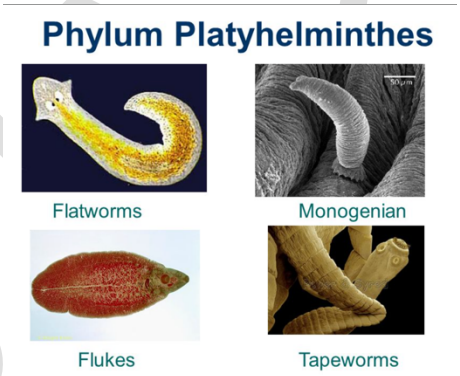


- They are **aquatic** and mostly live in marine water and some in fresh water (e.g. Hydra).
- Some of these Cnidarias live attached life and are called Polyp (Greek word for attached).
- Other Cnidarians like jelly fish can move around.
- Their body is radially symmetrical.
- They show more body design differentiation.

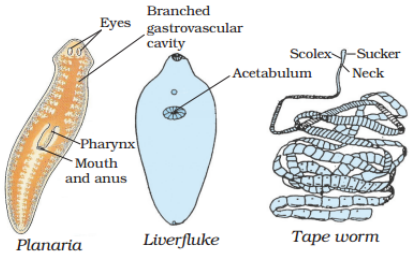
- They are **diploblastic organisms** as their embryonic body is made up of two layers of cells (outer Ectoderm and Inner Endoderm). One makes up the cells on the outside of the body, and the other makes the inner lining of the body.
- They have tissue level organization and were first animals to develop this. These animals also show gastrovascular cavity and primitive nervous system. The gastrovascular cavity has a single opening. Because of the presence of cavity, they are also called Coelenterate (Coel -> Cavity; and Enteron -> Intestine).

- Some of these species live in **colonies (Corals),** while others have a **solitary lifespan (Hydra)**.

C) PLATYHELMINTHES (PLATY -> FLAT AND HELMINTH-> WORM)



- More complex than Porifera and Coelenterate.
- The body is **bilaterally symmetrical**, meaning that the left and the right half of the body has the same design.
- There are three layers of cells (Ectoderm, Mesoderm and Endoderm) from which differentiated tissues can be made, which is why such animals are called **triploblastic**.
- This allows outside and inside body linings as well as some organs to be made. There is thus some degree of tissue formation.
- However, there is **not true internal body cavity** or Coelom, in which well-developed organs can be accommodated.
    - **Note**: Flat worms are the only triploblastic organism, which don't have Coelom.
    - Some flatworms have rudimentary organs.
- The body is flattened dorsiventrally (like ribbon), meaning from top to bottom, which is why these animals are called **flatworms.**
- Either **free living or parasitic**.
- Some of the members of this phylum are harmful and can cause diseases. They live like endo-parasites in humans or other organisms.
    - E.g. Tape worm (Taenia solium), Liverflukes (Fasciola) -> infects liver)



- Some of them can be useful as well for e.g. Planaria is used to feed on mosquito larvae and can be used to control mosquitoes.
- Some flatworms are very long (upto 90 feets)

D) NEMATODA (ASHCHELMINTHES)

- The nematode body is also **bilaterally symmetrical** and **triploblastic**.
- However, the **body is cylindrical** rather than flattened. Thus, it is this phylum which saw the **beginning of Coelom**, but coelom is not truly developed and thus it is the only phylum which has false coelom or **pseudo coelom**.
- There are tissues, but no real organs, although a sort of body cavity or a pseudo-coelom, is present.
- These are very familiar as **parasitic worms** causing diseases, such as the worms causing **elephantiasis (filarial worms)** or the worms in the intestines (**roundworms or pinworms**).

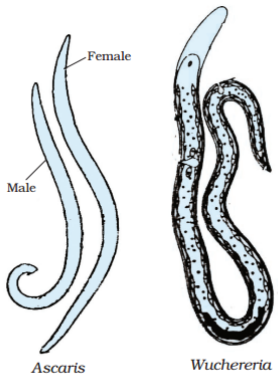


Fig. 7.15: *Nematodes (Aschelminthes)*

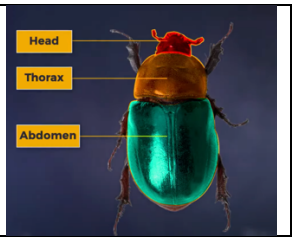
E) ANNELIDS

- They are defined as **triploblastic**, **bilaterally symmetrical**, metamerically segmented, a **coelomate worm** with a thin flexible cuticle around the body.

- They show a **very important step in animal evolution** -> **Segmentation**. Segments on annelids are usually ring like (Annulus is the Greek word of ring and hence the name Annelida)
- They are mostly aquatic; marine or fresh water; some are terrestrial, burrowing.
- Body organization is that of an **organ system level**.
- **E.g.**
  - **Earthworms** -> which help in ploughing of the land
  - **Leech ->** It sticks to the animal body to suck blood.

E) ARTHROPODS (ARTHRO -> JOINTED; PODS -> APPENDAGES)

- Probably the **largest group of animals**. They make upto 75% - 80% of the world's animal species and thus are most abundant.
-
- These animals are **bilaterally symmetrical** and **segmented.**
- They have jointed legs (the word arthropods mean jointed legs).

Segmentation (Head, Thorax and Abdomen): This segmentation helps an organism to travel and protect its sensitive organs. Each segment has a pair of legs attached for smooth locomotion.	

- They are triploblastic, and Coelomic (i.e., they possess true coelom or body cavity). There is an **open circulatory system** so the blood doesn't flow in well-defined blood vessels. The coelomic cavity is blood filled (therefore there Coelom is also called **Haemocoel).**

- They also have **an exoskeleton** which is hard, external skeleton made up of **Chitin**.
- They include cockroaches, crabs, butterflies, beetles, scorpions, shrimp, spider, lobster, lice, ticks, termites, potato bugs, and sea monkeys.
- **Reproduction:**
  - Most of them are oviparous (egg laying) (e.g., butterfly)
  - Some are viviparous (give birth to young ones) (e.g., scorpions)

Indirect Development: In most arthropods, young ones are totally different from adults (these young ones are called Larvae) [E.g. Butterfly]. The process of development of Larvae into an adult is called Metamorphosis.	
Direct Development: Here larval stage is not included	E.g. Scorpions

- Arthropods include animals such as **insects, crustaceans and arachnids**. Largest group of arthropods are the insects. The next largest group are crustaceans, including lobsters and crabs. The arachnids include spiders and ticks.

- **Insects** are the largest group of arthropods. Very adaptable, living almost everywhere in world. Exoskeleton that covers their entire body. Insects body consists of **three parts**: the head, thorax and abdomen.
  - e.g. Beetle, butterfly, moth, dragonfly, bee etc.

- **Crustaceans** live mostly in ocean or other waters. **Hard external shell** which protects their body.
  - E.g. Crab, lobsters and barnacle.

- **Arachnids: Spiders, Ticks and Scorpions**
  - Like other arthropods, the arachnids have a hard exoskeleton and joint appendage for walking. Most have four pairs of legs. Unlike other arthropods, arachnids **do not have antenna**.

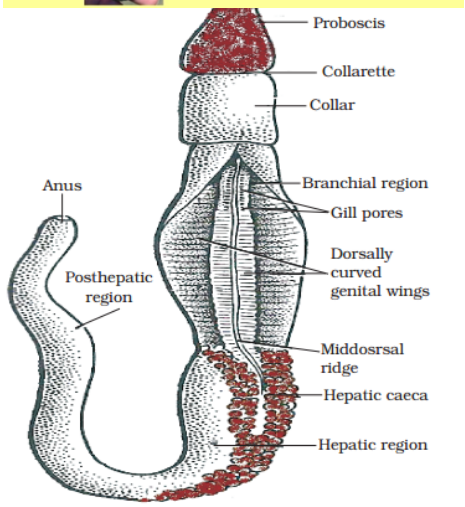
  E.g. spider, scorpion etc

F) MOLLUSCA

- This is the second largest phylum of the animal kingdom.
- In the animals of this group, there is bilateral symmetry (they can be asymmetric also)
- The coelomic cavity is reduced.
- Little segmentation
- There is an open circulatory system and kidney like organ for excretion.
- There is a foot that is used to move around.
- Most mollusks have a soft, skin like organ covered with a **hard-outside shell**.
- Some live on land such as snail or slug.
- Other mollusks live in water, such as the oyster, mussel, clam, squid octopus etc.

G) ECHINODERMS (ECHINA -> SPINY; DERM -> SKIN)

- **Exclusively free-living marine animals (**All echinoderms are exclusively marine**) [**i.e. there are no freshwater or terrestrial echinoderms known yet**]**
- They are **triploblastic** and have a **coelomic cavity**.
- Most **have arms that radiate from the centre of their body**. Centre body contains **organs** and mouth for feeding.



H) PROTOCHORDATES

- They are **informal category of animals**, named mainly for convenience to **describe invertebrate animals that are closely related to vertebrates**.
- These animals are bilaterally symmetrical, triploblastic and have a coelom.
- In addition, they show a new feature of body design, namely a **notochord**, atleast at some stages during their lives.
- The notochord is a **long-rod like support structure** (chord= string) that runs along the back of animal separating the nervous tissues from the gut. It provides a place for muscle to attach for ease of movement.
- Protochordates may not have a proper notochord present at all stages in their lives or for entire length of the animal.
- They are marine animals
- e.g. Balanoglossus, Herdmania and Amphioxus.

3) VERTEBRATES

Phylum Vertebrata can be divided into five classes (Fishes, Amphibians, Reptiles, Bird and Mammals)

A) FISHES (PISCES)

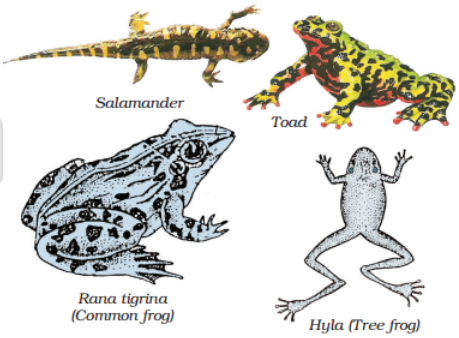
- **Exclusively aquatic** (live in water)
- Breathe in water using gills, not lungs

- **Cold blooded (**there body temperature change with change in environmental temperature**)**
- Have scales and fins
- **Lay many eggs**.
- **2 chambered heart**
- Body is streamlined, and a muscular tail is used for movement.
- **Many kinds of fish**
  - Some with skeletons made entirely of cartilage, such as sharks
  - Some with skeleton made of both bone and cartilage, such as tuna or rohu.

Note: Sometimes fish are divided into two different classes (based on the presence and absence of jaws; **Cyclostomes ->** Jawless fishes, they have sucker mouth e.g. Hag fish; **Pisces** -> Jawed fishes)

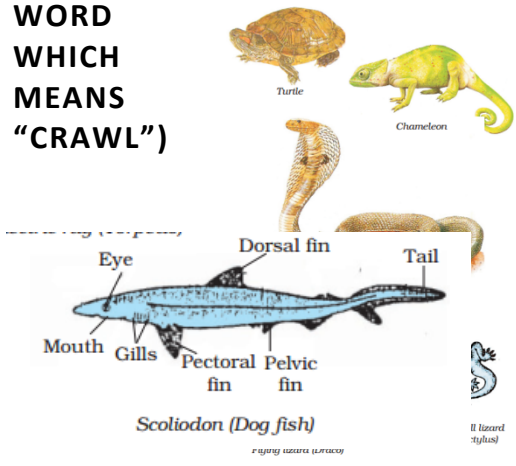
Other differences: Cyclostomes are only found in marine water. They don't have scales or paired fins.

B) AMPHIBIANS (AMPHI – DUAL; BIO - LIFE)



- **Differ from fish** in lack of scale and have a 3-chambered heart.
- Have Mucus glands on Skin -> Moist smooth skin
- **Cold blooded**
- Live on land & water
- Webbed feet
- Breathe with lungs and gills
- Four legs (sometimes none)
- **Lay many eggs**
  - These eggs are laid in water to avoid dehydration. Thus, the **larvae initially have gills** to breathe in water. These gills will be replaced by lungs in adult stage.
- **3 chambered hearts:** (Note: larvae has 2 chambers and adults have 3 chambers)
- **E.g.**
  1. Frogs, toads, and salamanders are some examples

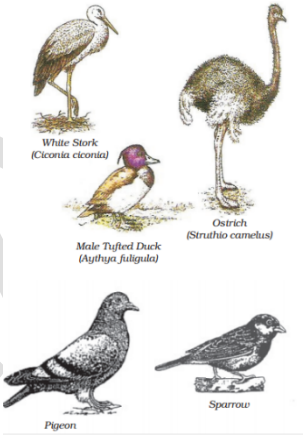
C) REPTILES (REPT IS A LATIN WORD WHICH MEANS "CRAWL")



- These were the first terrestrial vertebrates.
- **Cold Blooded**
- Have scales (to protect them from sun and from abrasions while moving on ground)
- Have dry skin
- Usually lay eggs with tough coverings
  - Don't need to lay eggs in water, unlike amphibians.
- **Ear holes instead of ears**
- 4 legs or no legs.

- **Heart:** Most reptiles have **a three chambered heart**. Crocodilians have 4 chambered hearts, turtles have a three-chambered heart but with an incomplete wall in a single ventricle, so their heart is functionally four chambered.
- **E.g**
  - Snakes, turtles, lizards, and crocodiles are some examples

D) AVES



- **Have feathers:** Feathers are actually modification of scales from their ancestor reptiles. The older scales can still be spotted on the legs of birds. Feathers help in insulation and keep them warm.
- **Warm blooded:** Feathers allow birds to keep themselves at constant temperature. This warm blooded nature allow birds to face their environmental nature.
- **Wings**: In birds, the fore limbs are modified into wings. This helps birds to fly. They have hollow bones which reduce their body weight and allow them to fly easily.
- Lay eggs
- Have 2 legs
- Earholes instead of ears
- Breathe through lungs.
- Four chambered heart (all birds) -> to provide them continuous supply of large quantity of oxygen.

E) MAMMALS

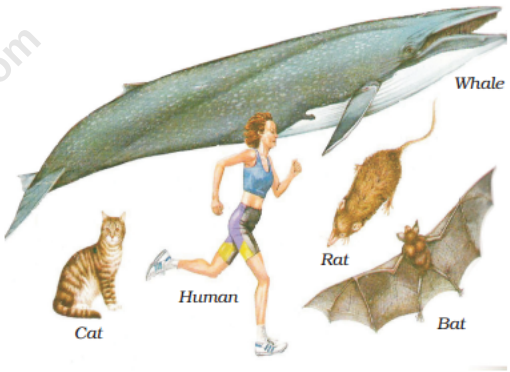


Fig. 7.25: *Mammalia*

- **Warm blooded**
- Have hairs or fur
- Skin has hairs as well as sweat and oil glands.
- Most give birth to live young mostly
  - **However,** a few of them, like the platypus and echidnas lays eggs and some like Kangaroos give birth to very poorly developed young ones.
- **Mammary glands:** Mammal mother's nurse the young ones with milk i.e. mammals have glands to give milk
- Breath with lungs
- Mammals live on all sorts of environment including the ocean, underground and on land.
- **Ears that stick out** (external ears evolved for the first time in Mammals)
- **Heart:** 4 chambered heart (all mammals)
- Blue whale is also mammal, so is bat.

Note: Amphibians, Reptiles, Birds and Mammals are together called **Tetrapods**. They have two forelimbs and two hindlimbs.

Adult snakes don't have limbs, but extremely young snake embryos do). Ancestors of today's snakes once spotted full-fledged arms and legs, but genetic mutations caused the reptiles to lose all four of their limbs about 150 million years ago.

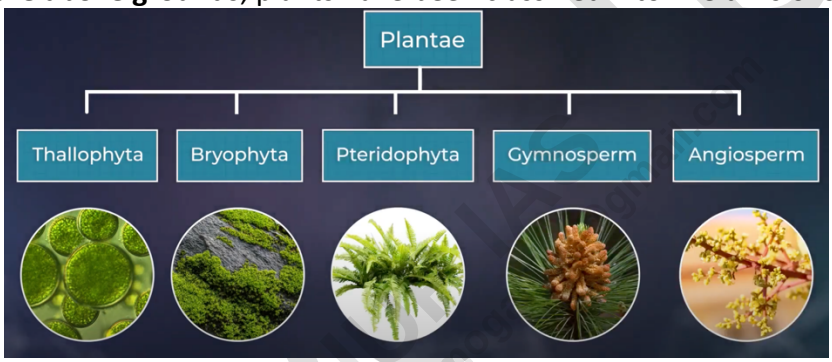
4) FLORAL DIVERSITY: PLANT KINGDOM

- **General Features:**
  - » Eukaryotic
  - » Multicellular
  - » Non-motile (Sedentary)
  - » Cell walls (Cellulose)
    - ▫ Thus, the most abundant sugar on earth is cellulose.
  - » Autotrophic

- In terms of **plant diversity**, India ranks tenth in the world and fourth in Asia. India represents nearly 11% of the world's known floral diversity.

- **Plant Kingdom** is classified in various sub-categories on the basis of following features:
  - » Extent of Differentiation of plants parts like stem, roots, leaves etc.
  - » Presence of special tissues (Xylem and Phloem)
  - » Ability to bear seeds
  - » Naked Seeds and Fruits enclosed seeds
  - » Ability to produce flowers

- **On the above grounds**, plants have been classified into five divisions:



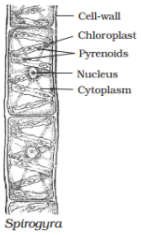
THALLOPHYTA (DERIVED FROM THALLUS -> UNDIFFERENTIATED PLANT BODY)

- ▫ Plants that **don't have well differentiated body design** fall in this group. They are not differentiated between roots, stems and leaves. The plants in this group are commonly called **algae**. The plants are **predominantly aquatic**.
  - Please note: In Protista we have unicellular algae, and generally all multicellular algae are put in Plantae Kingdom.
- ▫ **Features:** Eukaryotic, Multicellular, non-motile, cell walls made of cellulose, autotrophic.
- ▫ E.g. Spirogyra, Ulothrix, Cladophora, Ulva, Chara etc.
- ▫ **Usefulness of Thallophyta in our life:**
  - Seaweeds can be used for food purpose (soup made of sea weeds is popular in Korea and Japan)
  - Production of Biofuels


Ulothrix


Cladophora


Ulva



Spirogyra

- Anti-biotics development
- Gellies that we get in icecreams and other sweets are extracted from an organism called Gelatin which is a Thallophyta.

- **Harmful Algae's:**
  - **Karenia Brevis** is an alga which produces toxin and is harmful for aquatic life.
  - **Eutrophication (algal bloom)**

BRYOPHYTES (BRYON -> MOSS; PHYTON -> PLANT)

- They are part of Bryophyta division of Kingdom Plantae.
- Have **well differentiated body parts** like stems and leaves.
- However, **no specialized tissue for conduction of waters** and other substances from one part of the plant body to another.
- **Reproduction** through Spores (not seeds). All Bryophytes reproduce through spores and not seeds.
- E.g. Moss (Funaria), Marchantia, Liverworts, Hornworts, Mosses)

Mosses	Liver Worts
	

- They cannot circulate rainwater through their stems and leaves but must absorb it from environment that surrounds them. Therefore, they would be found in moist environments and not dry conditions. The plant body is differentiated into a small stem and simple leaves, but true roots are absent.
- **Note:** Ally Bryophytes reproduce through spores and not seeds.
- Bryophytes are the second largest group of green plants in India distributed largely in Eastern Himalaya, North-Eastern India, Western Himalaya and the Western Ghats.
- Mosses consist of the major component of Indian bryo flora followed by liverworts and hornworts.

C) PTERIDOPHYTE (PTERIS -> FERNS; PHYTONS -> PLANT)

- They are the **most basic vascular plants** – having simple reproductive system lacking flowers and seeds.
  - **Vascular Plants:** Have specialized tissues for conduction of water and other substances from one part of the plant body to another. (Xylem and phloem).
- **Well Differentiated body parts:** Well differentiated plant body into **roots, stem and leaves.**
- **Reproduction through Spores**. Produce **neither flowers nor seeds**, so they are referred to as **Cryptogams**.

- Most of them are terrestrial **plants flourishing well in moist and shady places** (thus avoiding sunlight)**, and some of them are aquatic**. This group include vascular cryptogams like club-mosses, horse-tails and ferns which are universally distributed all over the world.

Club Moss	Lady fern	Horsetail
		

- **Note:** About 1/3rd of the Pteridophytes are epiphytes (i.e., they grow on other plants)
- **Note: Thallophyte, Bryophytes and Pteridophytes** are called Cryptogams. This is because they have hidden (Crypto) reproductive organs. These plants are flowerless and seedless.
- **In India,** the north-eastern region (including eastern Himalaya) is rich in pteridophytes diversity, followed by south India (including eastern and western Ghats) and north India (including western Himalayas

SPERMATOPHYTES (DISPERSED BY SEEDS)

A) GYMNOSPERMS (SEEDS NOT ENCLOSED) E.G., CONIFERS

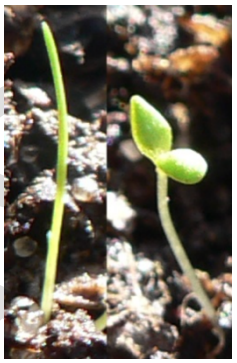
- Group of seed producing plants that include conifers, cycads, Ginkgo and Gnetales. (Origin of word: Greek, gymnos: naked, sperma: seed). This is named so after the **unenclosed condition of their seeds.** The naked condition of seeds of gymnosperm stands in contrast to the seeds and ovules of flowering plants (angiosperms), which are enclosed within an ovary. In Gymnosperms ovules are present on the surface of the megasporophylls and are directly pollinated by the pollen grains. There is nothing like ovary, style, and stigma, and naturally there is no fruit.
- E.g., **Pines, Deodar, Cycads** (look like palm tree, but they are not. Palms are angiosperms)

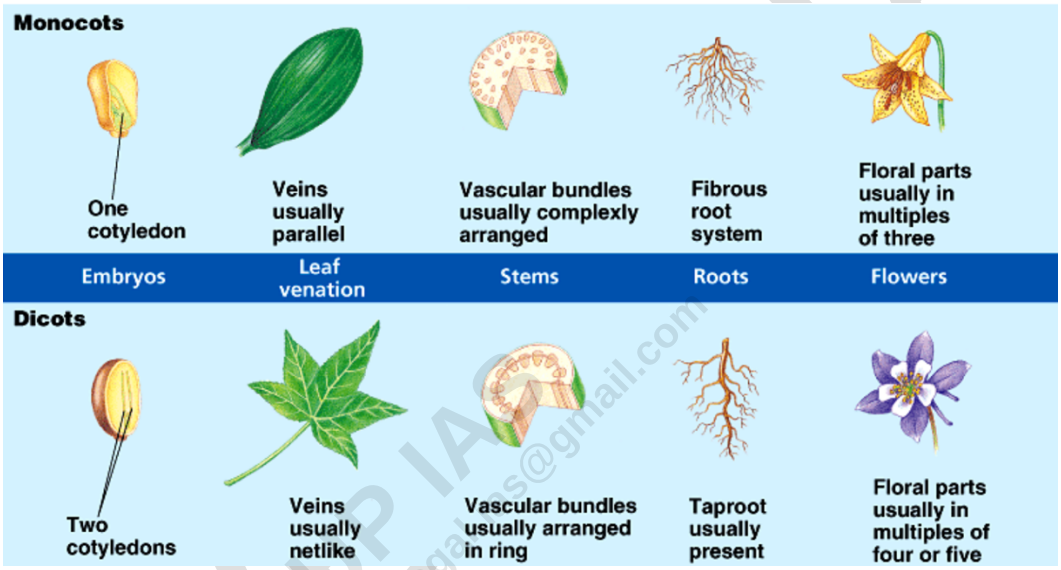
B) ANGIOSPERMS (SEED ENCLOSED) E.G. FLOWERING PLANTS

- The word is made from two Greek words: angio means covered, and sperma - means seed.
- Angiosperms, the flowering plants are the **most diverse group of land plants**. Angiosperms are the **seed producing plants** like the gymnosperms and can be distinguished from the gymnosperms by **characteristics including flowers, endosperm within the seeds, and the production of fruits that contain the seed**.
- These are the most highly developed plants which bear flowers having conspicuous accessory and essential whorls.
- Carpels have the ovary, style and stigma. With the stimulus of fertilization the ovary generally develops into fruit and the ovules in seeds. Thus, **the seed remains within the fruit**.

- **Plant embryos** in seeds have structure called **cotyledons**. Cotyledons are called 'seed leaves' because in many instances they emerge and become green when the seed germinates.
  - Thus, cotyledons represent a bit of pre-designed plant in the seed.

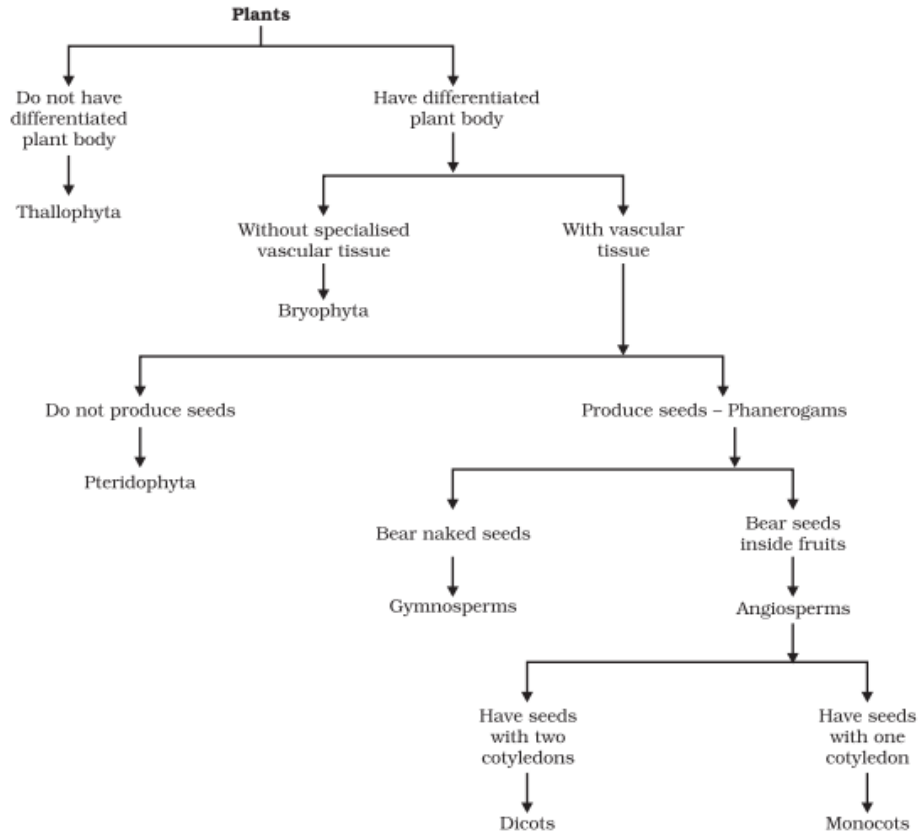
- The angiosperms are divided into **two groups on the basis of number of cotyledons** present in the seed.
  - **Monocotyledons/ monocots:** Plants with seeds having a single cotyledon (embryonic leaf). They are generally grass and grass-like flowering plants. (E.g. wheat, rice maize etc are a monocotyledons). Other economically important monocotyledons include Palms, Bananas, gingers, turmeric, onion, garlic etc.
  - **Dicots:** Plants with seeds having two cotyledons are called dicots.





- **India** has more than 7% of the world's known flowering plants

3. SUMMARY CHART: CLASSIFICATION OF PLANTS



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1. SPACE

1) GSLV-F14/INSAT-3DS MISSION (FEB 2024)

- GSLV-F14 (**GSLV-MK-II**) was the 16th mission of GSLV, and it deployed the INSAT-3DS meteorological satellite in GTO. This mission is fully funded by Ministry of Earth Science.

- **INSAT-3DS**: It is a follow-on mission of Third Generation Meteorological Satellite for Geostationary Orbit. It is designed for **enhanced meteorological observations and monitoring of land and ocean surfaces for weather forecasting and disaster warning**.

- The satellite will augment the Meteorological services along with the presently operational INSAT-3D and INSAT-3DR satellites.

- **Note**: GSLV MK-II is nicknamed '**Naughty Boy**'. It is because it has had a rather patchy track record.
  - » So far (including GSLV F14), GSLV has had 16 launches so far, and **four of them have been failures**.
  - » **What is the core issue?**
    - The main problem is the Cryogenic engine that powers the third and final stage. GSLV-MK-II uses a cryogenic engine which is a **reverse-engineered version of a Russian technology**.
    - **Why?** Russia couldn't supply technology to India due to MTCR restrictions. But it supplied a few of the engines. Initially India used these engines and later tried to reverse engineer the same.
    - **Note**: Now India has its own cryogenic engine as well, a result of decades of R&D. This engine has entirely Indian design, developed within ISRO, and uses a different process to burn fuel. It is closer to the designs of the Arianne rockets that were used by ISRO till a few years ago to launch its heavier rockets. This engine is being used in **LVM-3**.

2) CARTOSAT-2 BROUGHT DOWN (FEB 2024)

- **Background**: The satellite was **launched in 2007 in SSPO**. Until 2019, the satellite equipped with over 12,000 coupled charged devices used its "panchromatic and multi-spectral cameras" to generate high resolution images that were extensively used for urban planning, monitoring of road networks, and water distribution, creation of land use maps, among others.
- **17 years after its launch**, Cartosat-2, the first of India's second generation of high-resolution imaging satellites primarily used in urban planning has been deorbited.
- With a descent into earth's atmosphere, all of its components would be disintegrated. It has led to reduction of collision risk and safe end-of-life disposal of the satellite.

3) GAGANYAAN

- **Introduction**
  - **Gaganyaan project** envisages demonstration of human spaceflight capability by launching **crew of 3 members** to an **orbit of 400 km for a 3-day mission** and bring them back safely to earth, by landing in India sea waters.
  - Assuming two important test flights (unmanned) in 2024 and 2025 are successful, the first crewed flight of the mission is scheduled for 2025.
  - The GSLV MK-III launch vehicle will be used to launch the Gaganyaan mission.
  - **Technically, it is a demonstration mission**: It will test various technologies required for human spaceflight, which remains the most complicated form of spaceflight, and demonstrate India's familiarity with their production, qualification and use.

- **Significance/ Need of HSP**
  - **First step towards future space programs** like having India's own space station and sending humans to moon and on other interplanetary mission. PM Modi has set the target of having a **space station by 2035** and **landing an Indian on Moon by 2040**.
  - **More R&D in space** – ISRO will be able to conduct micro-gravity experiment.
  - **Advances in Science and Technology**
  - **Strengthen India's Soft power**: So far, only **three countries** USA, Russia and China have executed Human Spaceflight at their own.
  - **Technological spin-offs will benefit other sectors.**
  - **Improvements in Higher Education** in the field of aeronautical engineering, aerospace engineering and physics.
  - **Employment Opportunities**
  - **Symbolism: Great power status** – Achievements in outer space are a marker of great power status.

- **Key components of Human Space Program (HSP)**
  - **Human Space Flight Centre (HSFC)** – A body set up by ISRO as a coordinating body for Gaganyaan called the Human Space Flight Centre (HSFC).

- Development of **Human rated launch vehicles** for carrying crew safely to space.
  - **All systems in LVM3 launch vehicles** are-reconfigured to meet human rating requirements and christened **Human Rated LVM3** (HLVM3). It will be capable of launching the orbital module to an intended LEO of 400 km.
  - **HLVM3** also consist of **Crew Escape System (CES)** powered by a set of quick acting, high burn rate solid motors which ensure that Crew module along with crew is taken to safe distance in case of emergency either at launch pad or during ascent phase.

- **Orbital Module**: It is the object that LVM-3 rocket will launch and place in LEO. It will be orbiting earth and comprises of Crew Module (CM) and Service Module (SM). It is fit with adequate redundancy considering human safety.
  - **CM** is the habitable space with Earth like environment in space for the crew. It can house upto three astronauts for a week.
    - **Technical details of crew module:**
      - It is of double walled construction consisting of pressurized metallic Inner Structure and unpressurised External Structure with Thermal Protection System (TPS).
      - It houses the crew interfaces, human centric products, life support system, avionics and deceleration systems.
      - It is also **designed for re-entry to ensure safety of the crew during descent till touchdown.** It includes parachutes to slow its descent to the ground once it descends from orbit.
      - It also include a **gynoid** (feminine robot) named '**Vyomamitra**' fit with sensors to track the effects of radiation and weightlessness, monitor capsule conditions, and sound alarms in the event of an impending emergency, aside from being able to perform some task.
  - **SM** will be used for providing necessary support to CM while in orbit. It is an unpressurized structure containing thermal system, propulsion system, power systems, avionics systems and deployment mechanisms.

- **Life Support System (Habitable Modules)** to provide an earth-like environment to crew in space.
  - **Building a habitable module** in which astronauts will live and work. Such environmental control systems are being developed.
  - **Other life support systems** – Space suits etc.

- **Precursor Missions** for demonstrating the technology preparedness levels before carrying out the actual mission. This includes Integrated Air Drop Test (IADT), Pad Abort Test (PAT), and Test Vehicle (TV) flights.

- **Crew Training Facility established** in Bengaluru caters to Classroom training, Physical Fitness Training, Simulator Training and Flight suit training.
  - **Training Modules** cover academic courses, Gaganyaan Flight Systems, Micro-Gravity familiarization through parabolic Flights, Recovery & Survival training etc. **Aero medical training,** Periodical Flying Practice and Yoga are also included as part of the training.
  - **Note**: A shortlist of candidates was sent to Russia for advanced training.

- **Astronaut Training –** to live in a gravity less environment.
- **Capabilities for recovering astronauts safely.**

- **Other Steps taken so far**:
  - **Space Borne Assistance and Knowledge Hub for Crew Interaction (SAKHI)**: A multipurpose app developed by Vikram Sarabhai Space Centre that will help astronauts on Gaganyaan space flight mission carry out a range of tasks such as looking up vital technical information or communicating with one another. It will also monitor the health of astronauts, alert them about their dietary schedule etc. It will also help them stay connected with Earth. It will keep the crew connected with the onboard computer and ground-based stations, guaranteeing a seamless communication link.

  - **Pilots have been selected** and the identities of the four astronaut-designates, all IAF test pilots, were revealed in Feb 2024. The final crew for the mission will be chosen from among the four. **Prashanth Balakrishnan Nair, Ajit Krishnan, Angad Pratap** and **Shubhanshu Shukla** – are all airforce pilot.

  - In 2018, the Union Cabinet had allocated Rs 10,000 crore for the program.

A) CE-20 CRYOGENIC ENGINE IS NOW HUMAN RATED (FEB 2024)

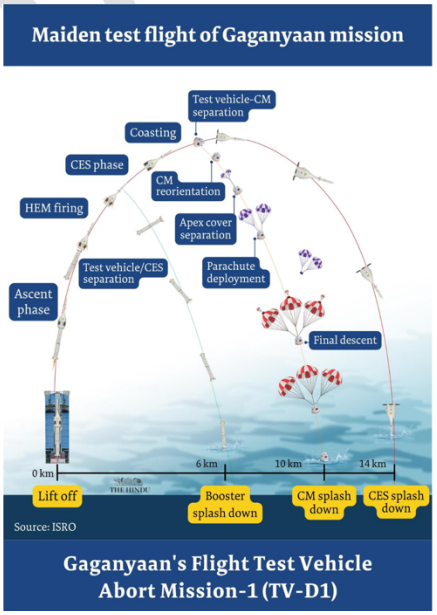
- **Human rating** refers to rating a system that is capable of safely transporting humans.

- ISRO has achieved a major milestone in the human rating of its CE20 cryogenic engine which powers the cryogenic stage of the human rated LVM3 launch vehicle for Gaganyaan missions, with completion of the final round of ground qualification tests.
- The final test was carried out on Feb 13, 2024. It was the seventh in the series of vacuum ignition test carried out at High Altitude Test Facility at ISRO propulsion Complex, Mahendragiri, to simulate flight conditions.
- According to ISRO, the ground qualification tests for the human rating of the CE20 engine involved life demonstration tests, endurance tests and performance assessment under nominal operating conditions as well as off-nominal conditions w.r.t thrust, mixture ratio, and propellant tank pressure.
- **All the ground qualification test** of the CE20 engine for the Gaganyaan programme have been successfully completed.

B) GAGANYAAN FIRST FLIGHT TEST VEHICLE ABORT MISSION-1 (TV D-1) WAS SUCCESSFULLY ACCOMPLISHED (OCT 2023)

- The purpose of the TV-D1 mission was to **demonstrate the Crew Escape System** for the Gaganyaan program through a test vehicle demonstration in which the vehicle went up to a Mach number, which is slightly above the speed of sound, and initiated an abort condition for the Crew Escape System to function.

- **Outcome**: TV-D1 Mission was fully achieved and that the Crew Escape System (CES) performed as intended.



4) SHIVA SHAKTI

- **What happened?**
  - The **IAU working group for Planetary System Nomenclature** has approved the name '**Station Shiv Shakti**' for the landing site of **Chandrayaan-3's Vikram** lander. The approval was given on 19th March 2023.

- **About International Astronomical Union**:

- The International Astronomical Union (IAU) was founded in 1919. It's an **NGO** with mission to promote and safeguard the science of astronomy in all its aspects, including research, communication, education and development, through international cooperation.
- The IAU consists of **Individual members**, who include both **professional astronomers and junior scientists**, and **national members**, such as professional associations, national societies, or academic institutions.
- Its **individual members** – structured into Divisions, Commissions, and Working Groups – are **professional astronomers** from all over the world, at the Ph.D. level and beyond, who are active in professional research, education and outreach in astronomy. It also has junior members.
- Among other tasks of the IAU are the definition of fundamental astronomical and physical constants, **unambiguous nomenclature** and informal discussions on the possibilities for future international large-scale facilities.
- Further, the **IAU serves as international authority for assigning designations** to celestial bodies and **surface features** on them. This authority was also recognized by the United Nations in 1982 in **UN Resolution 13 on Extraterrestrial features names**.
- The IAU also work to promote research, education, and public outreach activities in astronomy for the public.

- **How astronomical sites are named?**
  - **Why naming?**
    - According to the **Gazetteer of Planetary Nomenclature**, planetary nomenclature, like terrestrial nomenclature, is used to uniquely identify a feature on the surface of a planet or satellite so that it can be easily located, described, and discussed.
    - This gazetteer contains detailed information about all names of topographic and albedo features on planets and satellites (and some planetary ring- and ring-shaped systems) that the IAU has named from its founding in 1919 through the present time.
  - **IAU Rule 4** states: "**Solar system nomenclature** should be international in its choice of names. Recommendations submitted to the IAU national committees will be considered, but final selection of the names is the responsibility of the International Astronomical Union. Where appropriate, the [working group] strongly supports an equitable selection of names from ethnic groups, countries, and gender on each map; however, a higher percentage of names from the country planning a landing is allowed on landing site maps.
  - **IAU's Rule 9 states**: "No names having political, military or religious significance may be used, except for names of political figures prior to the 19th century.
  - **Note**: The **Astrogeology Science Centre of the U.S. Geological Survey** maintains the Gazetteer of Planetary Nomenclature on behalf of the IAU with funding from NASA.
- **About Station Shiv-Shakti**:
  - In Aug 2023, PM Modi announced that the **point where the moon lander of Chandrayaan-3 touched** will be called '**Shiv Shakti**'.
  - IAU has accepted this name.

- The citation for the name in the **Gazetteers reads**: "Compound word from Indian mythology that depicts the masculine ("Shiva") and feminine ("Shakti") duality of nature; Landing site of Chandrayaan-3's Vikram Lander".

5) SKYROOT SUCCESSFULLY TEST FIRES STAGE-2 OF VIKRAM-1 SPACE LAUNCH VEHICLE (MARCH 2024)

- **About Skyroot Aerospace:**
  - It is an Indian, private sector, space enterprise based in Hyderabad, Telangana, India. In 2020, when GoI announced opening up of the space sector, it became the first startup to sign an **MoU with ISRO to launch a rocket**.

- **Rockets being Developed by Skyroot**:
  - It is producing a series of Vikram Rockets named after Dr. Vikram Sarabhai. The goal is to launch small satellites using this rocket.

  - **Vikram-S**: In 2022, Skyroot created history by launching India's first privately developed rocket Vikram-S.
    - It is a single stage sub-orbital rocket. It is India's first privately developed cryogenic hypergolic liquid and solid fuel-based rocket engine. It was developed using advanced composite and 3-D printing technologies.
    - In its **first flight**, in Nov 2022, it carried three customer payloads in a sub-orbital flight. It was launched from the sounding rocket complex of the ISRO's Satish Dhawan Space Centre in Sriharikota, Andhra Pradesh. It achieved a peak altitude of 89.5 kms and has met all flight parameters. This mission was called **Prarambh Mission**.

  - **Vikram-1** is being developed to carry 480 kg payload to Low inclination Orbit.
    - **In March 2024**, Skyroot has successfully test fired the **Stage-2** of Vikram-1 space launch vehicle, called **Kalam-250**, at the propulsion test bed of the ISRO, at its SDSC, in Sriharikota, Andhra Pradesh.
    - Stage-2 is a critical stage for space launch vehicles as it carries the launch vehicle from atmospheric phase to the deep vacuum of outer-space.
    - **KALAM-250** is a high strength **carbon composite rocket motor**, which uses **solid fuel** and a high-performance Ethylene-Propylene-Diene terpolymers (EPDM) Thermal Protection System (TPS). It also houses a carbon ablative flex nozzle along with high-precision mechanical actuators for thrust vector control of the vehicle, which helps the rocket achieve the desired trajectory.
      - **Note**: EPDM is a durable material made to withstand the toughest conditions. It can withstand high temperature and abrasive chemicals.
    - The test also had an important contribution from **Vikram Sarabhai Space Center** (VSSC), which supplied its proprietary head-mounted safe arm (HMSA) for the test, used for the safe operation of the rocket stage.

- The Solid propellant in Kalam-250 was processed by **Solar Industries** at their Nagpur facility.
- The test lasted for 85 seconds and recorded a peak sea-level thrust of 186 KN.
- **Note**: Skyroot have already tested the stage-3 of Vikram-1 called **Kalam-100** in June 2021.
- **Note**: Vikram-1 is the first private orbital rocket launch.
- **Testing of Stage-2** is a milestone for Indian Space Industry, marking the successful test of the largest propulsion system ever designed and developed by the Indian private sector so far.
- **Skyroot** team expects to reach its maiden orbital launch of the Vikram-1 by 2024.

» **Vikram-2** which will follow Vikram-1, will carry 595 kg to low inclination orbit.
» **Vikram-3** will carry 815 kg to Low inclination orbit.

- Skyrocket also says that the rockets will be able to undertake multi-orbit insertion and inter-planetary missions as well as offer "customized, dedicated and ride share options covering a wide spectrum of small satellite customer's needs".

- **Significance of these initiatives**
  » Step towards privatization in space sector. This will bring innovation and youthful energy in the sector and is also expected to increase investment.
  » Huge future potential as the demand for launching small satellites is growing.
  » Scope to increase India's share in space sector. India's current share in the space economy is only 2%. PM Modi has been calling it to be increased to 10%.

6) INTUITIVE MACHINE – 1 (IM-1) (ODYSSEUS): USA'S PRIVATE SPACECRAFT ODYSSEUS LAND ON MOON (FEB 2024)

- **Why in news?**
  » US achieves first moon landing in 50 years with private spacecraft Odysseus (Feb 2024)

- **The Intuitive Machines 1** (IM-1, TO2-IM) mission objective was to place a NOVA-C lander, called **Odysseus,** at Crater **Malapert A** near the south pole of the Moon.
  » **Rocket:** The uncrewed mission was sent on its way to the moon **atop Falcon 9 rocket** launched by Elon Musk's company SpaceX from NASA's Kennedy Space Center in Cape Canaveral, Florida.

- **Success:**
  » **Spacecraft Odysseus** built and flown by **Texas-based company Intuitive Machines** landed near the south pole of the moon. This is the first US touchdown on lunar surface in more than 50 years. Before this a US Spacecraft to land on Moon was **Apollo 17 in 1972**, when NASA's last crewed moon mission landed there with astronauts Gene Cernan, and Harrison Schmitt.

» This is the first ever **achieved entirely by private sector**.

» This is also the first landing under NASA's Artemis lunar program. A host of small landers like **Odysseus** are expected to pave the way under NASA's Commercial Lunar Payload Services (CLPS) program, designed to deliver instruments and hardware to the moon at lower costs than the US Space Agency's traditional method of building and launching those vehicles itself.

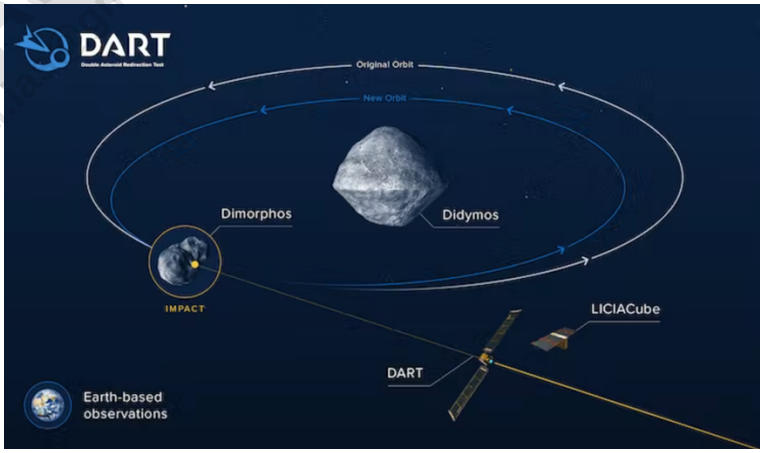
» The robotic lander is dubbed **Odysseus** and consist of six legs. It landed at a **crater named Malapert A** near the moon's south pole.

- **Payloads**: The vehicle is carrying a suite of scientific instruments and technology demonstration for NASA and several commercial customers **designed to operate for seven days on solar energy before the sun sets over the polar landing sites**.

- **Note**: So far, **spacecrafts from only five countries** have **landed on Moon** – USA, USSR, China, India and Japan.

7) DART MISSION CHANGED THE SHAPE OF DIMORPHOUS (MARCH 2024)

- **Why in news?**
  - Collision with NASA spacecraft altered shape of asteroid Dimorphos (March 2024: Source: TH)
- **Introduction**
  - DART is a **planetary defense-driven test of technologies** for preventing an impact of Earth by a hazardous asteroid.
  - Under this NASA launched a mission in Nov 2021, aboard Space X Falcon 9 rocket. It sent a space capsule of the size of a fridge towards an asteroid to shoot it off course. The target asteroids were 11 million kms away from Earth and DART mission reached here after 11 months of journey.
  - **Target Asteroid:**
    - DART's test target was an **asteroid (Diomorphos/Didymos B)** that passed the earth in 2022 and will come back two years later.
    - It's primary body (Didymos A) is approx. 780 meters across, its secondary body (or "moonlet") – Dimorphos/ Didymos B is about 160 meter in size, which is more typical of the size of asteroids that could pose the most likely significant threat to Earth.



    - NOTE: DART's target asteroid was **NOT** a threat to earth, and it is only a test mission.
  - In Sep 2022, this space capsule was crashed into Dimorphous/Didymos-B.
  - It used **autonomous targeting**, using images of the asteroids it acquires as it approaches. DART needed to recognize the asteroid itself, automatically lock onto Dimorphous, and adjust its trajectory to hit it. This is while it was moving at a speed of 24,000 km per hour.

- **Aim of the project**: Prepare to save earth from future threat of asteroids.

- **Technology**
  - DART is the first mission to demonstrate the **Kinetic Impactor Technique** - striking the asteroid to shift its orbit - to defend against potential future asteroid impact.

- **Aim of this test**: Evaluate weather Kinetic Impactor technique can be used to deflect an object (Dimorphous/Didymos B) from its orbit.

- **Why Didymos system was chosen**?
  - Because it is a binary pair, it will be possible for astronomers on Earth to **assess the results of the impact**.
  - These asteroids post **no risk to Earth** and have been chosen as the target for partly due to that fact.

- **How observations were made:**
  - Measurements from telescopes on Earth.
  - **LICIACube**: It is an Italian Space Agency CubeSat (a small type of satellite) that was deployed from a spring-loaded box aboard the craft on 11th Sep. LICIACube followed along and photographed the collision and its aftermath.

- **Outcome:**
  - For the **first time**, humans have demonstrated that it was possible to change celestial object's trajectory, if needed, to protect earth. The impact shortened Dimorphos' orbit time by 32 minutes.
    - **Proof**: The test was a proof of concept for many technologies, that NASA has invested over the last few years.
  - **Collision** has also changed asteroid's shape.
    - Before the DART encounter, the Asteroid was a bit plump in the waist, now appears to be shaped more like a watermelon – or, technically, a triaxial ellipsoid.
    - Scientists say that the **shape change was so dramatic** because of its rubble-pile composition.
  - **DART** has also given some fascinating data about both asteroid properties and the effectiveness of a kinetic impactor as a planetary defence technology.

8) JAPAN'S SLIM (SMART LANDER FOR INVESTIGATING MOON)

- **Japan** has become the fifth country to land on Moon when its spacecraft SLIM landed on the Lunar surface in Jan 2024. Before this, USA, USSR, China and India had reached moon.
- **SLIM (**nicknamed **Moon Sniper)** is a lightweight spacecraft about the size of a passenger vehicle.
- It **aimed for a pinpoint target**. While most previous probes have used landing zones about 10 kms wide, **SLIM was aiming at a target of just 100 meters** (330 feet). It was a product of **2 decades of work on precision technology** by Japan Aerospace Exploration Agency, JAXA.

- **Successful**: **Japan** has confirmed that its moon lander successfully achieved its pin-point landing on the moon on 19th Jan 2024

9) COSMIC MICROWAVE BACKGROUND RADIATION (CMBR)

- Cosmic Microwave Background (CMB) is a cooled remnant of the **first light** that could ever travel freely throughout the universe. This fossil radiation is the 'furthest that any telescope can see' and was released soon after the '**Big Bang**'.

- CMBR is electromagnetic radiation as a remnant from an early stage of the Universe in Big Bang Cosmology. It is an all-pervasive, but weak, electromagnetic radiation from early universe, when matter was still to be formed.

- **This radiation doesn't come from any of the object that we see in the universe around us** (like stars and galaxies). It is coming from the time when these things were still to be formed. Thus, they are relic from an early universe when matter and radiation were in Thermodynamic Equilibrium.

- It was first discovered in 1964 and since then has emerged as an **important source of information on the early universe**.
- **Spectrum of CMBR**
    - Spectrum produced by CMB **is very smooth**. It does, however, contains some wiggles, or deformities, in its shape.
    - These wiggles encode information about specific events that can be expected to be found from in the CMB spectrum in different scenarios.
    - It is believed that the neutral hydrogen pervading the cosmos during dark ages absorbed some of the CMB radiation to produce an **extremely small dip in the frequency of spreading radio waves**.
    - **Thus far** theory and actual observations of CMB spectrum have matched perfectly.

- **Key things that scientists have learned from CMBR.**
    - From CMBR, scientists have inferred that the **early Universe was filled with hot, dense and extremely uniform gas, mostly hydrogen** and that the first stars were formed when these blobs of gases came together. That is when visible light also made its first appearance. Scientists refer this phase as **cosmic dawn.**

    - It also gives evidence that **Universe expanded from an initial violent explosion**. Cosmic Microwave radiation have become less energetic due to the redshift which also gives evidence of expanding universe.

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10) SOME TELESCOPES PLANNED ON THE FAR SIDE OF THE MOON TO STUDY COSMIC MICROWAVE BACKGROUND (CMB) RADIATION (APRL 2024)

- **Need**: Terrestrial telescopes can't properly detect the frequency drop in the CMB radiation.
- **Advantages of placing telescopes on the far side of the moon (rather than on earth)**
  - » **No atmosphere**: On earth, the telescope has to peer through layers of atmosphere.
  - » **No pollution or artificial lighting**: On earth, it is becoming difficult for telescope to see through pollution or artificial lighting.
  - » **Long night of Moon**: On moon, one night lasts 14 days thus ensuring dark skies for observation for longer period.
  - » **Earth's ionosphere** also blocks radio waves from reaching earth. And an orbiting telescope also receive radio noise from the whole planet along with signals from outer space.

- **Therefore, scientists are seriously considering an idea they have toyed with since the 1950s**: Placing optical and radio-telescopes on the far side of the moon, which always faces away from earth.
- **Different agencies working towards sending satellite on far side of the moon**:
  - » **NASA-Berklee Joint Project – LuSEE Night** (Lunar surface electromagnetic Experiment): It is scheduled for launch in Dec 2025 and will launch on the far side of the moon and almost exactly opposite from the earth. This location is useful because it best shields radio frequency noise coming from the earth.
  - » **NASA's Long Baseline Optical Imaging Interferometer** is scheduled to be launched in parts before this decade is out.
  - » **China** also plans to send a moon orbiting radio telescope scheduled for launch by 2026.
  - » India's **PRATUSH** (Probing ReionizATion of the Universe Using Signal from Hydrogen) plans to orbit the moon and study the background radiation when it is on the far side of the moon. The telescope is being built by Raman Research Institute (RRI) in Bengaluru with active collaboration from ISRO.
    - Initially, ISRO will be put around earth. After some fine-tuning, the space agency will launch it moonward. It will carry a wideband frequency-independent antenna, a self-calibrating analog receiver and a digital correlator to catch radio noise in the all-important signal from the Dark ages.

11) MOONS IN SOLAR SYSTEM

- **How Many Moons are there in our Solar System**
  - » According to the latest data by NASA, planets together have **293 confirmed moons** now.
    - **Saturn** (146**) and Jupiter** (95), with total 241 account for more than 80% of these.
    - **Uranus** (28) and **Neptune** (16) are other planets with a greater number of Moons.
    - **Mars** (2) and **Earth** (1) are other planets with Moon in the solar system.
    - **Pluto** (It is a dwarf planet and not planet) also have five moons.

  - » **Why this kind of distribution?**

- **Mercury** is too close to sun and its gravity will not be able to hold on its own moon. The moon there would crash into Mercury or start orbiting around Sun.
- Scientists are **not yet sure about why Venus doesn't have a moon**.

» **Moons are classified into two separate categories.**
- **Regular Moons**: Moons which have prograde orbits (they orbit in the direction of the planet rotation) and lie close to plain of their equators.
- **Irregular Moons** can have pro or retrograde orbits and often lie at extreme angles to the planet's equators. Irregular moons are probably minor planets that have been captured from surrounding space. Most irregular moons are less than 10 kms in diameter.

- **Important Moons**
  - » Largest: **Ganymede** (Jupiter), Titan (Saturn), Callisto (Jupiter) etc.
  - » **Note**: Ganymede (though a moon) is bigger than Mercury and Pluto.

- **Number of Moons by dwarf planets:**

Dwarf Planet	Number of Moons
Ceres	0
Pluto	5
Haumea	2
Make make	0
Eris	1

A) GANYMEDE

- **About Ganymede:**
  - » It is the largest moon of our solar system, larger than planet Mercury and dwarf Planet Pluto. It is the **only natural moon in the solar system with a known magnetic field**. The magnetic field causes auroras.
  - » It's an ice-covered world that may hold more water than all the earth's water combined. But unlike Earth, Ganymede's oceans are below its 100-mile-thick icy crust.

- **Details of Water Vapor at Ganymede**:
  - » Astronomers using archival data from NASA's Hubble Space Telescope found evidence of water vapor in the thin atmosphere of Jupiter's Moon Ganymede. This water vapor may have come from sublimation of ice occurring on the surface of the moon.

B) CALLISTO

- **Why in news?**

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» An international team of scientists, including from India, has discovered strong evidence indicating the **presence of ozone on Jupiter's Moon Callisto**. (March 2024)

- **About CALLISTO**: Callisto is the 2nd largest moon of Jupiter (3rd largest of the solar system). More than its size, it is distinguished by its composition. Despite being as big as planet mercury, it is half as much mass. It is primarily composed of water ice, rocky materials, sulphur dioxide, and some organic compounds. These substances make moon a **potential candidate for supporting life in the Solar System** beyond the earth.
- **A study was published in March 2024** issue of the journal *Icarus*. It outlines the researchers' investigation into the chemical evolution of "SO2 astrochemical ice", which is ice primarily composed of SO2 in the presence of ultraviolet irradiation. This shed light on the chemical process and composition on the surface of **Callisto**. By analyzing the data of the UV absorption spectra of the irradiation ice samples, the team was able to **identify a distinct signature indicating the formation of ozone**.
- **Significance of Ozone**: the presence of ozone is crucial for life to exist. In the absence of ozone layers, UV-B and UB-C radiation reaching the surface will make the possibility of life less probable.
  - » The discovery of ozone also suggests presence of oxygen, which in turn is a fundamental ingredient required for the formation of complex molecules, required for life (as we know it), such as amino acids, raising question about moon's habitability. This extends to other icy moons in our Solar System, potentially informing our understanding of habitable conditions beyond Earth.

12) BINARY STARS EATING THEIR OWN PLANTS

- **Why in news?**
  - » A study of 91 pairs of stars finds that about 8%, or 1/12, swallowed up a planet at some point in their lives (March 2024)

- **Understanding Twin Stars (Or Binary Stars)**:
  - » A binary star or binary star system is a system of two stars that are gravitationally bound to and in orbit around each other. Binary stars in the night sky that are seen as a single object to the naked eye are often resolved using a telescope as separate stars, in which case they are called **visual binaries**.
  - » Stars in binary system don't necessarily have the same mass, size or brightness. The larger star of a binary couple is called the primary star, while the smaller one is known as the secondary star or the companion star.
  - » **Note**: **Binary stars are not rare**.
  - » It is estimated that around **85% of stars** exist in binary star systems or systems with three or more stars. **Single stars account for just 15% of all stars**.

- **Twin Stars** born at the same time should have a virtually identical composition, as they are both born from the same parent cloud of gas and dust.
    - » Any major chemical differences between these so-called "co-natal" stars may thus be a sign that one devoured a world.

- **A new study** by researchers used the **European Space Agency's Gaia satellite** to identify 91 pairs of stars.

- **How is composition of a star understood**?
    - » Within each travelling pair, the stars sit relatively close to one another – less than a million astronomical unit apart – and are likely co-natal. Scientists **analyzed lights coming from distant stars**. When **molecules are heated, they give off unique spectrum** of light wavelengths corresponding to the element's they are made up of. Scientists analyzing light coming from distant stars can therefore deduce the stars' elemental composition as stellar molecules are exposed to very high temperatures.
    - » The scientists **utilized** the European Southern Observatory's Very Large Telescope in Chile, the Magellan Telescope, also found in Chile, and the Keck Telescope in Hawaii to analyze the light from these co-natal stars. The found that about 8% of these pairs – about one in 12 – had one star that displayed signs it had **engulfed a planet**. In other words, its chemical makeup differed from its twin.
    - » **Note**: The study was analyzing stars in their prime phase engulfing the planets (not the Red-Giant phase) engulfing the planet.

- **Significant Understanding**: Stable Planetary Systems like our own solar system might not be a norm.

13) HIGH ALTITUDE PSEUDO SATELLITES (HAPS)

- **Why in news?**

  Why India wants to develop high-altitude pseudo-satellite vehicles, powered by the Sun (Feb 2024)

- **In Feb 2024**, the Bengaluru based **National Aerospace Laboratories** (NAL) successfully flew a prototype of new generation unmanned aerial vehicle (UAV). It is being seen as a huge breakthrough as it can fly at Great Heights, about 20 km above ground and runs **entirely on Solar Energy**. It can also **remain in the air for months on end**. Such UAV belong to the class of flying objects **called HAPS**, or **High-Altitude Pseudo Satellite Vehicles**, or '**HALE" High Altitude Long-endurance vehicles**.

- **Uses of HALES/HAPS**:
    - Surveillance and Monitoring
    - Disaster Management

- **Advantages of HAPS over UAV**s and **Satellites**.

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- **UAVs are battery powered** and thus can't stay in air for long duration.
- **Drones** fly at **relatively low height**, and thus their vision is restricted to small areas.
- **Satellites** in LEO move very fast and thus can't continuously watch the same point and Satellites in Geo stationary orbit are too expensive for these purposes and are very far to give a clear picture of ground.
- **HAPS** will overcome these challenges.

- **HAPS technology** is still under development. Several countries, and companies, have developed and flown such vehicles with encouraging success, but none has mastered the technology yet. The world record for a vehicle of this class is held by the **Airbus-manufactured Zephyr**, which flew for continuously 64 days in 2022 before crashing.

- **What about prototype tested by NAL**?
  - It flew for 8.5 hours. Next time, NAL wants to go for 24 hours. The full-scale machine that NAL is planning to build by 2027, would be aiming to remain in the air for **90 days** at a stretch.

- **HAPS** is another technology where India is entering the race at a **relatively early stage**.

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TARGET PRELIMS 2024
BOOKLET-39; S&T-13
NANO-TECHNOLOGY, ROBOTICS

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1. NANOTECHNOLOGY

- **N**anotechnology is science, engineering, technology, conducted at the nanoscale which is 1 to 100 nanometers. Nanotechnology and Nanoscience involve the ability to see and to control individual atoms and molecules. In other words, nanotechnology is the engineering of the functional system at molecular scale.
- Richard Feynman, the father of nanotechnology, in his 1959 talk described nanotechnology as a field which can manipulate and control things on the scale of a nanometer. He expected that matter will have surprising properties at Nano level and thus provide for enormous number of applications.

1) APPLICATIONS OF NANOTECHNOLOGY

- **Carbon Nanotubes** are used in various products ranging from paints and textiles to medical diagnostics tools and components of future quantum computers because of remarkable properties such as very high elastic strength alongside low mass density or very high current densities with no heat loss.

- **Electronics**
  - **Graphene** is used in transparent electrodes for solar cells, LCD, robust non-volatile atomic switches, chemical and biological sensors and in spintronic devices.
  - **Semiconducting nanowires** are highly versatile optoelectronic components, for a wide variety of applications such as nano-LEDs and nano-Lasers, solar cells, and biomedical sensors.

- **Health**
  - **Nanoparticles of silver** embedded into fibers have anti-microbial action. It is used in food packaging, clothing, disinfectants and household appliances. Bandages are being infused with silver nanoparticles to heal cuts faster.
  - **Gold Nanoparticles** have anti-bacterial properties
  - **Nano**medicines **–** Diagnosis and Treatment (see details separately)
  - **Water Purification: Special Filters using nanomaterials** can remove objects as tiny as viruses from water.

- **Nanotechnology in Agriculture –** Better fertilizers, pesticides, insecticides, feeds, better treatment for domesticated animals.
  - **Nano-Fibre based Agriculture Inputs**: For e.g., **FIB-SOL provides** a five-gram fiber that is soluble in water and can be applied on field using conventional or modern irrigation practices. The product addresses the demand for live bacteria that could rejuvenate the soil. It could also increase the nutrient utilization efficiency, allowing plants to assimilate nutrients in a better way.

- **Environmental Applications:**
  - **Iron nanoparticles** can be used to effectively clean-up organic solvents that are polluting the ground water. The nanoparticles disperse throughout the water and decompose the organic solvents in place.
  - Adding a **little boron to Carbon** while creating nanotubes produce solid, spongy, reusable blocks that can absorb large quantities of oil spilled in water.

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- **Nanotechnology based smart windows** have energy saving, easy cleaning, UV controlling and photovoltaic properties.
- **Renewable Energy Generation**
  - New and Cheap Solar Cells use nanoparticles of **Titanium oxide** coated with dye molecules to capture the energy of visible light and convert it into electricity.
  - A **novel catalytic nanosheet** from of a nickel molybdenum-nitride, a thousand time cheaper than traditional platinum, is the new model for harvesting hydrogen from water for use as fuel.

- **Structural Engineering Applications**
  - **Nano-enhanced Cement** contained by addition of nanoparticles like nano silica (silica fume), nanostructured metals, CNTs and carbon nanofibers give stronger, more durable, self-healing, air purifying, fire resistant, easy to clean quick compacting structure.
  - **Nano-enhanced Construction Ceramics** such as floor and wall tiles and sanitary ware have self-cleaning, anti-bacterial, hygienic and scratch resistant features.
  - **Nano-enhanced paints** can reduce emission of Nitrogen-di-oxide, hydrocarbons, and carbon monoxide in the atmosphere. It can also make paint scratch proof, easy cleaning, air purifying, UV resistant, water repellant, flame resistant, and anti-bacterial.
  - **Nanotechnology based smart windows** have energy-saving, easy cleaning, UN controlling and photovoltaic properties.
  - **Fire resistant glasses** are produced by addition of fumed silica nanoparticles in glasses.
- Nanotechnology can promote **different forms of insulation solutions** like coatings, vacuum insulations glazing and nanofoams.
- **Nano whiskers** on clothes create a cushion of air around the fabric so that liquids can't stain them.
- **Cosmetics:** Nanoparticles like Zinc oxides and titanium oxides are used in sunscreen and related products. They provide protection from UVA rays.

2) FUTURE POTENTIAL APPLICATIONS

- Advancements like **nano-machines** will lead to development in the field of nano-medicines, more advanced electronics circuitry, quantum computing etc.

3) CONCERNS AND LIMITATIONS

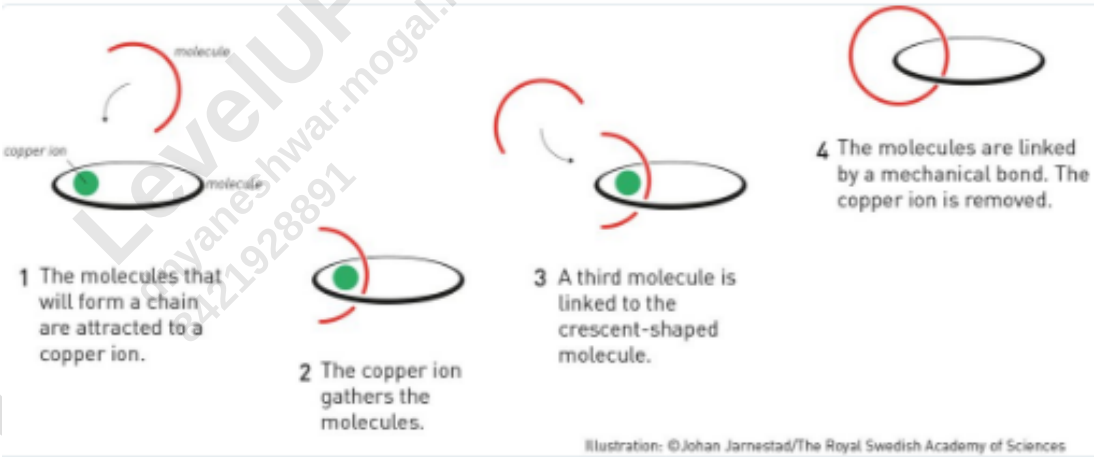
- Due to their extremely small dimensions, large surface area and high reactivity, they have the **potential ability to penetrate living cells** quite readily. As a result, their unique nano-features may also make them potentially hazardous for human health and environmental safety.
- **Health**
  - Inhaling airborne nanoparticles and nanofibers may lead to a number of **pulmonary diseases,** e.g. fibrosis. Some form of carbon nanotubes could be as harmful as asbestos if inhaled in sufficient quantities.
  - Experiments with rats have also shown impact on **skin (ageing) and brain**.
- **Toxicity**
  - Lack of investment on nanotoxicology research

- **Environmental impact**
  - **Lack of research on potential harmful impact:** Lack of study on Impact of nanomaterial on non-human species, on ecosystem or the global environment.
  - e.g. bacteriostatic **silver nanoparticles** used in socks to reduce foot odor are being released in the wash. These particles are then flushed into the wastewater stream and may **destroy bacteria which are critical component of natural ecosystem**, farms and wastewater treatment processes.
- **More dangerous Weapons**
  - As a general-purpose technology, it will be **dual use**, meaning it will have many commercial uses and it also will have military uses - making for **more powerful weapons and tools** of surveillance.
  - A technology this powerful could easily be misused. The rapid development cycle and massive manufacturing capability may lead to an **unstable arms race** between competing powers.
- **Other Concerns**
  - May lead to **loss of jobs** in traditional farming and manufacturing sector
  - May bring about **crash in certain markets** due to lowering of oil and diamonds due to possibility of developing alternative source of energy that are more efficient and won't require use of fossil fuels. Also, because people would be able to develop products at molecular level, diamond will lose its significance.
  - Atomic weapons may become more accessible and more powerful and more destructive.

4) MOLECULAR MACHINES OR NANO MACHINES

- Molecular Machine, or nano-machine, is any discrete number of molecular components that produce quasi-mechanical movements (output) in response to specific stimuli.

- **The 2016 Nobel Prize for Chemistry was awarded to 'Molecular Machine' trio:**
  - For the **design and synthesis of molecular machines**
  - **Details about their contributions**
    - » **Sauvage** in 1983 took the first step by linking two ring shaped molecule to form a chain



    - » **Stoddart** in 1991 developed a **rotaxane**, a dumbbell-shaped molecular structure that enabled him to **build molecular lift**, a molecular muscle and a molecule based computer chip

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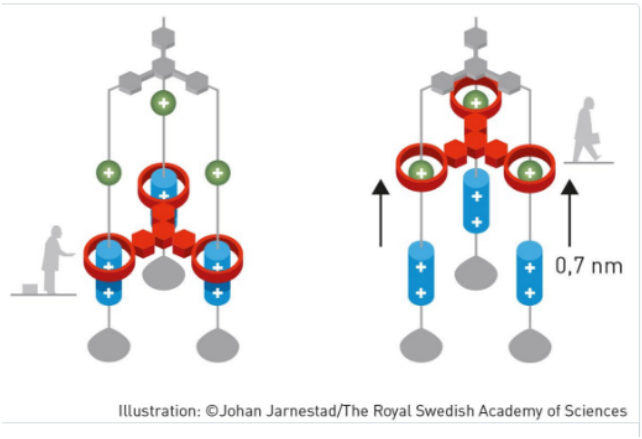
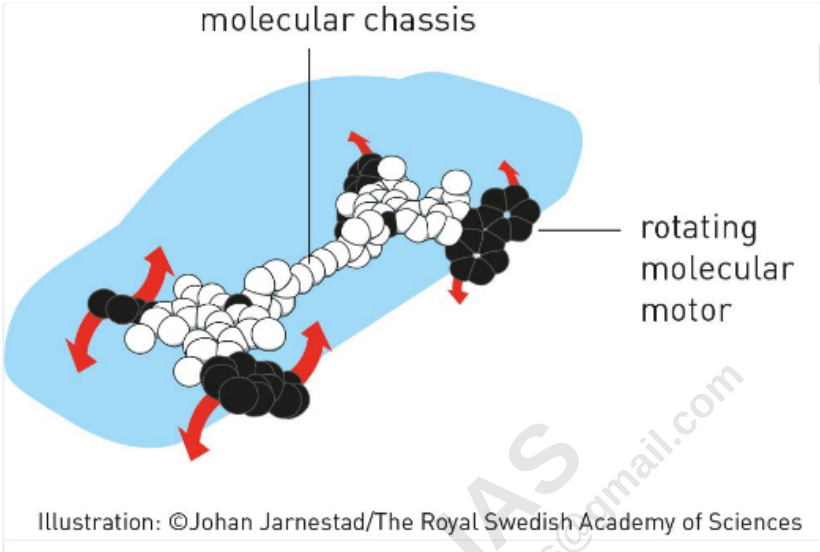


» Feringa in 1999 was the first person to develop a **molecular motor** and in 2011 designed a four-wheeled nano-car



- **Significance of those nano-machines**
  - These tiny machines that we can't even see have enormous potential.
  - » **Medicine and treatment**
    - Molecular technology could lead to development of machines that are so small they could be **swallowed or implanted into human bodies** with little negative effect.
    - They could be used to fight disease in the body, to repair damaged tissues, and even to probe DNA structure.
    - Such precise drug deliver will **minimize adverse side-effects**.
  - » **Smart materials** able to adapt to their environment, small sensors that can be controlled remotely, and drugs that are activated on command
  - » **Efficient energy storage devices**

5) EXAMPLES OF SOME MATERIAL

A) SCHWARZITE – NEW FORM OF CARBON CREATED – CLASS DISCUSSION

B) GRAPHENE

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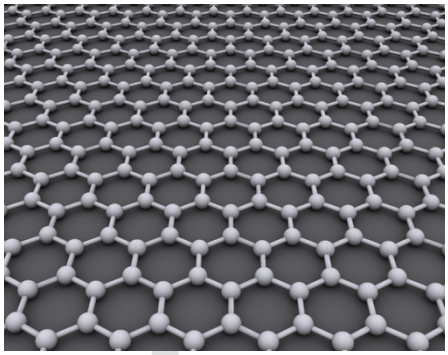
- It is an **allotrope of carbon** which is a one-atom thick layer of pure carbon. Carbon atoms are bounded together in a hexagonal honeycomb lattice.



- **How is it produced?**
  - By separating a single atom layer film from graphite.

- **Properties: Physical**
  - **2D** – world's first 2D material
  - Graphene is **harder** than diamond, **more elastic** than rubber, **tougher** than steel and yet **lighter than aluminum**.
    - In fact, it is 200 times stronger than steel (100 times stronger than the strongest steel).
  - **Thickness**: 1 million times thinner than a human hair
  - Stretchable as well as transparent, flexible and impermeable.
  - It can also act as **perfect barrier** – not even helium can pass through it.

- **Properties: Thermal, Electrical and Magnetic Properties**
  - **Highest electronic conductivity** of any material in the world.
  - **Best Heat conductivity** of any material in the world
  - Shows a **large and nonlinear diamagnetism.**

- **Applications:** Graphene's unique combination of extraordinary properties offer a fascinating material platform for the development of next-generation technologies in many areas.
  - **Energy Harvesting and Storage:** It can be used for better rechargeable batteries; superior capacitors; newer methods of making solar cells etc. Further, proton transfer in graphene shows promise for artificially mimicking photosynthesis.

  - **Electronics:** Very high electron conductivity allows graphene to be used for low-cost printable electronics, high performance transistors; thermal management and heat dissipation in nano-electronic devices.
    - **The optical properties** of graphene can also be controlled by doping and make it well suited for optoelectronic devices.

  - **Composites and Coatings:** Its low mass and low loading requirements make graphene standout as a reinforcing agent in composites. It can be used for making lubricants with enhanced anti-wearing capabilities; radiation shielding and lighting strike protection; superhydrophobic coating; transparent, flexible and conductive thin films etc.

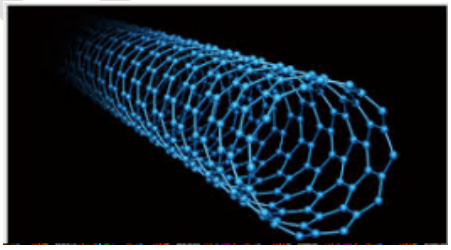
  - **Membranes** – It can improve the quality of filters used in desalination or other water purifying instruments. Graphene oxide is used for the purpose.
    - It can also act as gas barrier for e.g., in food packaging.
    - It can be used for separation of organic solvent with water.

  - **Biomedical Technologies:** Very high surface area, electron mobility etc. is paving the way for novel biomedical technologies. Graphene bioelectronics (transistors and electrode arrays) has become a ground-breaking field that offers existing opportunities for developing new

kinds of biosensors. Key **applications include** Thermal ablation of highly resistant cancer cells; Bioelectronics (bionics); Electronic interface to living cells and nerve tissues; etc.
    - **Sensors**: Since every atom of graphene is exposed, it is an ideal material for biological, gas and chemical sensors. It can be used for explosive detection; detecting biomarkers for Parkinson's disease; selective gas sensing; self-healable, multifunctional electronic sensor tattoos; environment monitoring etc.
    - Wearable technologies
    - Light weight cars, planes etc.

- **Health Risks:** Extensively debated.
    - Toxicity depends on several factors such as shape, size, purity, post-production processing steps, oxidative state etc.

C) CARBON NANOTUBES (CNT)



- **Intro**
    - » Carbon nanotubes are allotropes of carbon with a cylindrical nanostructure. These cylindrical carbon molecules have unusual properties, which are valuable for nanotechnology, electronics, optics and other fields of material science and technology.

- **Properties**
    - » Strength: One of the most tensile and elastic material discovered yet.

- **Wettability**
    - » Exhibits a super hydrophobic property.
    - » By applying a low voltage as low as 1.3 V, the extreme water repellants surface can be switched into super hydrophilic.

- **Electrical Properties**
    - » CNT are either metallic or semiconducting along the tubular axis.

- **Thermal Properties**
    - » All nanotubes are expected to be very good thermal conductors along the tube, exhibiting a property known as "ballistic conduction", but good insulators lateral to the tube axis.

- **Application**
    - » **Current uses and application** of nanotubes has mostly been limited to the use of bulk nanotubes, which is a mass of rather unorganized fragments of nanotubes.
    - » Used as composite fibers in polymers to improve the mechanical, thermal and electrical properties of the bulk product.
    - » Tips for atomic force microscope probes
    - » In tissue engineering, carbon nanotubes can act as scaffolding for bone growth.

- **Concerns:** Toxicity, health risk not clear yet.

6) ELABORATING ON SOME NANOTECHNOLOGICAL APPLICATIONS

A) NANOTECHNOLOGY IN HEALTH:

- **Medical Applications**:
  - » **Prevention of disease**:
    - **Nanoparticles of silver** embedded into fibers have anti-microbial action. It is used in food packaging, clothing, disinfectants, and household appliances. Bandages are being infused with silver nanoparticles to heal cuts faster.
    - **Gold Nanoparticles** have anti-bacterial properties.
    - **Water Purification: Special Filters using nanomaterials** can remove objects as tiny as viruses from water.

  - » **Diagnostics**
    - **By** studying and identifying individual molecules, it is possible to diagnose disease in time to improve the prognosis for the patient.

  - » **Improved Treatment**
    - Indian Institute of Nano Science and Technology (INST) is developing **Magnetic Hyperthermia mediated cancer therapy** - delivery and localization of magnetic material within the targeted tumour site followed by subsequent application of an alternating Magnetic Field (AMF), thereby generating heat at the tumour site.
    - E.g: **Scientist** are using gold **nanoparticles to target prostate cancer**. Here the nanoparticles or nano shells are made of small payers of Silica glass formed into a sphere and wrapped in a thin layer of gold. This is made to reach the tumour site and then harnessed to cause the tumorous tissue to pulse with extreme temperature when light is applied through a laser specifically designed to excite the particles
    - A team of scientists from IISc Bengaluru have developed nano robots to be used in dental procedure (like root canal therapy).
    - With more advancement in **Nanomachines –** complex surgical procedures would become less intrusive and less complicated.

USING NANOROBOTS FOR DENTAL PROCEDURE

- **Background/Need**
  - A significant percentage of root canal treatments fail, because the procedure leaves out some bacteria that are located deep within the dentinal tubules.

- **The new method:**
  - Scientists have developed **Spiral Silica robots** measuring 300 nanometers to travel through dentinal tubules and target bacterias.

MAGNETIC HYPERTHERMIA-MEDIATED CANCER THERAPY (MHCT)

B) ENVIRONMENTAL NANOTECHNOLOGY

- **Key areas where nano-material researchers are working:**
  i. **Ensuring Potable Drinking Water** – Use of Graphene based water filters are expected to increase the accessibility of clean drinking water in coming future

  ii. **Removing pollutants from water**
    - **Cleaning up organic chemicals polluting ground water**
      - **Iron nanoparticles** can be used to effectively clean-up organic solvents that are polluting the ground water. The nanoparticles disperse throughout the water and decompose the organic solvents in place. This method is more effective and costs significantly less than treatment methods that require the water to be pumped out of ground.
    - **Cleaning up of oil spills**
      - Using photocatalytic cooper tungsten oxide nanoparticles to break down oil into bio-degradable compounds.

  iii. **Generating Less pollution during manufacturing of materials**
    - E.g. Use of silver nano particles as catalysts can significantly reduce the polluting by products in the process used to manufacture propylene oxide.
      - Propylene oxide is used to produce common materials such as plastics, paint, detergents and brake fluid.

  iv. **Producing solar cells that generate electricity at competitive cost**
    - E.g. Silicon nanowires embedded in a polymer result in low cost but high efficiency solar cells.

  v. **Increasing the electricity generated by windmills**
    - E.g. use of carbon nanotubes in windmill blades results in stronger and lower weight windmill blades. This helps in more amount of electricity generated by each windmill.

  vi. **Reducing cost of fuel cells**
    - Changing the spacing of platinum atom in fuel cells increases the catalytic ability of the platinum. This allows the fuel cells to function with 80% less platinum, significantly reducing the cost of the fuel cells.

C) NANOTECHNOLOGY IN AGRICULTURE

i. **Nano-Fertilizers**

- **Introduction**:
  - India has become the first country in the world to have developed and roll out **nano-fertilizers**.
    - » So far, it has launched nano-versions of two fertilizers – Urea and Diammonium Phosphate (DAMP).
    - » While nano-Urea has been made available to farmers since late 2021, nano-DAP was launched in April 2023.

- **The Indian Farmers Fertilizer Cooperative Limited (IFFCO),** which had developed the variants using propriety technology, claims that Nano-UREA and Nano-DAP have several advantages over their conventional granular counterparts.

- **More Details:**
  - Both Nano-Urea and Nano-DAP come in liquid form.
  - IFFCO claims that a 500 ml bottle of nano-urea an replace at least a 45 kg bag of granular urea and a bottle of 500 ml nano-DAP can replace a 50 kg bag of granular DAP.

- **Advantages:** The Parliamentary Standing Committee on Chemicals and Fertilizers (2022-23), headed by Shashi Tharoor have enumerated several advantages of nano-fertilizers in its March 2023 report:
  - **Soil Health:** Nano-UREA can address the imbalanced and excessive used of conventional urea in the country, which accounts for around 82% of nitrogenous fertilizers applied to majority of the crops.
  - It costs lesser than subsidized conventional fertilizer thus **reducing the cost for farmers**.
  - They also result in **better productivity** and **higher income** for farmers.
    - The PSC report notes that it has average 8% higher crop yield.
  - Experts also believe that these nano-fertilizers will lead to **reduced import dependency of fertilizers** and save **forex reserves**.
  - It will also **contribute to reduced fiscal burden** of government because of reduced fertilizer subsidy cost.

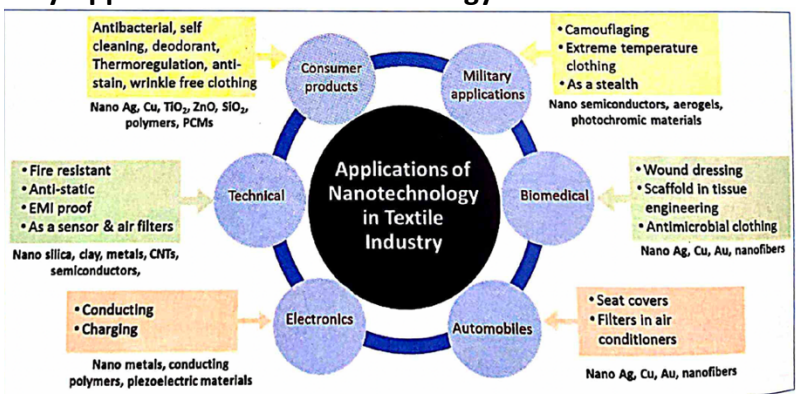
- **What is NANO UREA**
  - Fertilizer Minister, Mansukh Mandaviya has claimed that by 2025, India's domestic urea production as well as that of nano-Urea would together mean India would be "self-sufficient", in the manufacture of Urea and wouldn't require 90 lakh tonnes that it imported every year and would save the country close to Rs 40,000 crore.

- **When is Urea used in agriculture and when can it be replaced by Nano Urea?**
  - Urea is used on **two occasions** – at the time of sowing (or transplantation); and the second is done when the plant has sprouted a canopy of leaves and is approaching the reproductive phase of plant growth.
  - It is to be noted that **traditional Urea is still necessary during the initial stage**, as basal nitrogen, of crop development. The nano Urea could be useful once the plant grew after which the product could be sprayed on its leaves.

- **Limitations**:
  - **Doubts about Yield gain**: DTE has reported interviews of several farmers who had to resort back to traditional fertilizers after, nano-fertilizers didn't give good results.
  - **Labour cost for spraying fertilizer** is increasing the overall input cost for farmers.
  - **Complaints** about farmers being **forced** to buy Nano-Urea.
  - **Issue of Evaluation/Trial**: ICAR has given results of field trail based on a year (two seasons) of experiments in its affiliated labs. This was an exception as ICAR normally tests a new fertilizer for 2 years (or three seasons) before giving go ahead to a new fertilizer.

D) NANOTECHNOLOGY IN TEXTILES

Key Applications of Nanotechnology in textile sector



7) NANOTECHNOLOGY IN INDIA

- **Policies/Schemes/Programs**
  - **a. Mission on Nano Science and Technology (Nano Mission)**
    - **Introduction**
      - It is an umbrella program of GoI for overall development in the field of Nanotechnology.
      - It was launched in 2007 with an allocation of Rs 1,000 crore which was further extended during the 12th five-year plan.
      - It is structured in a fashion to **achieve synergy** between the national research efforts of various agencies in Nano Science and Technology and launch new programs in a concerted fashion.
      - Department of Science and Technology is the nodal agency for the mission.

    - **Objectives of the Nano-Mission**
      - **Basic Research Promotion** – funding of basic research by individual scientists or groups of scientists and creation of centre of excellence for pursuing this research.
      - **Infrastructure Development** for Nano Science and Technology Research -> development of a chain of facilities across the country.
      - **Human Resource Development** – Providing effective education and training to researchers and professionals in diversified fields. Launching of M.Sc./M.Tech programmes, create national and overseas post-doctoral fellowships, chairs in universities etc.
      - **International Collaborations** – Exploratory visits of scientists, organization of joint workshops, conferences and joint research projects, facilitate access to sophisticated research facilities abroad, forge academia-industry partnership.
      - Development of **product and processes for national development**
        - Especially in areas of national relevance like
          - Safe Drinking Water
          - Materials Development
          - Sensors Development
          - Drug Delivery

- **Achievements of the Mission**
  - The mission has resulted into more than 5,000 research papers and **some useful products** like nano-hydrogel based eye drops, pesticide removal technology for drinking water, water filters for arsenic and fluride removal and nano-silver based on anti-microbial textile coating.
  - India has moved from the fourth to the third position in the world in terms of scientific publications in nano-science and technology.

- **Institute of Nanoscience and Technology (INST):** It is an autonomous institute of the Department of Science and technology, GoI.

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2. ROBOTICS

1) LAWS OF ROBOTICS:

- **Isaac Asimov** gave the three laws of robotics as:
  - A robot must not harm a human being, or, through inaction, allow a human being to come to harm
  - A robot must always obey the human beings unless it is in conflict with the first law.
  - A robot must protect itself from harm unless it is in conflict with the first and/or second law.

1) WHERE ARE ROBOTS BEING USED CURRENTLY AND AREAS WHERE THERE IS A POTENTIAL TO USE ROBOTS

- Robotics is being used across a range of sectors such as:
- **Warehouse Automation**
- **Automotive manufacturing**
  - » They add precession, tirelessness and continuity in the manufacturing process.
- **Search and Rescue** after Disaster
  - » From collapsing building (due to faulty construction) to earthquake to flooding.
  - » IIT Hyderabad is working on a search-and-rescue robot called **SARP (Snake like articulated platform).** The engineering institute is applying several technologies in building **SARP**: navigation, camera, infrared, haptic feedback (to identify survivors) and collaboration (multiple snake robots can communicate with one another)
- **Defence & National Security**
  - » Whether it is with Pakistan or China, our borders are unsafe for border forces and human lives are getting lost whenever there is firing or illegal movement of people at LoCs.
  - » Government is looking at DRDO to develop next generation of robotic soldiers.
  - » **Other dangerous security tasks** like **bomb disposal**, **reconnaissance** etc can be performed by Robots.
  - » For e.g. **Daksha** is one of India's current military robots. It is used to locate, handle, destroy, risky objects safely and even can climb stairs.
- **Hazardous Industries**
  - » BARC is using robots to clean radioactive water tanks.
- **Mining and Mineral Extraction**
- **Marine Engineering**
  - » **Amogh** is an autonomous underwater vehicle. It is designated to inspect and repair bridges, pipelines and hulls of ships at the depth of upto 15 meters. The robot has an endurance capacity of upto 3 hours.

- **Space**
  - » Robots are used for exploration when humans can't be used.
  - » E.g., Fedor of Russia, Vyomamitra of India etc.

- **Health Sector**
  - » Robots are being used in operation theatres and rehabilitation centres to augment the quality of life.

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» Robots can also **assist surgical procedures** like removing gallbladders, performing hysterectomies and repairing knee ligaments.

- **Agri-Robots**
  » Can replace costly human labor and add precision in agriculture.

- They can be used *anywhere to improve productivity*.

2) ADVANTAGES OF USING ROBOTS

Accuracy
Untiring nature of robots
Non-complaining
Safety in hostile environments
Reducing cost of production
Industries facing global competition can't survive without robots
For e.g. the automobile industry can't actually survive without use of robotics

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TARGET PRELIMS 2024
BOOKLET-40; S&T-14
CA UPDATES ON S&T-2

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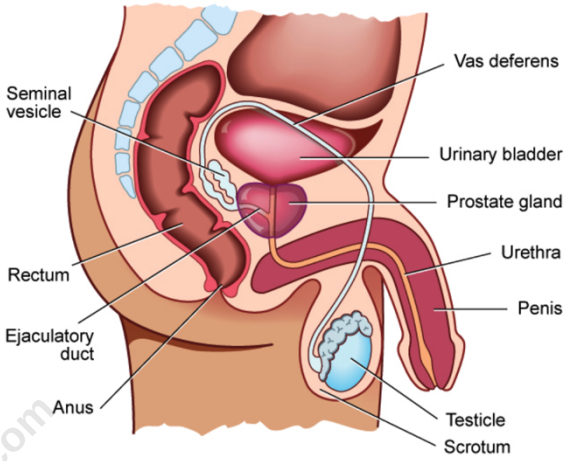
1. HEALTH

1) PROSTATE CANCER

- **What is Prostate?**
  - » Prostate is a gland which is part of **male reproductive system**.
  - » **What is the function of Prostate?**
    - ▫ Prostate contributes additional fluid to your semen (ejaculate). Ejaculate is a whitish grey fluid that release from your penis when you get orgasm. It contains enzymes, zinc and citric acid, which help nourish sperm cells and lubricate your urethra.
    - ▫ Prostate muscle also helps push semen into and through your urethra when you orgasm.
  - » **Location**: Prostate gland is located below the bladder and in front of your rectum. The urethra runs through the centre of the prostate.
  - » **Note**: **Women doesn't have prostate gland**. Women and people Assigned Female at Birth (AFAB) have Skene's gland. However, some people refer to Skene's gland as the female prostate gland.
  - » **Note**: Sperm is produced by Testes and not in Prostate.
  - » **Urethra**: It is the tube through which ejaculate and pee flow out of your body.



- **Prostate Cancer**: It is the one of the most common type of cancer that affects men and people assigned male at birth (AMAB).

- **Lancet Report (April 2024)**
  - » **Situation in India**:
    - » **Prostate cancer** accounts for 3% of all cancers in India, with an estimated 32K to 42K new cases diagnosed annually.
    - » Large proportion of cases are diagnosed in advanced stage which means that the **cancer has spread at the time of diagnosis**. Therefore, 65% of the patients die of the disease.
    - » **Prostate Cancer cases** in India will double to 71,000 new cases per year by 2040.
      - **Why?**
        - Ageing population and increasing life expectancy means there will be higher number of older men in the coming years.
        - The **main risk factors** are age and genetics, which, according to him, are **aggravated** by additional factors like smoking, obesity, a poor diet and lifestyle.
  - » **Global Scenario**:
    - » Globally cases are expected to double from 1.4 million per year in 2020 to 2.9 million per year by 2040 **with low and middle income countries predicted to see the highest increase**.
  - » **Recommendations**:

» Early testing in men over 60 as prostate cancer account for 3% of high risk cancers in India. This will pickup cancer at treatable stage.

2) H5N1 (BIRD FLU)

- **Since 2020**, a highly pathogenic version of bird flu, H5N1, has been spreading across the globe. It is becoming an existential threat birds and wildlife.

- The **virus** has infected birds in more than 80 countries (as of Dec 2023) and resulted in culling of millions of chickens and turkeys at commercial poultry farm. It also stuck numerous species of wild birds, such as gulls and terns, killing them by thousands.

- The **flu is also spreading to mammals**. Tens of thousands of seals and sea lions in different parts of the world have died due to the disease.

- The infection has also infiltrated mainland Antarctica for the time in history.

- **Factor behind large scale spread**: Largely unknown. Climate change could be one of the reasons. Soaring global temperature impact the behavior of birds in such a way that it exacerbates the spread of flu. These birds are forced to move to new territories and mix with species that they usually don't interact with, which possibly boosts the chances for the virus to spread even further.

3) INDIA TB REPORT, 2024: RELEASED BY MOH&FW IN MARCH 2024

- **Decline in 16% in TB incidence** (new cases emerging each year) since 2015.
  - » The incidence rate has fallen from 23.7 lakh population in 2015 to 19.9 million per lakh in 2022.

- **Decline in mortality due to TB** by 18% since 2015.
  - » Mortality rate has declined from 28 per lakh population in 2015 to 23 per lakh population in 2022, according to the India TB report 2024.

- **The gap between estimated number and actual cases of TB** is closing.
  - » There were only 2.3 lakh missing cases in 2023, as compared to 3.2 lakh the year before.
  - » This gap has been reducing over the years, specially with the government's Ni-Kshay portal tracking all TB patients.

- **Notification from Private sector**: Of all the TB cases notified in 2023, nearly 32% of notification came from the private health care sector which is an increase of 17% from the previous year.

- **Key Initiatives:**

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» After the COVID-19 pandemic, the National TB Elimination Program (NTEP) embarked on a journey towards accelerating TB elimination, guided by the National Strategic Plan (NSP) 2017-25.

» **NTEP**: It continued providing free diagnostic services, conducting approx. 1.89 crore sputum smear test and 68.3 lakh nucleic acid amplification tests (NAAT) in 2023.

» **DBT under the Nishay Poshan Yojana** continued to provide financial support to TB patients, with approx. Rs 2,781 crore disbursed to approximately one crore beneficiaries. It added that more than 1.5 lakh **Nikshay Mitras** have come forward and committed support persons affected with TB.

2. DEFENCE

1) AGNI-P (OR AGNI-PRIME)

- **Why in news?**
  - » New Generation Ballistic Missile Agni-Prime successfully flight tested by Strategic Force Command & DRDO (April 2024: Source - PIB)

- **Details**
  - » Agni P is **a new generation advanced variant of Agni class of missiles**. It is **a two stage, surface to surface, solid fueled, canisterized missile** with range capability between 1,000 and 2,000 kms. It is being developed by DRDO and will be successor of Agni-1 and Agni-2 missiles.
  - » It is the sixth missile in the Agni Series of **ballistic missile**. Since it is canisterized, it can be transported on train or stored in canister.
  - » It is also **lighter than earlier Agni Missiles**.

- **April 2024 Test**: Strategic Force Command (SFC), along with DRDO, conducted the successful flight-test of the New Generation Ballistic Missile Agni-Prime from Dr APJ Abdul Kalam Off the coast of Odisha. The **test met all the trial objectives** validating its reliable performance.
  - » Note: The missile was first tested in June 2021. Then in June 2023, the first pre-induction night launch was conducted by the users after three successful development trials of the missile, validating the accuracy and reliability of the system.

- **Background:**
  - » **Agni class of missiles** are the mainstay of India's nuclear launch capability which also includes the Prithvi short range ballistic missiles, submarine launched ballistic missiles and fighter aircraft. The longest of the Agni series, Agni-V, an Inter-Continental Ballistic Missile (ICBM) with a range of over 5,000 km, has already been tested several times and validated for induction.

2) AKASHTEER SYSTEM

- **Why in news?**
  - » Army inducts indigenous Akashteer system (April 2024)

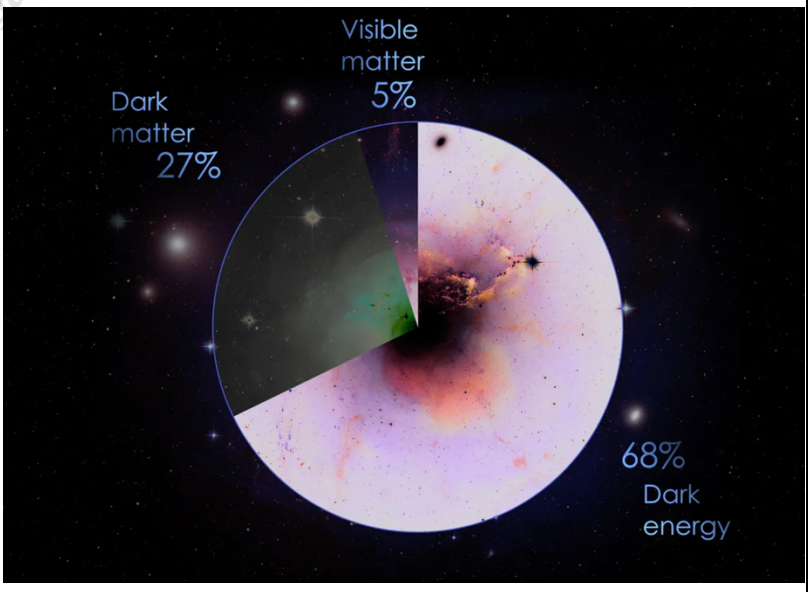
- **About Akashteer**:
  - » The Automated Air Defence Control & Reporting System 'Project Akashteer' is an initiative to **automated air defence control** and **reporting processes by digitizing the entire process**.
  - » It will empower the Air Defence Unit of Indian Army with an indigenous, state of art capability, **to effectively operate in an integrate manner**. It will enhance the operational efficiency and integration of the Army's air defence mechanisms.
  - » It will **enable monitoring of low-level airspace** over the battle areas of Indian army and effectively control the Ground Based Air Defence Weapon Systems.
- **In April 2024**, Army started induction of control and reporting systems under 'Project Akashteer' to bolster its air defence capabilities.
- **Earlier in May 2023**, Ministry of Defence had signed a contract with **Bharat Electronics Limited (BEL)** for procurement of Automated Air Defence Control and Reporting System 'Project Akashteer' worth Rs 1,982 crore for the Indian Army.

3. SPACE

1) BUILDING BLOCK OF THE UNIVERSE: NORMAL MATTER, DARK MATTER AND DARK ENERGY

- **Introduction**: Everything that we can observe in the universe is made of matter. **Matter** is defined as any substance that has mass and occupies space. But there is more to the universe than the matter we can see. **Dark Matter** and **Dark Energy** are mysterious substances that affect and shape the cosmos, and scientists are still trying to figure them out.

- **Normal Matter**: It makes up everything that we can observe. This matter can be seen by us in visible light with our own eyes or through a telescope that can detect light we can't see, like ultraviolet or infrared. It can exist as a gas, liquid, or plasma of charged particles. While normal matter is everywhere in our daily lives, it composes less than 5% of the total universe.



- **Dark Matter**: Like ordinary matter, dark matter takes up space and holds mass. But it doesn't reflect, absorb, or radiate light – at least not enough for us to detect yet. While scientists have measured that dark matter makes up about 27% of the cosmos, they're not sure what it is. **Theories** include several kinds of as-yet unidentified types of particles that rarely interact with normal matter.

» **How was Dark matter first understood**: In the 1930s, Swiss astronomer Fritz Zwicky coined the term while studying the Coma galaxy cluster. It contains more than 1,000 galaxies. The speed at which galaxies within a galaxy cluster move depends on the cluster's total mass and size. Zwicky noticed that **galaxies in the Coma Cluster were moving faster than could be explained by the amount of matter astronomers could see**.

- **Dark Energy**: It may be comprising roughly 68% of the universe, but **scientists know even less** about it than they do about dark matter. But **something like dark energy must exist to explain the universe's accelerating expansion**.

- Since the late 1920s, astronomers have known that the **universe is expanding**. In the 1990s, observations of distant star explosions, called supernova, showed that the **universe expanded more slowly in the past than it does now**. The reason for this remains unclear, but the leading explanation is that the universe contains something that has a **repulsive gravitational effect** – it pushes the universe apart instead of pulling it back together. This phenomenon is called dark energy.

1) DARK ENERGY SPECTROSCOPIC INSTRUMENT (DESI)

- An international team of scientists has released the **most comprehensive "three dimensional" map of the Universe**, which, scientists hope, **could reveal some clues about dark energy**, the mysterious force that is believed to be causing the universe to expand uncontrollably.
- The researchers, including a team from India's TIFR, has published its findings from the first year of observation by the **Dark Energy Spectroscopic instrument, or DESI.**
  - » DESI is a unique piece of equipment that, once fitted over a telescope, can capture light from 5,000 galaxies at the same time.
  - » **DESI** is measuring the effect of dark energy on the expansion of the Universe. It is obtaining optical spectra for 10s of millions of galaxies and quasars, constructing a 3D map spanning the nearby universe to **11 billion light years**.
  - » **The survey** is being conducted on the **Mayall 4-mter telescope** at Kitt peak national observatory, Arizona, USA.

- **The key thing** is that scientists have been able to **measure the distance between these galaxies** with a very high degree of accuracy. This is why **scientists are calling it a 3-D Map**. Knowing the precise distances of the galaxies is crucial because that allows us to **calculate the expansion rate of the Universe**. This can offer first clues into the mystery of dark energy.

- **Some important information provided by DESI**:
- The DESI collaboration has measured that the expansion rate of the Universe was increasing by 68.5 km/s after every 3.26 million light year of distance, a unit astronomers define as **megaparsec**. This expansion rate can give first clue into the behavior of dark energy.

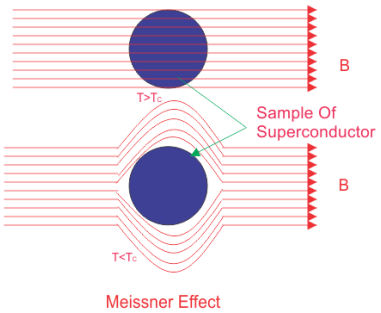
- **Future**: So far scientists have analyzed only 1 year of observational data from DESI. On 31st March 2024, DESI has been collected data for 3 years and it is scheduled to run for five years.

4. PHYSICS: MISCELLANEOUS TOPICS

1) SUPERCONDUCTIVITY

- **Why in news?**
  - » In Aug 2023, two South Korean researchers posted two related papers on the internet, not yet peer-reviewed, claiming that a lead based compound they had developed had shown superconducting properties at room temperature, under normal pressure conditions. (Aug 2023)

- **Definition**
  - » Some materials when they are cooled below certain temperatures ($T_{critical}$), they lose all electrical resistivity. This is called superconductivity.
    - ▫ It is one of the nature's most intriguing quantum phenomenon and was first discovered more than 100 years ago in mercury cooled to temperature of liquid helium (-270 degree C) by **Heike Kamerlingh-Onne**s in 1911. He received 1913 physics Nobel Prize.
    - ▫ **How many elements show superconductivity.**
      - Almost half of the elements in the periodic table display low temperature superconductivity, but applications of superconductivity often employ easier to use or less expensive alloys. For e.g., MRI machines use an alloy of niobium and titanium.
  - » **At what temperature superconductivity is achieved**: The first material to have been discovered to show superconductivity was mercury. Most of the other materials commonly used as superconductors - Lead, Aluminium, Tin, Niobium, and several others also become superconducting at comparable temperatures, called **Critical temperature.**
  - » **In some cases**, superconductivity is achieved at slightly higher temperature but that is under increased pressure conditions.
  - » Even the materials that are classified as '**high temperature superconductors**', as of now, show superconductivity properties only **well below -150 degree C**.
  - » The temperature at which the metals change from normal conducting state to superconducting state is called **Critical/Transition** temperature.
    - ▪ For e.g. below 4-degree Kelvin the metal mercury becomes a superconductor, therefore critical temperature for mercury is 4 K.
- ▪ The transition from normal conducting stage to superconducting stage is **reversible**.
- The super conducting material shows **some extra ordinary properties** which make them very important for modern technology. The research is still going on to understand and utilize these extraordinary properties of superconductors in various fields of technology.
  - ▫ **Infinite conductivity** (zero electric resistance)
    - » **Persistent current**
  - ▫ **Meissner Effect**: a superconductor, expel the magnetic field and doesn't allow the magnetic field to penetrate inside it. This phenomenon in superconductors is called Meissner effect.
  - ▫ **Critical temperature**
  - ▫ **Critical magnetic field**



Meissner Effect

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- **Critical Current**

- **Applications of Superconductivity**
  - **Medical Sector:** Used in magnetic resonance imaging, Magnetic Source imaging etc.
  - **Electric Engineering:** For generation of high performing generators, motors, transformers, relays, superconducting magnets etc.
  - **Electronics: Quantum Computing**, high quality sensors, filters, circuitry radar etc.
  - **Transportation:** Magnetically levitated trains, Marine propulsion motors etc.
  - **Fundamental Physics:** Particle accelerators, Magnets, Plasma / fusion research etc.

- **Superconductivity at Room Temperature???**
  - The **holy grail of superconductivity** today is to **find or create materials that can transfer energy between each other in a non-pressurized container**.
    - If an efficient superconductor becomes possible at room temperature, it would revolutionize power transmission system for industry, commerce, and transportation.
  - **Several Wrong Claims and Skepticism**: In recent years several claims of achieving superconductivity at room temperature has been found to be wrong. This has made scientific community a bit skeptic about any such new claim.
    - For e.g. in July 2023 only a research paper published in Physical Review Letters in 2021, by a US-based researcher making a similar claim had to be retracted.
    - Scientists at IISc Bengaluru had made similar claims in 2018, only to be sent for more reviews. The case is still unresolved.
  - **In July 2023**, the South Korean researchers have posted two related papers on internet, not yet peer reviewed, claiming that a lead-based compound that they had developed had shown superconducting properties at room temperature, under normal pressure conditions. They are calling this material to be **LK-99**.

2) QUANTUM MECHANICS

- **Introduction**
  - Quantum mechanics is the science of very small. Quantum mechanics explains the behaviour of matter and its interaction with energy on the scale of atoms and subatomic particles.
  - **Three revolutionary principles**
    - **Quantized Property**
      - Some properties, such as position, speed and color, can sometimes only occur in specific set amounts.
    - **Particles of Light**
      - Light can sometimes behave as particles.
    - **Waves of Matter**
      - Matter can also behave like wave.

  - **Differences between Classical Mechanics and Quantum Mechanics**

Concept	Classical Mechanics	Quantum Mechanics
	Continuous, everything is allowed	**Discrete**, discontinuous, not all allowed

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	All wavelength available in light	Each element is unique, not every wavelength is possible
	Something is wave or particle	Both - everything is wave and particle
Heisenberg's uncertainty principle	Know position and velocity precisely	Know either position of velocity precisely. We can't know both accurately

» **Uses**
  - Since the breakthrough of renormalization, QFT has served as the foundation for developing quantum theories about four fundamental forces of nature
    - » Electromagnetism
    - » The weak nuclear force
    - » The strong nuclear force
    - » Gravity

» **Uses for real life.**
  - **Ultra-Precise Clocks**
    - » Atomic clocks, are able to use principle of quantum theory to measure time
  - **Uncrackable codes**: **Quantum Cryptography**
  - **Superpower Computers**
    - » Quantum computers supercharge processing power because they use quantum bits, or qubits, which exist in a superposition of states - until they are measured, qubits can be both 1 or 0 at the same time.
  - **Improved Microscopes**
    - » This type of microns **fires two beams of photons at a substance** and measures the interference pattern created by the reflected beam - pattern change based on whether they hit flat or uneven surface.
  - **Biological Compass**
    - » A light sensitive protein called cryptochrome, which may contain entangled electrons.

3) ATOMIC CLOCK

- An atomic clock is a clock device that uses an **electronic transition frequency** in the microwave, optical, or ultraviolet regions of the electromagnetic spectrum of atoms as a frequency standard for its timekeeping element.
- They are the most accurate time and frequency standards known and are used as primary standards for international time distribution services, to control the wave frequency of television broadcasts, and in global navigation satellite systems such as GPS.
- **Principle**
  - » Based on atomic physics. It uses the microwave signal that **electrons in atoms emit when they change energy levels**.
  - » When exposed to certain frequencies of radiation, such as radio waves, the subatomic particles called electrons that orbit an atom's nucleus will "jump" back and forth between energy states.

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Clocks based on this jumping within atoms can therefore provide an extremely precise way to count seconds.

» Currently the most accurate atomic clocks first cool the atoms to near absolute zero temperature by slowing them with lasers and probing them in atomic fountains in a micro-wave filled cavity.

» Since 1967, the official definition of a second is **9,192,631,770** cycles of the radiation that gets an atom of the **element called cesium to vibrate between two energy states**.

▪ Inside a cesium atomic clock, cesium atoms are funneled down a tube where they pass through radio waves. If this frequency is just right 9,192,631,770 cycles per second, then the cesium atoms "resonate" and change their energy state.

» **Accuracy**

▪ The NIST-F1 cesium clock can produce a frequency so precise that its time error per day is about 0.03 nanoseconds, which means that the clock would **lose one second in 100 million years**.

- **Where is atomic clock used -> Wherever accurate timings are required:**
  - » Satellite navigation services
    - ▪ E.g. GPS
  - » CERN lab for precisely timing the collision.
  - » Standard organization (to provide accurate time)

4) NOBEL PRIZE IN CHEMISTRY: QUANTUM DOTS

- **Quick Summary**:
  - » The **Royal Swedish Academy of Sciences** has decided to award the Nobel Prize in Chemistry, 2023 to:
    a. **Moungi G. Bawendi** (MIT, USA)
    b. **Louis E. Brus** (Columbia University, USA)
    c. **Alexei I. Ekimov** (Nanocrystals Technology Inc., New York, NY, USA)

  "**For the discovery and synthesis of "Quantum Dots**".

- **Details**:
  - » **Quantum Dots** are nanoparticles so tiny that their size determines their properties.
    - ▪ **Understanding Size of Quantum Dots**:

A quantum dot is a crystal that often consists of just a few thousand atoms. In terms of size, it has the same relationship to a football as a football has to the size of the Earth.

- **Understanding Properties:** They have many fascinating and unusual properties. Importantly, they have different colors depending on their size.

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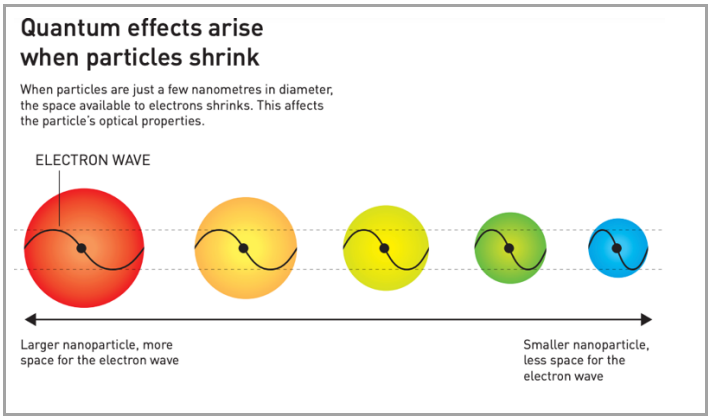

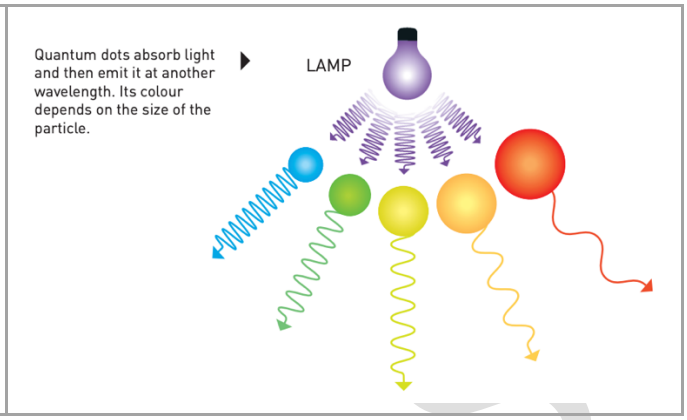

- **For decades**, Quantum phenomena in the nanoworld were just a prediction.
- **Contributions:**
  - » **In the early 1980s,** Alexie Ekimov and Louis Brus succeeded in creating - independently of each other - quantum dots, which are nano-particles so tiny that quantum effects determine their characteristics.
    - ▫ **Alexie Ekimov**, in early 1980s, succeeded in creating size-dependent quantum effects in colored glasses.
      - ▪ The color came from nanoparticles of copper chloride and Ekimov demonstrated that the particle size affected the color of the glass via quantum effects.
      - ▪ This was the first time someone had succeeded in deliberately producing quantum dots - nanoparticles that cause size-dependent quantum effects.
    - ▫ **Louis Brus**, a few years later, was the first scientist in the world to prove **size-dependent quantum effects** in particles floating freely in a fluid.
  - » **Moungi Bawendi**, in 1993, revolutionized the chemical production of quantum dots, resulting in almost perfect particles. This high quality was necessary for them to be utilized in applications.

- **Applications:**
  - » Researchers have primarily utilized quantum dots to create colored light.
    - ▪ The luminous property of quantum dots are utilized in **computer and television screens** based on QLED technology, where the Q stands for quantum dot.
    - ▪ In these screens blue light is produced using the energy-efficient diodes that were recognized with the Nobel Prize in Physics 2014. **Quantum dots are used to change the color of some of the blue light, transforming it into red or green**. This makes it possible to produce three primary colors of light needed in a television screen.
  - » **LED Lamps**: Quantum dots are used in LED lamps to adjust the cold light of the diodes. The light can then become as energizing as daylight or as calming as the warm glow from a dimmed bulb.
  - » **Biochemistry and Biomedicine**: Biochemists attach quantum dots to biomolecules to map cell and organs. Doctors are also investigating the potential use of quantum dots to track tumour tissue in the body. Chemists instead use the catalytic properties of quantum dots to drive chemical reactions.
  - » **Health Sector**: These can guide surgeons when they remove tumour tissues, among many other things.
  - » **Future Applications**: Researchers believe that in the future they could contribute to flexible electronics, tiny sensors, thinner solar cells, and quantum cryptography.

5) THE NOBEL PRIZE IN PHYSICS 2023: ATTOSECOND PHYSICS

- **Quick Summary:**
  - » **Anne L'Huillier**, **Pierre Agostini** and **Ferenc Krausz** have been awarded Nobel Prize in Physics, 2023.
  - » **What did they do?**
    - ▫ Through their experiments, they have created **flashes of light that are short enough to take snapshots of electrons**' extremely rapid movements.
    - ▫ **Anne L'Huillier** discovered a new effect from laser light's interaction with atoms in a gas.
    - ▫ **Pierre Agostini** and **Ferenc Krausz** demonstrated that this effect can be used to create shorter pulses of light than were previously possible.

- **Background: Understanding the Problem**:
  - » Human eyes cannot clearly see hummingbird's beating its wings which can be around 80 times per second. We are only able to perceive this as a whirring sound and blurred movement. It is because extremely short events are impossible to observe by human eyes.
  - » **High Speed photography** can capture detailed images of fleeting (short) phenomena. **A highly focused photograph of a hummingbird in flight requires an exposure time that is much shorter than a single wingbeat**.
  - » **The faster the event, the faster the picture needs to be taken if it is to capture the instant**.
  - » **Atom's** natural timescale is that of femtoseconds (10^{-15} sec). These movements can be studied with the very shortest pulses that can be produced with a laser.
    - ▪ A **femtosecond** was, in the 1980s, regarded as the limit for the flashes of light it was possible to produce.

Explanation:	Light consists of waves – vibrations in electrical and magnetic fields – that move through a vacuum faster than anything else. These have different wavelengths, equivalent to different colours. For example, red light has a wavelength of about 700 nanometres (4.29 * 10^{14} Hz), one hundredth the width of a hair, and it cycles at about four hundred and thirty thousand billion times per second. We can think of the **shortest possible pulse of light as the length of a single period in the light wave**, the cycle where it swings up to a peak, down to a trough, and back to its starting point. In this case, the wavelengths used in ordinary laser systems are never able to get below a femtosecond, so in the **1980s this was regarded as a hard limit for the shortest possible bursts of light**

- But, electrons natural timescale is further lower in **attoseconds (10^{-18} sec)** i.e. in the world of electrons, positions and energies change at speeds of between one and a few hundred attoseconds. Therefore, flashes of light produced at femtosecond was not enough to see processes occurring on the timescale of electrons.

- **Development of Attosecond Pulses**:
  - » The mathematics that describes waves demonstrate that any wave form can be built if enough waves of the right sizes, wavelengths, and amplitudes (distance between peaks and troughs) are

used. The **trick to attosecond pulses** is that it is possible to make shorter pulses by combining more and shorter wavelengths.

» **In 1987**, **Anne L' Huillier and her colleague**s at a French laboratory passed an infrared laser beam through a noble gas. The beam's interaction with atoms in the gas produced **overtones** (overtones are waves of light whose wavelength was an integer fraction of the beam. For e.g, if the beam had a wavelength of 100, the overtones would have wavelength of 10, 25, 50 etc.)
  - By finetuning the setup used to produce the overtones, scientists realized that it should be possible to create intense pulses of light each a few attosecond long.

» **In 2001**, **Pierre Agostini** and his research group in France successfully produced and investigated a series of 250-attosecond light pulses, or a pulse train.

» **At the same time**, **Ferenc Krausz** and his team in Australia developed a technique to separate an **individual 650 second pulse from a pulse train**.
  - Using this researcher were able to measure the energy of some electrons released by some krypton atoms.

- **Applications of attosecond physics**:
  » It allows scientists to capture images of activities that happen in incredible short spans. This can be used for exploring short-lived atomic and molecular processes implicated in fields like material, science, electronics, and catalysis.
  » In **medical diagnostics,** attosecond pulses can be used to check for the presence of certain molecules based on their fleeting signatures.
  » These pulses could also be used to develop faster electronic devices, and better telecommunication, imaging and spectroscopy.

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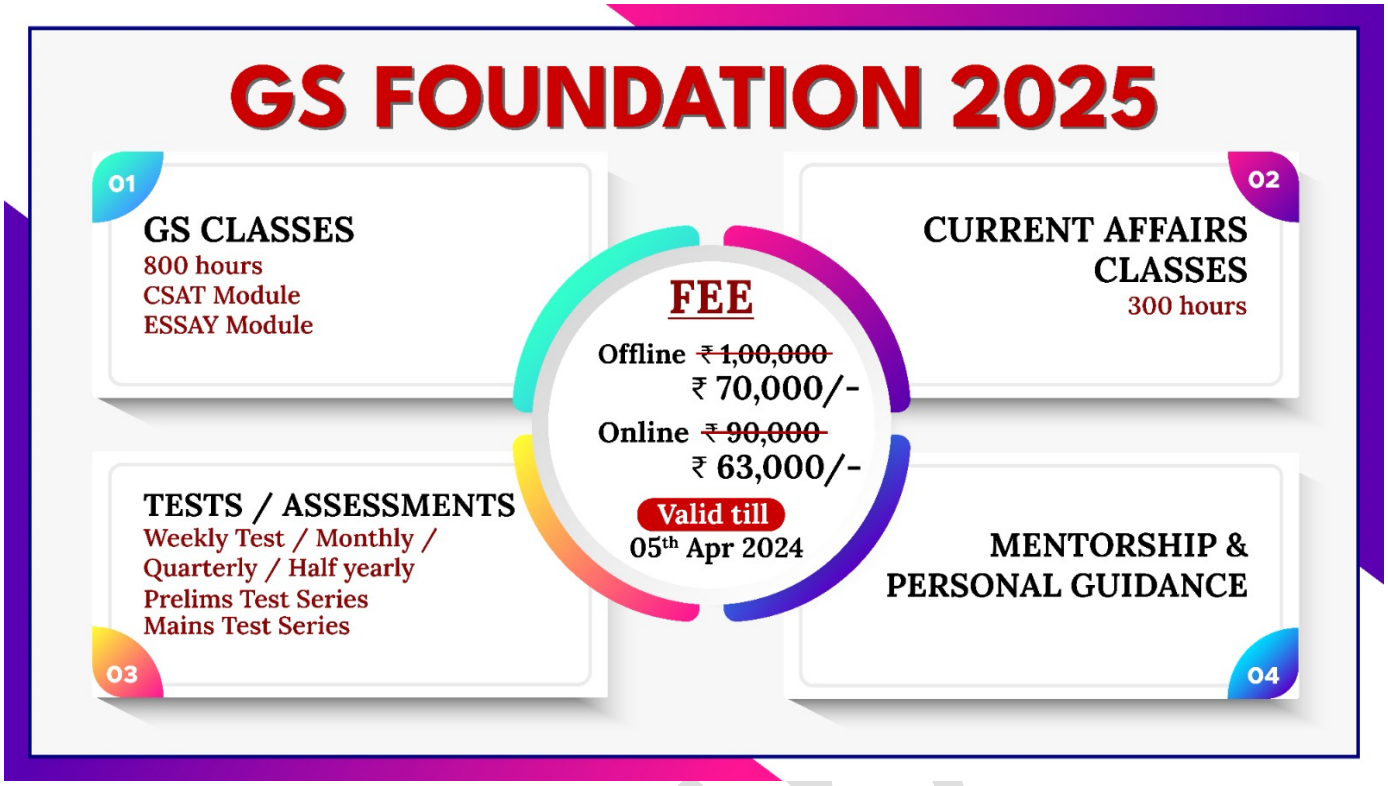

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INTERNATIONAL CONSERVATION EFFORTS

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2. UNESCO'S MAN AND BIOSPHERE PROGRAM (MAB)

- **Introduction**
  - » MAB Program is a **major effort in biodiversity conservation**, launched in 1971.
  - » It is an **inter-governmental scientific program** that aims to establish a scientific basis for **improvement of relationships between people and their environments**.
  - » MAB **combines natural and social sciences, economics and education** to improve human livelihood, and the equitable sharing of benefits.

- **Implementation of the MAB program**
  - » For implementation of its inter-disciplinary work on ground, MAB relies on the **World Network of Biosphere Reserves (WNBR)** and partnership for knowledge sharing, research and monitoring, education and training, and participatory decision making.

- **Characteristics of Biosphere Reserves**
  - » The characteristics feature of biosphere reserves are
    - **People are integral component**
    - **Remain under national jurisdiction** but share their experience and ideas nationally, regionally and internationally within the WNBR.
    - **Achieve three inter-connected functions: Conservation, development and logistic support**
    - **Zonation Scheme**
    - **Multi-stakeholder approach** with particular emphasis on the **involvement of local communities** in management.
    - **Integrating cultural and biological diversity,** especially the role of traditional knowledge in ecosystem management.
    - **Fostering dialogue** for conflict resolution in natural resource use.

- **Details about Zonation Scheme**
  - » While countries maintain flexibility at the national levels with regard to the definition of zones, **the zonation needs to ensure that biosphere reserves effectively combine conservation, sustainable use of resources, and knowledge generation through integrated zonation and collaborative management**.
  - » **Each biosphere reserve includes three zones: (Core, Buffer and Transition)**
    i. **The Core Zone**

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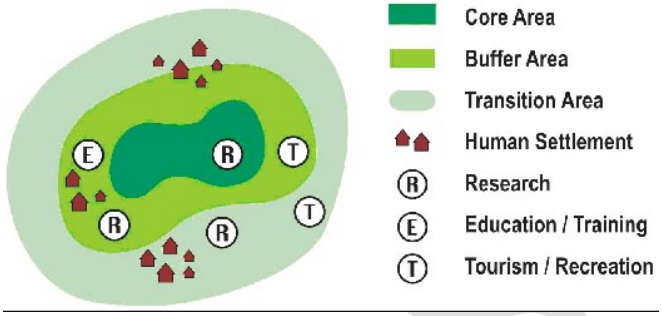
- Generally the **strict nature reserves and wilderness portions** are designated as core area in a BR.
- It should be kept absolutely undisturbed (or minimally disturbed).
- Non-destructive research and low impact uses (e.g. education) allowed.
- **Key functions of Core Area:**
  - **Conservation** function
  - **Range of ecosystem services:**
  - Employment opportunities can also **complement conservation goals** (e.g. environmental education, research, environmental rehabilitation and conservation measures, recreation and eco-tourism).

Structure of a model biosphere reserve.



ii. **The Buffer Zone** usually surrounds or adjoins the core area.
- It is used for **cooperative activities compatible with sound ecological practices** including, environmental education, recreation, ecotourism, and applied and basic research.
- They can also have important **connectivity function** in a larger spatial context as they connect biodiversity components within the core areas with those in transition areas.
- **Human activities, if natural within BR, are likely to be permitted** to continue if these don't affect the ecological diversity.

iii. **Transition Zone**
- Outermost part of biosphere reserve
- It has a central function in sustainable development which may contain a variety of agricultural activities, settlements, and other uses and in which local communities, management agencies, scientists and non-governmental organizations, cultural groups, economic interests, and other stakeholders work together to manage and sustainably develop the area's resource.
- Usually not delimited

- **Designation of Biosphere Reserves: International Coordination Council (ICC)** of the MAB program, UNESCO takes the final decision on the nomination for designation.

- **Relation between Biosphere Reserves and other protected areas (NP, WLS etc)**
  - BRs **don't replace other PAs** but it further strengthens the protected area network.
  - **Existing PAs can become part of BR** without any change in their legal status.
  - Inclusion of such PA in BR will enhance their national value
  - It doesn't mean the BR are to be established only around National Parks and WLS.
  - **Key differences**
    - » Conservation of **overall biodiversity** rather than a some specific flagship species.

» **Increases broad-basing of stakeholders**, especially local people's participation and their training, compared to the features of scheme on WLS and NPs.
» BRs are **internationally recognized** within the framework of UNESCO's MAB programme, after receiving consent from the participating countries.

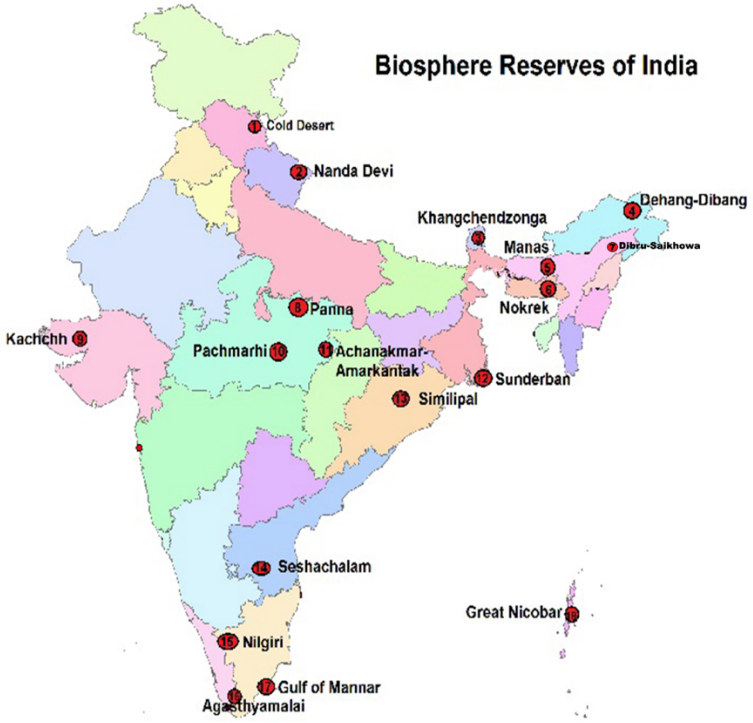
- **Biosphere Reserves in India**
  - The Indian government has established **18 biosphere reserves in India**, (categories roughly corresponding to **IUCN Category 5 protected areas**).

- A **scheme called Biosphere Reserve** is being implemented by GoI since 1986, in which **financial assistance is given to states** for maintenance, improvement and development of certain items. (60:40 general states, 90:10 - Northeastern and 3 Himalayan states)

- **The Indian National Man and Biosphere Committee** constituted by the Central govt identifies new sites, advises on policies and programmes, lays down guidelines, reviews progress and guidelines in the light of evaluation studies and feedback.

- **Management** of the biosphere reserves is the responsibility of **concerned state/UT** with necessary financing assistance, guidelines for management and technical expertise provided by the central government.

- **World Network of Biosphere reserves**
  » **12** of the 18 biosphere reserves are a part of the World Network of Biosphere Reserves, based on the UNESCO Man and Biosphere (MAB) programme list.



Name	States	Key Fauna	Type	Year

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Great Nicobar Biosphere Reserves	Andaman and Nicobar Islands	Saltwater Crocodile	Islands	2013
Gulf of Mannar Biosphere Reserve	Tamil Nadu	Dugong or Sea cow	Coastal	2001
Agasthyamalai Biosphere Reserve	Kerala, Tamil Nadu	Nilgiri Tahr, Elephants	Western Ghats	**2016**
Nilgiri Biosphere Reserve	Tamil Nadu, Kerala, Karnataka	Nilgiri Tahr, Lion-tailed macaque	Western Ghats	2000
Similipal Biosphere Reserve	Odisha	Gaur, Royal Bengal Tiger, Wild Elephant	Deccan Peninsula	2009
Achanakmar-Amarkantak Biosphere Reserve	Chhattisgarh, Madhya Pradesh	-	Maikala Hills	2012
Panna	Madhya Pradesh	Tiger, Chital, Chinkara, Sāmbhar, Sloth Bear	Ken River	2020
Panchmarhi Biosphere Reserve	Madhya Pradesh	Giant Squirrel, Flying Squirrel	Semi-Arid	2009
Sunderbans Biosphere Reserve	West Bengal	Royal Bengal Tiger	Gangetic Delta	2001
Nokrek Biosphere Reserve	Meghalaya	Red Panda	Tura Range, Meghalaya Plateau	2009
Khangchendzonga National Park	Sikkim		Himalayas	**2018**
Nanda Devi Biosphere Reserve	Uttarakhand	-	Western Himalayas	2004

- **Other Biosphere reserves, not part of MAB include the following:**

Name	States	Key Fauna	Type	Year
Seshachalam Hills	Andhra Pradesh (Eastern Ghats)		Eastern Ghats	2010
Little Rann of Kutch	Gujarat	Indian Wild Ass	Desert	2008
Manas	Assam	Golden Langur, Red Panda	Eastern Himalayas	1989
Dibru Saikhowa	Assam	Golden Langur	East Himalayas	1997
Dihang-Dibang	Arunachal Pradesh		Eastern Himalayas	1998

Cold Desert	Himachal Pradesh	Snow Leopard	Western Himalayas	2009

1) PANNA BIOSPHERE RESERVE

- In 2020, UNESCO included Panna National Park/ TR in the list of UNESCO's World Network of Biosphere Reserves. Thus, Panna becomes the third biosphere reserve in MP after Panchmarhi and Amarkantak. MoEF&CC had declared Panna a Biosphere reserve in 2011 itself.

- **Details of Panna**
  - » It is a "**Critical Tiger Habitat**" in the state of Madhya Pradesh. It is also home to World Heritage Site of Khajuraho.
  - » It is characterized by forest and marshy vegetation, with an abundance of rare medicinal plants.
  - » **Ken river** flows through the reserve and the Ken-Betwa project will also be located in it.

CRITICAL TIGER HABITATS:

- Critical Tiger Habitat (CTH) refers to the areas within the tiger reserve that are considered to be the **most important for the conservation of tigers**.
- These areas are critical for:
  - i. Maintaining the **breeding population** and their prey species, as well as
  - ii. **Providing connectivity** to other habitats for long term survival of the tiger population.
- Certain areas under the Tiger Reserves are designated Critical Tiger Reserves under the Wildlife Protection Act, 1972. These areas are given highest level of protection under the law, and any development or human activity within these areas is strictly **regulated** to prevent any disturbance to the tiger population.
- The designation of Critical Tiger Habitats has played a significant role in conservation of tigers in India. As of March 2023, there are 54 tiger reserves in India, and each reserve has its own Critical Tiger Habitat area.

2) KANCHENJUNGA BIOSPHERE RESERVE

- **About Kanchenjunga Biosphere Reserve -**
  - » It is one of the highest ecosystems in the world. It falls within the Himalayan global biodiversity hotspots.
  - » **The core zone** alone has over 150 glaciers and 73 glacial lakes. **Zemu glacier** is one of the famous one.
  - » 86% of the core lies in **Alpine zone** and the remaining portions are in the **Himalayan Wet temperate and sub-tropical moist deciduous forest.**
  - » It is also home to many threatened species including **musk deer, snow leopard, red panda, and Himalayan Tahr**.
  - » It is also home to many ethnic communities including **Lepcha, Nepalese, and Bhutia**.

- **Significance**
  - » The inclusion in the list will **boost the unique ecosystem of Sikkim** on two counts: Collaborative research and tourism.
    - ▫ It will boost the **international research collaboration** relating to flora and fauna and ecosystem of KBR.

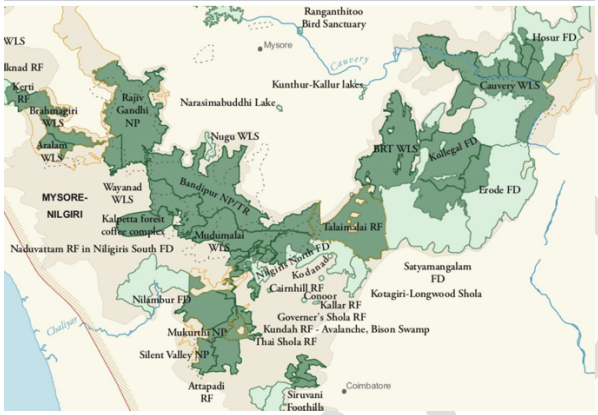
- Further, this will help Sikkim get **more tourists**.

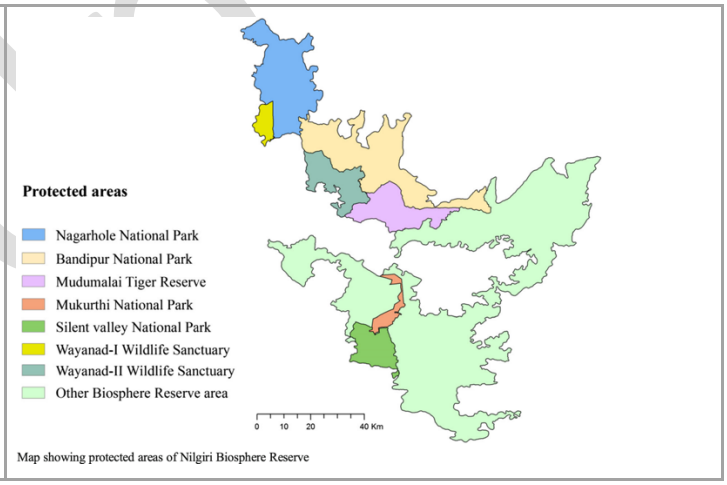
3) NILGIRI BIOSPHERE RESERVE

- The Nilgiri Biosphere Reserve was the first BR in India established in the year 1986. It is located in the Western Ghats and includes 2 of the 10 biogeographical provinces of India.

- **Location and Area:** The reserve encompasses 5,520 km^2, in the state of Tamil Nadu (2537.6 Km^2), Karnataka (1527.4 Km^2) and Kerala (1455 km^2). It forms an almost complete ring around the Nilgiri Plateau.

- **Protected Area in Nilgiri BR include:**
  - **Nagarhole NP**
  - **Bandipur National Park**
  - **Wayanad WLS**
  - **Mudumalai WLS**
  - **Sathyamangalam WLS**
  - **Mukurthi NP**
  - **Silent Valley NP**





Map showing protected areas of Nilgiri Biosphere Reserve

- **Vegetation type of Nilgiri BR**

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Vegetational Types of the Nilgiri Biosphere Reserve			
S.No	Forest type	Nature of Vegetation	Area of occurrence
1	Moist evergreen	Dense, moist and multi storeyed forest with gigantic trees	In the narrow valleys of Silent Valley
2	Semi evergreen	Moist, deciduous	Nilambur and Palghat division
3	Thorn	Dense	North east part of the Nilgiri district
4	Savannah woodland	Trees scattered amid woodland	Mudumalai and Bandipur
5	Sholas & grasslands	High elevated evergreen with grasslands	South and western catchment area, Mukurthi national park

- **The People:**
  - » A variety of human cultural diversity can be found in the Nilgiri Biosphere Reserve.
  - » Tribal groups like the Todas, Kotas, Irullas, Kurumbas, Paniyas, Adiyans, Edanadan Chettis, Cholanaickens, Allar, Malayan, etc., are native to the reserve. Except for Cholanaickens who live exclusively on food gathering, hunting and fishing, all the other tribal groups are involved in their traditional occupation of agriculture.

4) 3RD NOV: INTERNATIONAL DAY FOR BIOSPHERE RESERVE

- In the year 2022, at the 41st session of UNESCO's general conference, it was decided that Nov 3 would be celebrated worldwide as the International Day of Biosphere Reserve.
- This international day by UNESCO aims to:
  - i. Conserve nature, protecting biodiversity and cultural diversity.
  - ii. Promote scientific research, underpinning development through research monitoring, education and training.
  - iii. Promote socio-culturally and environmentally sustainable economic development.
  - iv. To foster the growth of local economies.

5) GLOBAL SITUATION OF BIOSPHERE RESERVES UNDER MAB NETWORK

- As of Nov 2023, there are 738 properties in 134 countries, including 12 in India, four in Sri Lanka and three in Maldives

6) TRANSBOUNDRY BIOSPHERE RESERVES

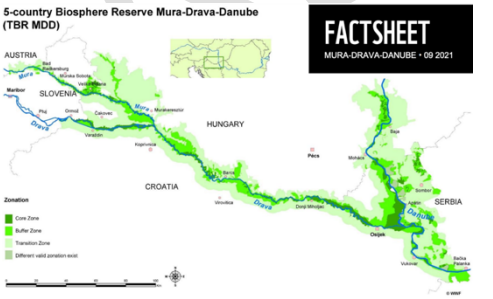
- A TBR is first and foremost a cooperation between established Biosphere reserves. UNESCO formally designates it as a TBR if certain conditions are met:

» A political agreement between the states concerned.
» A Common zoning that promotes the spatialization of conservation and development issues
» Identification of local and national partners and the establishment.

- TBR is an international recognition of a political will to cooperate in the conservation and sustainable use, through common management, of a shared ecosystem.

7) IN 2021 UNESCO DECLARED WORLD'S FIRST 5 COUNTRY BIOSPHERE RESERVE IN AMAZON OF EUROPE

- In Sep 2021, UNESCO designated **Mura-Drava-Danube** (MDD) as the world's first 'five country biosphere reserve'.
- **Unique Features**:
  - » It is Central Europe's largest near natural free-flowing river system without any dams across five countries.
  - » It is the first biosphere reserve in the world which is commonly shared and managed by five countries.
  - » With, 930,000 ha along 700 km of Mura, Drava and Danube Rivers Europe's largest river protected area.
  - » Flagship project for international understanding and regional cooperation.



- The reserve covers 700 kms of the Mura, Drava and Danube rivers and stretches across **Austria, Slovenia, Croatia, Hungary, and Serbia**.

- It is home to floodplain forests, gravel, and sand banks, river islands, oxbows, and meadows.

- It is home to **continental Europe's highest density of breeding white-tailed eagle (**more than 150 pairs), as well as endangered species such as the little tern, black stork, otters, beavers, and sturgeons.

- It is also an important annual resting and feeding place for more than 250,000 migratory birds, according to WWF. Almost, 900,000 people live in the biosphere reserve.

- The **total area** of the reserve **- a million hectares** - in the so called 'Amazon of Europe', makes it the largest riverine protected area on the continent.

- The new reserve represented an important contribution to the European Green Deal and contributes to the implementation of the EU Biodiversity Strategy in the Mura-Drava-Danube region.
  - » The strategy aims to revitalize 25,000 km of rivers and protect 30% of the EU's land area by 2030.

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3. UNESCO WORLD HERITAGE CONVENTION

- In 1972, UNESCO adopted the **Convention Concerning the Protection of the World Cultural and Natural Heritage**.
  - » This convention seeks to encourage the identification, protection, and preservation of cultural and natural heritage around the world, considered to be of outstanding value to humanity.

- **Strategic Objectives** (the "Five Cs")
  - » Credibility
  - » Conservation
  - » Capacity Building
  - » Communication
  - » Communities

- **What does the convention contain?**
  - » The Convention sets out the **duties of state parties** in identifying potential sites and their role in protecting and preserving them.
    - By signing the Convention, each country pledges to conserve not only the World Heritage sites situated on its territory, but also to protect its national heritage.
  - » It explains **how the World Heritage Fund is to be used** and managed and under what conditions international financial assistance may be provided.
  - » The Convention **obligates States Parties to report regularly** to the World Heritage Committee on the state of conservation of their World Heritage properties.
  - » It also **encourages States Parties to strengthen the appreciation of the public for World Heritage properties** and to enhance their protection through educational and information programmes.

- **World Heritage Site**
  - » A world heritage site is a l**andmark which has been officially recognized by the UN**, specifically by UNESCO.
  - » Sites are selected on the basis of **cultural, historical, scientific or some other form of significance** and they are legally protected by international treaties. UNESCO regards these sites as being important to the collective interests of humanity.
  - » The list is maintained by the **International World Heritage Program** administered by the UNESCO World Heritage Committee, composed of 21 UNESCO member states which are elected by General Assembly.
  - » While each World Heritage site remains part of legal territory of state wherein the site is located, **UNESCO considers it in the interest of the International Community to preserve each site**.

- **How UNESCO grants World Heritage Site tag?**
  - » **Step 1: Inclusion in tentative list**

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- A tentative list is an "inventory" of properties a country believe deserves to be a World Heritage Site.

» **Step 2: Nomination File**
- After UNESCO includes a property in the Tentative List, the country has to prepare a nomination document.
- The Nomination file is evaluated by the International Council for Monuments and Sites and the World Conservation Union. These bodies then make recommendations to the World Heritage Committee.

» **Step 3:** Consideration by **UNESCO World Heritage Committee**
- The country meets once a year to determine whether or not to inscribe each nominated property on the World Heritage List and sometimes defer the decision to request more information from the country which nominated the sites.
- There are 10 selection criteria - a site must meet at least one.

- **10 Criteria**
  - » Up to 2004 there were six criteria for cultural heritage site and four criteria for the natural heritage site.
  - » In 2005 this was modified so that, **now only one set of ten criteria**.
  - » Nominated sites must be of **"outstanding universal value" and meet atleast one of the ten criteria**.

1) WORLD HERITAGE SITES IN INDIA

As of Jan 2024, India has 42 World Heritage sites (34 Cultural, 7 Natural and 1 Mixed)

Cultural Heritage Sites in India	Year of Entry	State
#1 Agra Fort	1983	Uttar Pradesh
#2 Ajanta Caves	1983	Maharashtra
#3 Ellora Caves	1983	Maharashtra
#4 Taj Mahal	1983	Uttar Pradesh
#5 Group of Monuments at Mahabalipuram	1984	Tamil Nadu
#6 Sun Temple, Konark	1984	Odisha
#7 Churches and Convents of Goa	1984	Goa
#8 Fatehpur Sikri	1986	Uttar Pradesh
#9 Group of Monuments at Hampi	1986	Karnataka
#10 Khajuraho Group of Monuments	1986	Madhya Pradesh
#11 Elephanta Caves	1987	Maharashtra
#12 Great Living Chola Temples	1987	Tamil Nadu

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#13 Group of Monuments at Pattadakal	1987	Karnataka
#14 Buddhist Monuments at Sanchi	1989	Madhya Pradesh
#15 Mountain Railways of India	1999	West Bengal, Tamil Nadu, Himachal Pradesh
#16 Humayun's Tomb, Delhi	1993	Delhi
#17 Qutub Minar and Monuments, Delhi	1993	Delhi
#18 Mahabodhi Temple Complex at Bodh Gaya	2002	Bihar
#19 Rock Shelters of Bhimbetka	2003	Madhya Pradesh
#20 Champaner-Pavagadh Archaeological Park	2004	Gujarat
#21 Chhatrapati Shivaji Terminus (formerly Victoria Terminus	2004	Maharashtra
#22 Red Fort Complex	2007	Delhi
#23 Jantar Mantar	2010	Jaipur
#24 Hill Forts of Rajasthan	2013	Rajasthan
#25 Rani Ki Vav (The Queen's Stepwell)	2014	Gujarat
#26 Archaeological Site of Nalanda Mahavira at Nalanda	2016	Bihar
#27 The Architectural Work of Le Corbusier, an Outstanding Contribution to the Modern Movement	2016	Chandigarh
#28 Historic City of Ahmedabad	2017	Gujarat
#29 Victorian Gothic and Art Deco Ensembles of Mumbai	2018	Maharashtra
#30 Jaipur City	2019	Rajasthan
#31 Kakatiya Rudreshwara (Ramappa) Temple	2021	Telangana
#32 Dholavira, a Harappan City	2021	Gujarat
#33 Santiniketan	2023	West Bengal
#34 Sacred Ensembles of the Hoysala	2023	Karnataka

Natural Heritage Site in India	**Year of Entry**	**State**
#1 Sundarbans National Park	1987	West Bengal

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#2 Western Ghats	2012	Kerala, Tamil Nadu, Karnataka, Goa, Maharashtra, and Gujarat
#3 Nanda Devi and Valley of Flowers National Parks	1988	Uttarakhand
#4 Manas Wildlife Sanctuary	1985	Assam
#5 Great Himalayan National Park	2014	Himachal Pradesh
#6 Keoladeo National Park	1985	Rajasthan
#7 Kaziranga National Park	1985	Assam

Mixed Heritage Site in India	**Year of Entry**	**State**
#1 Khangchendzonga National Park	2016	Sikkim

2) ADVANTAGE OF GETTING WORLD HERITAGE TAG

- **Identity:** the recognized site gets a new identity world over. The status itself confirms that the outstanding and exceptional features of the listed site.
- **Funding:** the site gets fund from World Heritage Fund for its protection
- **Tourism:** International recognition attracts attention of both domestic and global tourists.
- **Protection during Wartime:** The site becomes protected under Geneva convention against destruction or misuse during war.
- **National governments also become more responsible** in the protection of the site.
- **Access to global project management resources,** as they are now more willing to participate with the project.

"MARATHA MILITARY LANDSCAPES OF INDIA" WILL BE INDIA'S NOMINATION FOR RECOGNITION AS UNESCO WORLD HERITAGE LIST FOR THE YEAR 2024-25 (JAN 2024)

- It was developed between 17th and 19th centuries, and represent an extraordinary fortification and military system envisioned by the Maratha rulers

- The **twelve component parts of this nomination** are, Salher Fort, Shivneri Fort, Lohgad, Khanderi fort, Raigad, Rajgad, Pratapgad, Suvarnadurg, Panhala fort, Vijay durg, Sindhudurg in Maharashtra and Gingee Fort in Tamil Nadu.

- The Maratha Military Landscapes of India is nominated under **criterion (iii)**: To bear a unique or at least exceptional testimony to a cultural tradition or to a civilization that in living or which has disappeared, **criterion (iv)**: to be an outstanding example of a type of building, architectural or technological ensemble, or landscape that illustrates significant stage(s) in human history and **Criterion**

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(vi): To be directly or tangibly associated with events or living traditions, with ideas or with beliefs, with artistic and literary works of outstanding universal significance.

UNESCO INSCRIBES KARNATAKA'S SACRED ENSEMBLE OF HOYSALAS IN WORLD HERITAGE LIST (SEP 2023)

- The ancient site was part of UNESCO's tentative list since 2014 and now the global body has decided to inscribe **Sacred Ensembles of the Hoysalas in the World Heritage List**.
  - » **The** serial property encompasses the **three most representative examples of Hoysalas-style temple complexes in Southern India** dating from 12th to 13th century.
  - » The Hoysala style was created through a careful selection of **contemporary temple features** and those from the **past to create a different identity from neighbouring kingdoms**.
    - The shrines are characterized by hyper real sculptures and stone carving that cover the entire architectural surface, a circumambulatory platform, a large-scale sculpture gallery, a multi-tiered frieze, and Sculpture of the Sala legend.
  - » **Chennakesava Temple** was constructed by King Vishnuvardhana of the Hoysala dynasty in the 12th century to commemorate his victory over Cholas.
    - Other temples which are part of the Sacred Ensemble of Hoysala at Belur are Kappe Chennigaraya temple, Veeranarayan Temple, and Ranganayaki Temple which are relatively smaller in size than Chennakesava Temple but are famous for their architectural marvel.
  - » **Sacred Ensembles of Hoysala at Halebid**:
    - Intricate carving, finely detailed sculptures, and star shaped architectural plans are the prime features of sacred ensembles of Hoysala at Halebid.
    - The main **Hoysaleswara temple** was built in the 12th century during the reign of the King Vishnuvardhana and is dedicated to Lord Shiva.
    - **Kedareshwara temple** showcases remarkable Hoysala architecture and stone carvings.

SANTINIKETAN: NEW INDIAN SITE IN THE UNESCO'S WORLD HERITAGE LIST (SEP 2023)

- **Santiniketan**, West Bengal has been inscribed on the UNESCO's list of World Heritage sites during the ongoing 45th session of the UNESCO World Heritage Committee in Riyadh, Kingdom of Saudi Arabia.
  - » It is **India's 41st UNESCO World Heritage site**.
    - **Established in Rural West Bengal in 1901**, Santiniketan was founded by Rabindranath Tagore, a renowned poet and philosopher.
    - It is an ensemble of historic buildings, landscapes, and gardens, pavilions, artworks, and continuing educational and cultural traditions that together express its outstanding Universal value.
    - The built and open spaces of Santiniketan constitute an exceptional global testimony to ideas of environmental art and educational reform where progressive education and visual art intertwined with architecture and landscape, with the Ashram, Uttarayan, and Kala Bhavan areas forming the prime sites of these practices.

4. CONVENTION ON BIOLOGICAL DIVERSITY (CBD)

- **Introduction :**
  - The CBD is a multilateral treaty which was **approved in 1992** at the Earth Summit in Rio and **came into force on 29 Dec, 1993**.
    - » NOTE: Other two convention finalized at Rio summit included UNFCCC and UNCCD.

  - It has **3 main objectives**:
    - » The conservation of Biodiversity.
    - » The sustainable use of the component of biodiversity.
    - » The fair and equitable sharing of benefits arising out of the utilization of genetic resources.

  - **Membership**
    - » As of Feb **2022**, 196 countries were parties to convention.
      - **India** ratified CBD in 1994.
      - USA - signed the convention in 1993, but has not ratified it.

- **Key provisions**
  - » The Convention requires governments to undertake to **conserve and sustainably use biodiversity**. They are required to **develop national biodiversity strategies and action plans** and to integrate these into broader national laws for environment and development

  - » **Key treaty commitments include**
    1. Identifying and monitoring important components of biological diversity.
    2. **Establishing protected areas** to conserve biodiversity while promoting environmentally sound development around the area.
    3. **Rehabilitating degraded ecosystems** and promoting **recovery of threatened species** in collaboration with local residents
    4. Respecting, **preserving and maintaining traditional knowledge** of the sustainable use of biodiversity with the involvement of indigenous people and local communities.
    5. **Preventing** introduction of, controlling and eradicating **alien species that could threaten ecosystems**, habitats or species.
    6. Controlling the risks posed by **GM Organisms**.
    7. Promoting **public participation**, educating people and raising awareness regarding the significance of biodiversity.
    8. **Reporting** on how countries are meeting biodiversity goals.

1) CARTAGENA PROTOCOL ON BIOSAFETY TO THE CONVENTION ON BIOLOGICAL DIVERSITY

- **Introduction**

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- It is an international agreement which aims to ensure the **safe handling, transport and use of living modified organisms (LMOs) resulting from modern biotechnology** that may have adverse effects on biological diversity, taking also into account risks to human health.

- The protocol makes it clear that products from new technologies must be based on the **precautionary principle** and allow developing nations to balance public health against economic benefits.

- It was the **first international regulatory framework** on safer transfer, handling and use of **LMOs**.
- It was adopted in 2000 and entered into force on 11th Sep 2003.
- The protocol **promotes biosafety by establishing rules and procedures f**or the safe transfer, handling, and use of LMOs.

- **Advanced Information Agreement**
  - The Cartagena Protocol provides for **Advanced information agreement** (AIA) procedure for ensuring that countries are provided with the information necessary to make decisions **before agreeing to the import of such organisms into their territory**.

- **Biosafety Clearing House** is established by the protocol to facilitate the exchange of information on LMOs and to assist countries in the implementation of the Protocol.

2) NAGOYA-KUALA LUMPUR SUPPLEMENTARY PROTOCOL ON LIABILITY AND REDRESS TO THE CARTAGENA PROTOCOL ON BIOSAFETY

- Liability and redress in the context of Cartagena Protocol concerns the question of what would happen if the trans-boundary movement of LMO has caused damage.
- It provides international rules and procedures on liability and redress for damage to biodiversity resulting from LMOs.
- **India ratified in 2014**

3) NAGOYA PROTOCOL TO CBD

- **What is Nagoya Protocol and what is its objective?**
  - The Nagoya Protocol on **Access to Genetic Resources and the Fair and Equitable Sharing of Benefits** Arising from their utilization *(ABS) to the CBD* is a supplementary agreement to the CBD.
  - It provides a **transparent legal framework for the effective implementation of one of the three objectives of the CBD**: the fair and equitable sharing of benefits arising out of the utilization of genetic resources.
  - The Nagoya Protocol on ABS was adopted on 29 October 2010 in Nagoya, Japan and entered into force on 12 October 2014

- **Significance of Nagoya Protocol**
  - Creates greater legal certainty and transparency for both providers and users of genetic resources by:
    - » Establishing more predictable conditions for access to genetic resources

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» Helping to ensure benefit sharing when genetic resource leave the country providing the genetic resources.

- **What is covered by NP?**
  - Genetic resources that are covered by CBD and benefits arising from their utilization.
    - » It also covers traditional knowledge (TK) associated with genetic resources that are covered by CBD and the benefits arising from its utilization.

- **Core Obligations of Nagoya Protocol wrt Genetic Resources**
  - **Access Obligation**
    - » Parties have to take domestic level access measures
  - **Benefit Sharing Obligation**
    - » Domestic level benefit sharing measures are to provide for the fair and equitable sharing of benefits arising from the utilization of genetic resources with the contracting party providing genetic resources
  - **Compliance Obligation**
    - » Specific obligations to support compliance with the domestic legislation or regulatory requirements of contracting party providing genetic resources , compliance with mutually agreed terms

- **What is the Access and Benefit-sharing Clearing House?**
  - The ABS clearing house is a **platform for exchanging information** on access and benefit sharing established by Article 14 of the Protocol, as part of the clearing house of the Convention.
  - It is one of the key tool in **facilitating implementation of the Nagoya Protocol**, by enhancing legal certainly and transparency on procedures for access and benefit-sharing and for monitoring the utilization of genetic resources along the value chain, including through internationally recognized certificates of compliance

4) CBD-COP15: KUNMING-MONTREAL BIODIVERSITY FRAMEWORK (DEC 2022)

- After multiple delays due to COVID-19, nearly 200 countries at the UN Biodiversity Conference (COP15) in Montreal sealed a landmark deal - ***The Kunming-Montreal Global Biodiversity Framework*** **(GBF)**, with four goals and 23 action oriented targets.

- **Some Facts about COP15:**
  - COP15 was held in Montreal, Canada. It was chaired by China and hosted by Canada.
  - It resulted in the adoption of The Kunming-Montreal Global Biodiversity Framework (GBF) which replaces the Aichi Biodiversity targets set in 2010.

- **Key Features:**
  - **Four Goals and 23 action-oriented targets** were adopted.
  - **Four Goals:**

GOAL A

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- The **integrity, connectivity and resilience of all ecosystem**s are maintained , enhanced, or restored, substantially increasing the area of natural ecosystems by 2050;
- Human induced extinction of known threatened species is halted, and, by 2050, extinction rate and risk of all species are reduced tenfold, and the abundance of native wild species is increased to healthy and resilient levels;
- The genetic diversity within populations of wild and domesticated species ,is maintained, safeguarding their adaptive potential.

GOAL B

- **Biodiversity is sustainably used and managed** and nature's contributions to people, including ecosystem functions and services, are valued, maintained and enhanced, with those currently in decline being restored, supporting the achievement of sustainable development, for the benefit of present and future generations by 2050.

GOAL C

- **The monetary and non-monetary benefits from the utilization of genetic resources**, and digital sequence information on genetic resources, and of traditional knowledge associated with genetic resources, as applicable, **are shared fairly and equitably**, including, as appropriate with indigenous peoples and local communities, and substantially increased by 2050, while ensuring traditional knowledge associated with genetic resources is appropriately protected, thereby contributing to the conservation and sustainable use of biodiversity, in accordance with internationally agreed access and benefit-sharing instruments.

GOAL D

- Adequate means of implementation, including financial resources, capacity-building, technical and scientific cooperation, and access to and transfer of technology to fully implement the Kunming-Montreal global biodiversity framework **are secured and equitably accessible to all Parties**, especially developing countries, in particular the least developed countries and small island developing States, as well as countries with economies in transition, **progressively closing the biodiversity finance gap of $700 billion per year**, and aligning financial flows with the Kunming-Montreal Global Biodiversity Framework and the 2050 Vision for Biodiversity.

- **23 Targets:**
  - **TARGET 1:** Bring the **loss of areas of high biodiversity importance,** including ecosystems of high ecological integrity, close to zero by 2030, while respecting the rights of indigenous peoples and local communities.
  - **TARGET 2:** Ensure that by 2030 **at least 30 per cent of areas of degraded terrestrial, inland water, and coastal and marine ecosystems are under effective restoration**,
  - **TARGET 3** (commonly called **30X30**): Ensure and enable that by 2030 at least 30 per cent of terrestrial, inland water, and of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem functions and services, ar**e effectively conserved** and managed through ecologically representative, well-connected and equitably **governed systems of protected areas** and other effective area-based conservation measures.
    - **Note:** Currently, 17% of terrestrial and 10% of marine areas are protected.

- **Note:** Countries are not individually required to attain the 30X30 target.
-

- **TARGET 4:** Ensure **urgent management actions, to halt human induced extinction** of known threatened species and for the recovery and conservation of species, in particular threatened species,

- **TARGET 5:** Ensure that the **use, harvesting and trade of wild species is sustainable, safe and legal,**
- **TARGET 6:** Eliminate, minimize, reduce and or mitigate the impacts of **invasive alien species on biodiversity** and ecosystem services; reducing the rates of introduction and establishment of other known or potential invasive alien species by at least 50 percent, by 2030, eradicating or controlling invasive alien species especially in priority sites, such as islands.

- **TARGET 7: Reduce pollution risks and the negative impact of pollution** from all sources, by 2030, to levels that are not harmful to biodiversity and ecosystem functions and services, considering cumulative effects.

- **TARGET 8: Minimize the impact of climate change and ocean acidification** on biodiversity and increase its resilience through mitigation, adaptation, and disaster risk reduction actions,
- **TARGET 9:** Ensure that the **management and use of wild species are sustainable,** thereby providing social, economic and environmental benefits for people, especially those in vulnerable situations and those most dependent on biodiversity,
- **TARGET 10:** Ensure that **areas under agriculture, aquaculture, fisheries and forestry are managed sustainab**ly,
- **TARGET 11: Restore, maintain and enhance nature's contributions to people, including ecosystem functions and services,**
- **TARGET 12:** Significantly increase the area and quality and connectivity of, access to, and benefits from **green and blue spaces in urban and densely populated areas** sustainably
- **TARGET 13:** Take effective **legal, policy, administrative and capacity-building measures** at all levels, as appropriate, to ensure the fair and equitable sharing of benefits that arise from the utilization of genetic resources and from digital sequence information on genetic resources, as well as traditional knowledge associated with genetic resources, and facilitating appropriate access to genetic resources, and by 2030 facilitating a significant increase of the benefits shared, in accordance with applicable international access and benefit-sharing instruments.
- **TARGET 14:** Ensure the **full integration of biodiversity and its multiple values into policies, regulations, planning and development processes**, poverty eradication strategies, strategic environmental assessments, environmental impact assessments and, as appropriate, national accounting, within and across all levels of government and across all sectors, in particular those with significant impacts on biodiversity, progressively aligning all relevant public and private activities, fiscal and financial flows with the goals and targets of this framework.
- **TARGET 15:** Take legal, administrative or policy measures to encourage and enable business, and in particular to ensure that large and transnational companies and financial institutions:
  (a) Regularly monitor, assess, and transparently disclose their risks, dependencies and impacts on biodiversity including with requirements for all large as well as transnational companies and financial institutions along their operations, supply and value chains and portfolios;

(b) Provide information needed to consumers to promote sustainable consumption patterns;

(c) Report on compliance with access and benefit-sharing regulations and measures, as applicable;

in order to progressively reduce negative impacts on biodiversity, increase positive impacts, reduce biodiversity-related risks to business and financial institutions, and promote actions to ensure sustainable patterns of production.

- **TARGET 16:** Ensure that people are encouraged and enabled to make sustainable consumption choices including by establishing supportive policy, legislative or regulatory frameworks, improving education and access to relevant and accurate information and alternatives, and **by 2030, reduce the global footprint of consumption in an equitable manne**r, h**alve global food waste**.

- **TARGET 17:** Establish, strengthen capacity for, and implement in all countries in **biosafety measure**s as set out in Article 8(g) of the Convention on Biological Diversity and measures for the handling of biotechnology and distribution of its benefits as set out in Article 19 of the Convention.

- **TARGET 18:** Identify by 2025, and **eliminate, phase out or reform incentives, including subsidies harmful for biodiversity,** in a proportionate, just, fair, effective, and equitable way, while substantially and progressively reducing them by at **least 500 billion US$per year by 2030**, starting with the most harmful incentives, and scale up positive incentives for the conservation and sustainable use of biodiversity.

- **TARGET 19:** Substantially and progressively **increase the level of financial resources from all sources,** in an effective, timely and easily accessible manner, including domestic, international, public and private resources, in accordance with Article 20 of the Convention, to implement national biodiversity strategies and action plans, by 2030 mobilizing at least 200 billion United States dollars per year.

    - **Financial Package to poor countries**: The agreement asks for increasing to at least $20 billion annually by 2025 the money that goes to poor countries. That number would be increased to $30 billion each year by 2030.

- **TARGET 20:** Strengthen capacity-building and development, access to and transfer of technology, and promote development of and access to innovation and technical and scientific cooperation, including through South- South, North-South and triangular cooperation,
- **TARGET 21:** Ensure that the best available data, information and knowledge, are accessible to decision makers, practitioners and the public
- **TARGET 22:** Ensure the full, equitable, inclusive, effective and **gender-responsive representation and participation in decision-making**, and access to justice and information related to biodiversity by indigenous peoples and local communities, respecting their cultures and their rights over lands, territories, resources, and traditional knowledge, as well as by women and girls, children and youth, and persons with disabilities and ensure the full protection of environmental human rights defenders.
- **TARGET 23:** Ensure **gender equality** in the implementation of the framework

5) COMMEMORATIVE PERIODS

A) 2010: INTERNATIONAL YEAR OF BIODIVERSITY

B) 2011-2020: UN DECADE OF BIODIVERSITY

- This was announced on recommendation of the CBD signatories during COP10 at Nagoya in October, 2010.

C) INTERNATIONAL DAY FOR BIOLOGICAL DIVERSITY: 22ND MAY

- The UN has proclaimed May 22 as the International Day for Biological Diversity (IDB) to increase understanding and awareness of biodiversity issues.
- This day was chosen as **Convention on Biological Diversity was adopted by UN Conference** on this day.

6) REPORT: GLOBAL BIODIVERSITY OUTLOOK

- The report provides a **summary of the status of biological diversity** and an analysis of the steps being taken by the global community to ensure that biodiversity is conserved and used sustainably, and that benefits arising from the use of genetic resources are shared equitably.
- **The fifth** edition (GBO-5) is the final report card on progress against 20 global biodiversity targets agreed in 2010 with a 2020 deadline, and offers lessons learned and best practices for getting on track.
- None of the 20 targets have been fully achieved, though six targets have been partially achieved (Targets 9, 11, 16, 17, 19 and 20)

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5. POLLINATORS AND ASSOCIATED ISSUES

- There are more than 20,000 species of wild bees alone, plus many species of butterflies, flies, moths, wasps, beetles, birds, bats, and other animals that contribute to pollination. Pollinated crops include those that provide fruit, vegetables, seeds, nuts, and oils. Many of these are important dietary sources of vitamins and minerals, without which the risks of malnutrition might be expected to increase. Several crops also represent an important source of income in developing countries from, for example, the production of coffee and cocoa

1) IPBES GLOBAL ASSESSMENT OF POLLINATORS

- This assessment, titled **Thematic Assessment of Pollinators, Pollination and Food Production** is the first ever assessment of pollinators issued by IPBES.

- **Key Highlights**
  - **Significance of Pollinators:**
    - **75% of world's food crops** depend at least in part on pollination.
    - **90% of the wild flowering plants** depend on pollinators
    - **Volume of agri-production dependent on pollinators** has increased by 300% during the past 50 years.
  - **A number of pollinator species worldwide** are being driven towards **extinction**. This is threatening millions of livelihoods and 100s of billions of dollars' worth of food supply.
  - **Key factors affecting pollinators**
    - Changes in land use
    - Intensive agri production
    - Pesticides (including neonicotinoid insecticides)
    - Alien invasive species
    - Diseases and pests are specially problematic for managed bees.
    - Climate change
  - **Way forward -** Sustainable Agriculture, reducing chemical pesticides, Improved managed bee husbandry

2) ABOUT INTERGOVERNMENTAL SCIENCE POLICY PLATFORM ON BIODIVERSITY AND ECOSYSTEM SERVICES (IPBES)

- It is an **independent inter-governmental body** established by states **to strengthen the science policy interface for biodiversity and ecosystem services** for the conservation and sustainable use of biodiversity, long term human well-being, and sustainable development.
- It was **established in 2012** at Panama city.
- It is **not an UN body**. However, at the request of the IPBES plenary and authorization of UNEP Governing Council, the **UNEP provides secretariat services to IPBES**.
- It currently has 134 member states. Many NGOs, organizations, conventions and civil society groupings also participate in the formal IPBES process as observers, with several thousand individual stakeholders,

ranging from scientific experts to representatives of academic and research institutions, local communities and the private sector, contributing to and benefiting from our work

- **The work of IPBES** can be categorized in **four complementary areas:**
    1. **Assessments:** e.g., the Assessment of Pollinators
    2. **Policy Support:** Identifying policy-relevant tools and methodologies, facilitating their use, and catalysing their further development.
    3. **Building Capacity and Knowledge**
    4. **Communication and Outreach**

3) ABOUT "THE GLOBAL COALITION OF THE WILLING ON POLLINATORS)

- The coalition was formed in 2016 **to follow up on the findings of IPBES Assessment** on Pollinators, Pollination and Food Production.
- The coalition has 28 signatories including 17 European countries, five from Latin America and the Caribbean and four from Africa.

- **Members are supposed to do the following:**
    - Taking action to protect pollinators and their habitats by developing and implementing national pollinator strategies
    - Sharing experience and lessons learnt in developing and implementing national pollinator strategies, especially knowledge on new approaches, innovations, and best practices
    - Reaching out to seek collaboration with a broad spectrum of stakeholders—countries as well as businesses, NGOs, farmers, and local communities
    - Developing research on pollinator conservation

4) WORLD BEE DAY: 20TH MAY

- The World observes Bee Day on May 20 to raise awareness about the importance of pollinators and how they contribute to our sustainable developments. The day has been designated by the UN.

6. CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES (CITES) ON WILD FLORA AND FAUNA

- **About Convention**
    - » Convention also known as **Washington convention** is a multilateral treaty to protect endangered plants and animals.

    - » It was drafted as a result of **resolution adopted in 1963 at a meeting of members of the IUCN (International Union for Conservation of Nature)**.

    - » It came into force in 1975 and now has **184 parties** (as of Nov 2022). Almost every country in the world has signed up + the European Union.

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        - The convention is **binding on Parties** in the sense that they are committed to implementing it; however, it doesn't take the place of national laws.

- **Aim**: It's aim is to ensure that **international trade** in specimens of wild animals and plants **does not threaten the survival of the species** in wild, and it accords varying degree of protection to more than 35,000 (>5000 plants, and > 30 thousand animals) species of plants and animals.
    - » In essence, **CITES ban hunting, capturing, and selling of endangered or threatened species**.

- **Categorization of Species covered by CITES according to degree of protection they need:**
    - » **Appendix I:**
        - The appendix includes those species which are **threatened with extinction** and where trade is a current or potential threat to their continued existence.
        - **Any international movement of these species** - or products made from them - **requires permits from both the exporting and importing country**.
        - **International trade for commercial purpose** is generally not allowed and is permitted only in exceptional circumstances.
        - The appendix currently has over 1,000 species.

    - » **Appendix II:**
        - Species included in this appendix are **not necessarily threatened with extinction,** but their **trade must be controlled** in order to avoid utilization incompatible with their survival.
        - **In practice**, the appendix includes many highly endangered species.
        - This is the **biggest appendix** and has around 40,000 species.
        - **International Trade** in the species is allowed but **requires a permission from exporting countries**, after determining that the export will not harm the survival of the species and that the specimen has been obtained legally.

    - » **Appendix III:**
        - This appendix is used when a country wants to regulate trade in a given species. Here, a country can get a species listed unilaterally.
        - Export permits are then required for that species be exported from the country.
        - **Note: A**dditions to Appendix 1 and Appendix 2, require the agreement of two-third of the COP.

- **Significance**
    - » Even though enforcement is difficult, CITES has helped reduce trade in many threatened species including elephants, crocodiles, and chimpanzees.

A) COP OF CITES

- » CoP of CITES meet every three years. The 18th CITES was held in Geneva in 2019 and the COP-19 was held in Panama in Nov 2022.

7. CONVENTION ON CONSERVATION OF MIGRATORY SPECIES OF WILD ANIMALS (BONN CONVENTION – CMS)

- **Introduction:**
  - **Migratory species** are those animals that move from one habitat to another during different times of the year, due to various factors such as food, sunlight, temperature, climate, etc. The movement between habitats, can sometimes exceed **thousands of miles/kilometres** for some migratory birds and mammals. A migratory route can involve nesting and requires the availability of habitats before and after each migration.

  - To **protect the migratory specie**s throughout their range countries, a **Convention on Conservation of Migratory Species (CMS)**, has been in force, under the **aegis of United Nations Environment Programm**e.
    - Also referred to as the **Bonn Convention**, it provides a **global platform** for the conservation and sustainable use of migratory animals and their habitats and brings together the States through which migratory animals pass, the Range States, and **lays the legal foundation for internationally coordinated conservation measures throughout a migratory range.**

  - It is **only global convention specializing in the conservation of migratory species, their habitat and migration routes**.

- **Appendix I and Appendix 2**
  - Migratory species **threatened with extinction** are listed on **Appendix I** of the Convention.
    - CMS Parties strive towards **strictly protecting** these animals, conserving or restoring the places where they live, mitigating obstacles to migration and controlling other factors that might endanger them.
    - Besides establishing obligations for each State joining the Convention, CMS promotes concerted action among the Range States of many of these species.

  - Migratory species t*hat n****eed or would significantly benefit from international co-operation*** *are liste*d in **Appendix II** of the Convention.
    - For this reason, the Convention encourages the Range States to conclude global or regional agreements.

- **Members**
  - Currently there are 132 members to the convention.
  - **India** has been party to the CMS since **1983**.

- **COP** is the decision making body of CMS.

- **Key Highlights: 13th COP Summit, Gandhinagar Gujarat**
  i. **Gandhinagar Declaration** sends strong message on importance of migratory species for new global biodiversity strategy.

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iii. **The First Ever Report on the Status of Migratory Species,** presented to CMS COP13, shows that despite some success stories, the **populations of most migratory species covered by CMS are declining**.

iv. **Great Indian Bustard, Asian Elephant, and Bengal Florican** have been classified as "Endangered Migratory Species" (Appendix 1) by CMS as per Indian proposal.

v. **Animal Culture Linked to Conservation for the first time at UN Wildlife Conference in India**

vi. **Seven Migratory Species Champions** were recognized during the conference.

- Under the Champion program, Germany, **India**, Italy, Monaco, Norway, the European Commission, and the Environmental Agency - Abu Dhabi were acknowledged for their **generous contributions to the CMS initiative**s.

- **India also has non-legally binding MoUs with CMS** on the conservation and management of **Siberian Crane** (1998), **Marine Turtles** (2007), **Dugongs** (2008) and **Raptors** (2016).
- India is temporary home to **several migratory animals and birds**. The important among these include Amur Falcons, Bar headed Geese, Black necked cranes, Marine turtles, Dugongs, Humpbacked Whales, etc.

8. TRAFFIC

- **TRAFFIC** is a wildlife **trade monitoring network**. Its **mission** is to ensure that trade in wild plant and animals is not a threat to the **conservation of nature**. It plays a pivotal role in **tackling illegal wildlife** trade through research and analysis, advocacy, and awareness work and by supporting remedial action against illegal wildlife trade.
  - It **specializes** in investigating and analyzing wildlife trade trends, impacts and drivers; informing and supporting governments to enforce effective policies and laws; advising private sector on mechanism for sustainable sourcing of wildlife etc.

- It was established **in 1976 as** a strategic alliance of **IUCN** and **WWF.**

- **TRAFFIC and CITES**
  - **One of the TRAFFIC priorities** is to promote international cooperation to address wildlife trade issues, with **particular emphasis on CITES**.
  - It provides information and assistance to help the decision making process of CITES, supporting efforts to ensure that international wildlife trade is at sustainable levels and doesn't pose a threat to the conservation of species.
  - In 1999, **CITES and TRAFFIC** signed an MoU to undertake joint activities for capacity building.

9. BIRDLIFE INTERNATIONAL

- It is a **global partnership of conservation organizations (NGOs)** which work towards **conservation of birds, their habitats, and global biodiversity**.
  - Its priorities include preventing extinction of bird species, identifying, and safeguarding important sites of birds, maintaining, and restoring key bird habitats, and empowering conservationists worldwide.

- It is the **world's largest partnership** of conservation organizations, with over **121 NGO partner organizations**.
  - For e.g., in India, the partner organization is **Bombay Natural History Society (BNHS)**

- Birdlife International has so far identified more than 7,500 important bird areas.

10. IMPORTANT BIRD AND BIODIVERSITY AREAS (IBAS)

- **Introduction**
  - An Important Bird and Biodiversity Area (IBA) is an area **identified using an internationally agreed set of criteria as being globally important for the conservation of bird population**. The program was developed and sites are identified by B**ird Life International**.
  - Since the late 1970s, the **Bird Life Partnership** has been working collectively to identify, document and protect all places on earth of greatest significance for the conservation of the world's birds.
  - As a result, over 13,000 Important Bird and Biodiversity Areas (IBAs) have been identified. All of these sites are also **(Key Biodiversity Areas) KBAs** for birds at the global or regional level.

- **Significance**
  - IBA recognition enhance the conservation attention of the bird species of the region.
  - Some of the region also get statutory protection.

- **Criteria** to be identified as IBAs
  i. **Globally Threatened Species**
     - The site qualifies if it is known, estimated, or thought to hold a population of a species categorized by the IUCN Red List as Critically Endangered, or Endangered or Vulnerable.
       - Presence of CR or EN -> sufficient for qualification
       - Presence of Vul -> presence of more than a threshold is necessary to trigger selection.
  ii. **Restricted Range Species**
     - The sites form one of a set selected to ensure that all restricted-range species of an Endemic Bird Area (EBA) or a Secondary Bird Area (SA) are present in significant numbers in at least one site and preferably more.
  iii. **Biome Restricted Species**
  iv. **Congregations**

- **How do Birdlife International work to protect these habitats?**
  - Each of the **Birdlife Partners** has responsibility for their national network of Important Bird & Biodiversity Areas (IBAs).
  - The Birdlife Secretariat takes the lead on all international aspects as well as in some priority countries where BirdLife is not present and in the High Seas

- **Other Important sub-programs**
  - **IBAs in Danger**
    - These are IBAs under threat from damaging development - the majority of which appears to be poorly planned and doesn't take environmental values into account.
    - The IBAs in Danger initiative provides an **essential focus for governments, development agencies, the international environmental and conservation conventions, business and**

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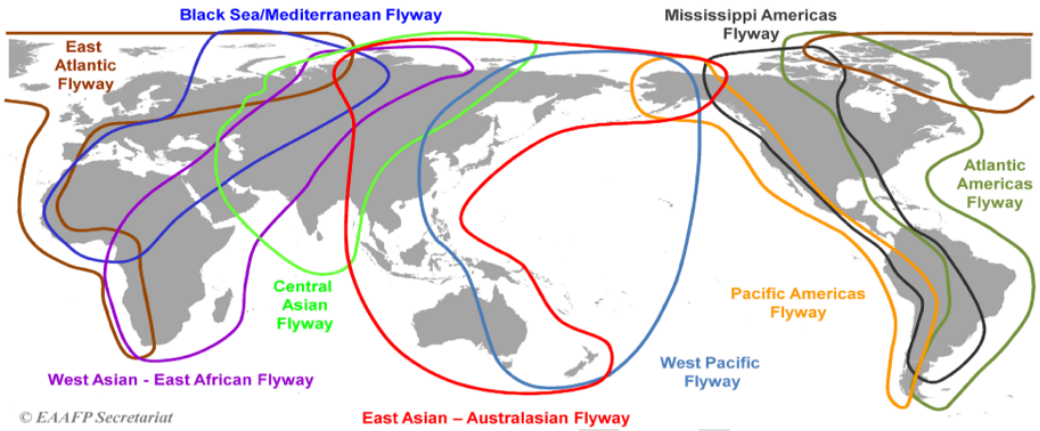
wider civil society to act to prevent the further damage or loss of the sites crucial to the survival of the world's birds.

11. MIGRATORY BIRDS AND FLYWAYS

- Bird migration is one of the great wonders of the natural world. A huge variety of birds, millions of them, make the journey: the **tiny Rufous Hummingbird** migrates up and down the North American continent, while the **Arctic Tern**, BirdLife's emblem, **migrates from pole to pole**. In fact, **roughly one in five bird species migrate**.



- **Flyways**
  - Flyways are **migratory path taken by birds every year** between their summer breeding grounds and their wintering grounds.
  - While taking the migratory routes, birds don't change path at random. They follow set routes which include habitats where they can rest and refuel along the way.
  - Many different **species share broadly similar** routes, which have been loosely split into **9** (some sources mention 8**) major flyways**. They are **like bird super-**highways across the sky. '

- **Flyways and India**
  - **Major Bird Flyway Network through India**
    - **370 species of birds visit India through three flyways:**
      - Central Asian Flyway (CAF)
      - East Asian - Australasian Flyway
      - Asian - East African Flyway
    - **Over 80% of migratory birds through India comes through CAF** among which 87 species are of high conservation concern including two critically endangered, five endangered and 13 vulnerable species.
  - India has also launched the National Action Plan for conservation of migratory species under the Central Asian Flyway.

- **Birdlife International's Flyway Program** focuses on protecting birds across all major flyways.
  - Key aims of the BI's Flyway Program:
    - Save the threatened migratory species from extinction by addressing main threats and conserve key sites and habitats which will be beneficial to a wider set of migratory species.
    - **Address landscape-scale barriers** especially illegal and unsustainable killings of birds and proliferation of poorly planned energy and power transmission infrastructure.

» **Conserve network of critical stopover sites** through action on the ground by BI's local conservation groups.
» **Strengthen local and national capacity** in the stop-over sites by strengthening the collaboration between BirdLife Partners.

12. RAMSAR CONVENTION ON WETLANDS

- **What is a Wetland?**
  - **A Wetland** is a **transitional land between terrestrial and aquatic ecosystem**. It is an ecosystem that is flooded either permanently or seasonally.
    - **UN Ramsar Convention** defines wetlands as '*areas of marsh, fen, peatland or water, weather natural or artificial, permanent or temporary, with water that is static or flowing, fresh brackish or salt, including areas of marine water the* ***depth of which at low tide doesn't exceed six meters***'.

- **Significance of Wetlands:** Wetlands provide a wide range of important resources and ecosystem services such as:
  - **Food:** Rice cultivation, fishery etc.
  - **Water storage** and **ground water recharge**
  - **Water purification, flood moderation and erosion control**
  - **Climate regulation**
  - **Tourism** is another area where Wetlands such as large lakes have played crucial role.
  - **Biodiversity** -> wetlands are transition zones between two different ecosystems and thus are highly productive.
  - **Coastal Protection** is ensured by Wetlands as they act as buffer zones.

- **Ramsar Convention**
  - **Introduction**
    - The **Convention on Wetlands of International Importance, called the Ramsar Convention**, is the **intergovernmental treaty** that provides the framework for the **conservation** and **wise use** of wetlands and their resources. It is the only global treaty that focuses on a **single ecosystem** (Wetlands).
    - The convention was adopted in the Iranian city of Ramsar in 1971 and came into force in 1975. Since than almost 90% of UN member states, from all the world's geographic regions, have accepted and become contracting parties.
    - **Headquartered** in Geneva

  - **The aim** of the Ramsar list is "to **develop and maintain an international network of wetlands** which are important for the conservation of global biological diversity and for sustaining human life through the maintenance of their ecosystem components, processes and benefits".

  - **Concept of 'Wise use"** is at the centre of Ramsar Convention.
    - Through this, the convention continues to emphasize that **human use on sustainable basis is entirely compatible with Ramsar principles and wetland conservation in general**. **Application of "wise use" concept is crucial to ensure that wetlands continue to support biological diversity as well as human well-being**.

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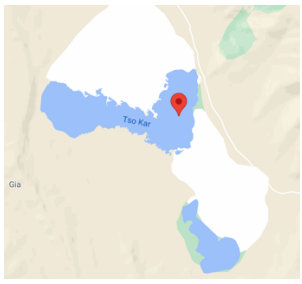
- **The wise use guidelines** emphasize on:
    1. **Adoption of national wetland policies,** involving review of local legislation and institutional arrangements to deal with wetland matters.
    2. **Development of programs** of wetland inventory, monitoring, research, training, education etc.
    3. **Take action at wetland sites**, involving the development of integrated management plans covering every aspect of the wetlands and their relationships.

- The concept applies to all wetlands and water resources in contracting parties territories (not just to Wetlands of International Importance)

1) LIST OF RAMSAR SITES IN INDIA: WETLANDS OF INTERNATIONAL IMPORTANCE

#	Name of the Site	State	Other Speciality
1	Tso Kar Wetland Complex	Ladakh	Tso Kar Wetland Complex was included in the Ramsar list in Dec 2020. **Location**  **Two Lakes**  The complex is a notable example of two connected lakes, the **freshwater Startsapuk Tso** & the **hypersaline Tso Kar**. They are situated in Changthang region of Ladakh. **Tso Kar** means **white lake**, because of the white salt efflorescence found on the margins due to the evaporation of highly saline water. The Tso Kar Basin is also an A1 category Important Bird Area (IBA) as per Bird Life International and a key staging site in the Central Asian Flyway. The site is also amongst the most important breeding areas of the Black-necked Crane (Grus nigricollis) in India.

			This IBA is also the major breeding area of Great Crested Grebe (Podicepscristatus), Bar-headed Geese (Anserindicus), Ruddy Shelduck, Brown headed Gull, Lesser Sand-Plover, and many other species.
2	Tso Moriri Lake	Ladakh	
3	Wular Lake	J&K	
4	Surinsar-Mansar Lakes	J&K	
5	Hokera Wetland	J&K	
6	Hygam Wetland Conservation Reserve	J&K	It falls within Jhelum River Basin and plays an significant role as a flood absorption basin, biodiversity conservation site, eco tourism site, and livelihood security of the local community. It is located in the Baramulla district. It serves as an abode to many residents and migratory bird species. It is also recognized as an IBA. **High rate of siltation** is leading to wetland characteristics being changed to landmass in several areas.
7	Shallbugh Wetland Conservation Reserve	J&K	It is located in Srinagar district. It is an abode to more than 4 lakh resident and migratory birds of at least 21 species.
8	Harike Lake	Punjab	
9	Kanjli Lake	Punjab	
10	Ropar Lake	Punjab	
11	**Keshopur-Miani** Community Reserve	**Punjab**	
12	**Beas Conservation Reserve**	**Punjab**	
13	**Nangal WlS**	**Punjab**	
14	Chandertal Wetland	Himachal Pradesh	
15	Pong Dam Lake	Himachal Pradesh	
16	Renuka Wetland	Himachal Pradesh	**Smallest of all Ramsar site** in India.

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17	Asan Conservation Reserve	UK	Became Ramsar Site in Oct 2020 It is a 444 hectare stretch of the Asan river running down to its confluence with Yamuna river in Dehradun district of UK. The river was dammed by the Asan Barrage in 1967 and it resulted in siltation above the dam wall which created suitable habitat for birds. This supports, 330 species of birds including the critically endangered vultures - (red headed vulture and white-rumped vulture) and Baer's Pochard. It is also a significant ground for migratory birds. It is strategically located within the Central Asian Flyways. This was declared conservation reserve in 2005 under Section 36A of Wildlife Protection Act, 1972.
18	Sultanpur	Haryana	Sultanpur National Park from Haryana supports more than 220 species of resident, winter migratory and local migratory waterbirds at critical stages of their life cycles. More than ten of these are globally threatened, including the critically endangered sociable lapwing, and the endangered Egyptian Vulture, Saker Falcon, Pallas's Fish Eagle and Black-bellied Tern
19	Bhindwas	Haryana	Bhindawas Wildlife Sanctuary, the largest wetland in Haryana is a human-made freshwater wetland. Over 250 bird species use the sanctuary throughout the year as a resting and roosting site. The site supports more than ten globally threatened species including the endangered Egyptian Vulture, Steppe Eagle, Pallas's Fish Eagle, and Black-bellied Tern.
20	Keoldeo Ghana NP	Rajasthan	
21	Sambhar Lake	Rajasthan	
22	Upper Ganga River (Brijghat to Narora Stretch)	Uttar Pradesh	
23	**Nawab Ganj**	Uttar Pradesh	
24	**Parvati Agra**	Uttar Pradesh	
25	**Saman**	Uttar Pradesh	
26	**Samaspur**	Uttar Pradesh	
27	**Sandi**	Uttar Pradesh	
28	**Sarsai**	Uttar Pradesh	

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29	**Sur Sarovar Lake (Keetham lake), Agra**	Uttar Pradesh	It is a human made lake that was created to supply water to the city of Agra. The wetland soon became an important and rich ecosystem. It now provides refuge to resident and migratory birds, and more than 60 species of fish. It is located on Delhi-Mathura Highway in Agra district. It was declared a bird sanctuary in 1991. It is also listed as an Important Bird Area. Sur Sarovar also has the biggest Bear Rescue Center for rescued dancing bears.
30	**Bakhira WLS**	Uttar Pradesh	
31	**Haiderpur Wetland**	Uttar Pradesh	Haiderpur is one of the largest human-made wetlands that was formed in 1984 after the construction of Madhya Ganga Barrage at the confluence of **Saloni and Ganga rivers**. It is a part of Hastinapur WLS. It covers an area of 6,908 hectares and is situated on the Muzaffarnagar-Bijnor border. **Significance**: **Source of fresh water and ground water recharge** **Biodiversity Protection**: It hosts, more than 30 species of plants, over 300 species of birds including 102 waterbirds and more than 40 fish and 10 mammals species. It has CR Gharials; EN Hog Deer, Swamp Deer, Black bellied Tern, Steppe Eagle, etc.
32	**Kebartal Wetland** (Kanwar Lake)	**Bihar**	**Kabartal (Kanwar Jheel) Wetland, Bihar** Became Ramsar site in Oct 2020 This is Bihar's first Ramsar site. It is located in Bihar's Begusarai district. It covers 2,620 hectares of the Indo-Gengetic plains in Northern Bihar. It is a residual oxbow lake, formed during the meandering of Gandak river, a tributary of Ganga in the geological past. It is an important stopover along the Central Asian Flyway, with 58 bird species using it to rest and refuel. Some critically endangered birds of the site include re-headed vulture, white rumped vulture, Indian Vulture, Baer's pochard, and the Sociable Lapwig. **Note:** Kabartal is **Asia's largest freshwater oxbow lake**

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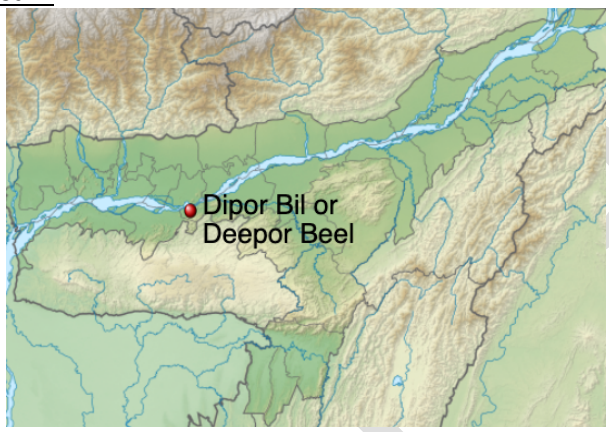
33	Deepor Beel	Assam	It is a lake located to the South West of Guwahati city in Assam. It is a permanent freshwater lake, in a **former channel of Brahmaputra river**, to the south of the main river. It is also an Important Bird Area. It is the only Ramsar site of Assam.  The **Deepor Bil WLS** measures 4.1 sq km within this wetland
34	Loktak Lake	Manipur	
35	Pala Wetland	Mizoram	
36	Rudrasagar Lake	Tripura	
37	Nalsarovar Bird Sanctuary	Gujarat	
38	Thol Lake	Gujarat	Thol Lake Wildlife Sanctuary from Gujarat lies on the Central Asian Flyway and more than 320 bird species can be found here. The wetland supports more 30 threatened waterbird species, such as the critically endangered White-rumped Vulture and Sociable Lapwing , and the vulnerable Sarus Crane, Common Pochard and Lesser White-fronted Goose
39	Wadhwan Lake	Gujarat	Wadhvana Wetland from Gujarat is internationally important for its birdlife as it provides wintering ground to migratory waterbirds, including over 80 species that migrate on the Central Asian Flyway. They include some threatened or near-threatened species such as the endangered Pallas's fish-Eagle, the vulnerable Common Pochard, and the near-threatened Dalmatian Pelican, Grey-headed Fish-eagle and Ferruginous Duck
40	Khijadia WLS	Gujarat	
41	Bhoj Wetlands	Madhya Pradesh	

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42	Sakhya Sagar	Madhya Pradesh	
43	Sirpur Sagar	Madhya Pradesh	
44	Yashwant Sagar	Madhya Pradesh	It is one of the two Important Bird Areas (IBA) in the Indore region as well as one of the most important birding sites in Malwa region of Madhya Pradesh. Presently it is being used for water supply to the city of Indore and is being also used for fish culture on a commercial basis.
45	**Sundarban Wetlands**	West Bengal	**Largest** Ramsar site in India **Sundarbans** • It comprises of hundreds of islands and a network of rivers, tributaries and creeks in the **delta of the Ganga and the Brahmaputra** at the mouth of Bay of Bengal in India and Bangladesh. • **Indian Sundarban** consists of **60% of the country's total mangrove forest area**. **Sundarbans Reserve Forest (SRF)** • It is the largest mangrove in the world and is now a wetland of international importance. So, it has now become the **largest protected wetland (**4,23,000 hectare**)** in the country.
46	East Calcutta Wetlands	WB	It comprises of a larger number of waterbodies distributed east of city of Kolkata across the districts of South and North 24 Parganas. It is spread over 125 km^2. Along with the wetlands, it also has **254 sewage-fed fisheries,** agricultural and solid waste farms and some built up areas. It was included in **the Ramasar List** in Aug 2002. The hydrology of this wetland is unique. It **doesn't have a catchment area of its own**. Approximately 250 million gallons of sewage flows into it everyday. • The sewage is then drawn by the local fishery owners into fish ponds or **bheris** directly from the tributary wastewater canals. .

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			• Sunlight is enough to promote high growth of dense plankton and algae which serves as food for the fish population which thrive on the nutrient rich plankton. • Organic pollution in the wastewater is thus reduced by 80% and the coliform bacteria in the wastewater is reduced by 99.9 % in these ponds. The **Kolkata Municipal Corporation** saves Rs 5,000 - 7,000 crores every year - the cost of sewage treatment plant for treating so much water. • Channels drain out the effluents and slurry from the treated wastewater, that is then used to grow rice and vegetables. • Around 25% of Kolkata's fish and vegetables are grown with the help of this water. This wetland thus support livelihood of more than a lakh population. It acts **as kidney of Kolkata** as the wastewater from the city is converted into food and used in fisheries and agriculture across this wetland. ***Bheris** are a unique feature of the* Kolkata wetlands, and are shallow fishponds fed by naturally treated wastewater rich in algae, which allows for low-cost fish cultivation. **Safety of Fish/Vegetables:** Some experts have raised the issue of heavy metal contamination from this kind of fishery and vegetable cultivation.
47	Bhitarkanika Mangroves	Odisha	Bhitarkanika is also the second largest mangrove ecosystem in the country (after Sundarbans). • Freshwater mixed with seawater near the lower end of the Brahmani and Kharasrota river to produce brackish water ideal for mangroves. **Key threats:** • **Diversion of water from Brahmani river basin**: The Talcher-Angul coal mines, steel and power generating units as well as the Kalinga Steel and power hub in Jajpur district were drawing enormous quantities of freshwater from the Brahmani river.
48	Chilka Lake	Odisha	
49	Satkosia Gorge	Odisha	

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50	Tampara Lake	Odisha	It is the most prominent fresh water Lake situated in the state of Odisha (Ganjam district). The depression in the ground gradually filled with rainwater from catchment flow and was called "Tamp" by the British and subsequently termed "**Tampara**" by the locals. It supports varied biodiversity including that of birds, fishes, phytoplanktons, and more than seven species of terrestrial plants and macrophytes. It is important habitat for vulnerable species such as Cyprinus carpio, common pochard (Aythya ferina), and river tern (Sterna aurantia). With large fish yield, it is an important source of livelihood for the local communities.
51	Hirakud Reservoir	Odisha	It is the largest earthen dam in Odisha which started operating in 1957.
52	Ansupa Lake	Odisha	It is the largest freshwater lake of Odisha situated in the Banki sub-division of Cuttack district and has its fame from time immemorial for its scenic beauty. It is an oxbow lake formed by River Mahanadi and is spread over 231 ha. It is home to several species of birds, fishes, mammals and macrophytes. It provides a safe habitat for at least three threatened bird species - **Rynchops albicollis (EN), Sterna acuticauda (EN) and Sterna aurantia** and **three threatened fish species** - **Clarias magur** (Clariidae) (EN), Cyprinus carpio (Cyprinidae) (VU), and Wallago attu (VU). The lake also sustains fresh water demand of the surrounding area and supports livelihood of local communities through fisheries and agriculture. It is a famous wintering ground for migratory birds and is also known for its scenic beauty.
53	**Nandur Madhameshwar**	**MHA**	
54	**Lonar Lake**	**MHA**	It is an **ancient circular crater lake** created by **Meteorite strike** in Maharashtra It got National geo-heritage tag in 1979. It is relatively young geo-logically, just about 50,000 years old. A meteorite estimated to weigh two-million-tonnes slammed into the Earth, creating a 1.83-km diameter crater where the lake formed. It is distinguished by a near-perfect,

			circular ejecta blanket, which refers to earth thrown up during the collision, around it. It is an endorheic (i.e., no outflow) basin, almost circular in shape. The lake is high in salinity and alkalinity, as the lack of outflow leads to a concentration of minerals as the lake water evaporates. Outside the lake, there is a considerable diversity of plant and animal life, as springs which help feed the lake provide a source of fresh water.
55	**Thane Creek**	Maharashtra	It is located in Maharashtra India. **Thane Creek** is an inlet in the shoreline of the Arabian Sea that isolates the city of Mumbai from the Konkan region of the Indian Mainland. There are several source of fresh water to the Creek, the largest being the Ulhas River. It has been declared as Thane Creek Flamingo sanctuary. Thane creek is fringed by Mangroves on both banks & comprise around 20% of the total Indian mangrove species. The mangrove serves as a nursery for several fishes & sustains the local fishery. The area is an important part of the wetland complex of the Central Asian Flyway of the birds and has been categorized as IBA. **Thane Creek Flamingo Sanctuary**: The Western bank of the Thane Creek has been declared the "Thane Creek Flamingo Sanctuary". 
56	Kolleru Lake	AP	
57	Nanda Lake	Goa	

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58	Ranganathittu Bird Sanctuary	Karnataka	
59	Magadi Kere Conservation Reserve	KAR	Artificial Lake One of the largest nesting ground for bar headed goose in southern India
60	Ankasamudra Bird Conservation Reserve	KAR	Artificial Lake Home to 210 species of plants, 8 species of mammals, 25 species of birds, and 41 species of fish
61	Aghanashini Estuary	KAR	The site is an estuary where the Aghanashini River flows into the Arabian Sea in Karnataka state. It addition to its estuarine and shallow marine waters, it features rocky and pebble shores, intertidal mudflats and some aquaculture ponds and rice fields. These diverse environments provide habitat to more than 80 fish, 115 birds and 45 mangroves species.
62	Karaivetti Bird Sanctuary	TN	It is one of the most important fresh water feeding grounds for migratory water birds in the state of TN. It is also an important nesting site for threatened species like the spotted eagle and the tawny eagle.
63	Longwood Shola Reserve Forest	TN	It is among the last vestiges of urban shola forest, where everything else has been lost to tea cultivation and other land use changes.
64	Point Calimere	TN	
65	Karikili Bird Sancutary	TN	
66	Pallikaranai Marsh Reserve Forest	TN	
67	Pichavaram Mangrove	TN	
68	Gulf of Mannar Marine Biosphere Reserve	TN	
69	Konthankulam Bird Sanctuary	TN	
70	Udhayamarthandapuram Bird Sanctuary	TN	
71	Vedanthangal Bird Sanctuary	TN	

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72	Vellode Bird Sanctuary	TN	
73	Vembannur Wetland Complex	TN	
75	Chitrangudi Bird Sanctuary	TN	Chintrangudi Bird Sanctuary, locally known as "Chitrangudi Kanmoli" is located in Ramnathapuram district of TN. Notable waterbirds spotted from the site are spot billed Pelican, little egret, grey heron, large egret, Open billed stork, Purple, and pond herons.
75	Suchindram Theroor Wetland Complex	TN	It is part of the Suchindram-Theroor Manakudi Conservation Reserve. It is an important bird area and lies at the southern tip of the Central Asian Flyway of migratory birds. It was formed for birds' nesting purposes and it attracts thousands of birds every year.
76	Vaduvur Bird Sanctuary	TN	It is a large human made irrigation tank and shelter for migratory birds as it provides a suitable environment for food, shelter, and breeding ground. While these irrigation tanks have socio-economic and cultural significance, very little is known of their ecological importance. These tanks have the potential to harbor good populations of resident and wintering water birds but no studies have been done to confirm this.
77	Kanjirankulam Bird Sanctuary	TN	It is a protected area near Mudukulathur Ramanathapuram District, TN. It is notable nesting site for several migratory heron species that roost in the prominent growth of babul trees here. The breeding population of migratory waterbirds arrive here between October and February and include: Painted stork, white ibis, black ibis, little egret, great egret.
78	Ashtamudi Lake	Kerala	
79	Sashthamkotta Lake	Kerala	
80	Vembanad Kol Wetland	Kerala	

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- **Note1:** Globally, there are around 2500 wetlands in Ramsar list. India with 80 Ramsar Sites have the highest number of wetlands in **South Asia**.

2) HOW A SITE IS DESIGNATED AS RAMSAR SITE

- According to Ramsar convention "**Each contracting party shall designate** suitable wetlands within its territory for inclusion in a List of Wetlands of International Importance".

- The wetlands are selected on account of their **international significance** in terms of ecology, botany, zoology, limnology, or hydrology. Accordingly any wetland which meets **at least one of the criterion** of identifying **Wetlands of International Importance (9 criteria)** can be designated by the appropriate national authority to be added in the Ramsar list.

- The **Ramsar secretariat ensures that data and map meet the standards set by the Conference of parties**, before publishing the information on the site of the **Ramsar Sites Information System**.

- The **nine criteria for identifying Wetlands of International Importance:**

- **Group A of the Criteria**: Sites containing **representative, rare or unique wetland types**
  - **Criterion 1**:
    - A wetland should be considered internationally important if it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region.

- **Group B of the Criteria**. Sites of international importance for **conserving biological diversity Criteria based on species and ecological communities**
  - **Criterion 2**: It **supports vulnerable, endangered, or critically endangered species** or threatened ecological communities.
  - **Criterion 3:** It supports **populations of plant and/or animal species important for maintaining the biological diversity** of a particular biogeographic region.
  - **Criterion 4**: It supports **plant and/or animal species at a critical stage in their life cycles**, or provides refuge during adverse conditions.

- **Specific criteria based on water birds**
  - **Criterion 5**: It regularly supports 20,000 or more water birds.
  - **Criterion 6**: It regularly supports 1% of the individuals in a population of one species or subspecies of water bird.

- **Specific criteria based on fish**
  - **Criterion 7**: It supports a significant proportion of indigenous fish subspecies, species or families, life-history stages, species interactions and/or populations that are representative of wetland benefits and/or values and thereby contributes to global biological diversity.
  - **Criterion 8**: It is an **important source of food for fishes, spawning ground, nursery and/or migration path** on which fish stocks, either within the wetland or elsewhere, depend.

- **Specific criteria based on other taxa**

- **Criterion 9**: It **regularly supports 1% of the individuals in a population of one species or subspecies** of wetland-dependent non-avian animal species

3) MONTREUX RECORD

- It is the principle tool of the Ramsar Convention for highlighting those sites, where an **adverse change in ecological character**:
  - Has occurred
  - Is occurring
  - Is likely to occur as the result of technological developments, pollution or other human interference and which are therefore, in need of priority conservation attention.

- If such changes are brought to the notice of the Convention Secretariat (by Government or by NGOs), the site is then placed under Montreux Record.
  - This is a **means to drawing attention** to such sites, and it is subject to continuous review.
  - Convention Secretariat, will help the country in taking conservation measures, and if they succeed, the site may be removed from the Montreux Record after a review, and at the request of the country.

- **Indian Ramsar Sites in Montreux Record:**
  - Keoladeo National Park
  - Loktak Lake
    - Chilka lake was once placed on the record. Later, when conservation measures were implemented and succeeded, it was removed from the record.

4) THREATS FACED BY WETLANDS IN INDIA

- **Water Pollution**
- **Noise Pollution** caused by rapid urbanization around the wetlands continues to be an irritant and is putting migratory visitors away.
- **Dumping of Wastes** (Municipal solid waste, construct waste) etc is leading to loss of Wetlands.
- **Very less focus on** small non-notified wetlands.
  - Absence of any **inventory** related to wetlands.
- **Lack of resources with local bodies** to ensure proper care and protection of the wetlands.

5) WORLD WETLAND DAY: 2ND FEBRUARY

- World wetland day is celebrated every year on 2nd February. The date marks the day of adoption of Ramsar Convention on Wetlands on 2nd February 1971, in the Iranian city of Ramsar on the shores of the Caspian sea.
- **Theme for 2023**: "Wetland Restoration"
  - It highlights the urgent need to prioritize wetland restoration.

- **Why Wetland is significant for Biodiversity?**

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- It is stressed by the recently released global **IPBES assessment** which identifies wetlands as the most threatened ecosystem. This impacts **40% of the world's plants and animals** that live or breed on wetlands.

6) WETLAND (CONSERVATION AND MANAGEMENT) RULES, 2017

- It was notified by MoEF&CC replacing the 2010 rules.
- **Key Highlights**
  - **Decentralization** -> empowers states and Uts to identify and manage their wetlands.
  - **State Wetland authorities** to be established in each state and UT
    - Headed by State environment minister.
  - **National Wetland Committee:** It will replace Central wetland regulatory authority and will be responsible for monitoring the implementation of these rules
    - Headed by Secretary, MoEF&CC.
    - It will also advise the central government on appropriate policies and action programmes.
  - **Banned activities** like dumping solid waste, electronic etc.
  - **Applicability**
    - Wetland classified under RAMSAR
    - Wetland notified by Central, state or UTs.

13. WORLD WILDLIFE DAY: 3RD MARCH

- It is celebrated on 3rd March
- **UNGA** in 2013 had passed a resolution for choosing 3rd of March as the WWD. This day was chosen as on March 3, 1973, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) was adopted.

14. WORLD WILDLIFE FUND FOR NATURE (WWF)

1) ABOUT WWF

- The World Wildlife Fund for Nature is an **international NGO founded in 1961**, working in the field of **wilderness preservation**, and the reduction of **human impact on the environment**.

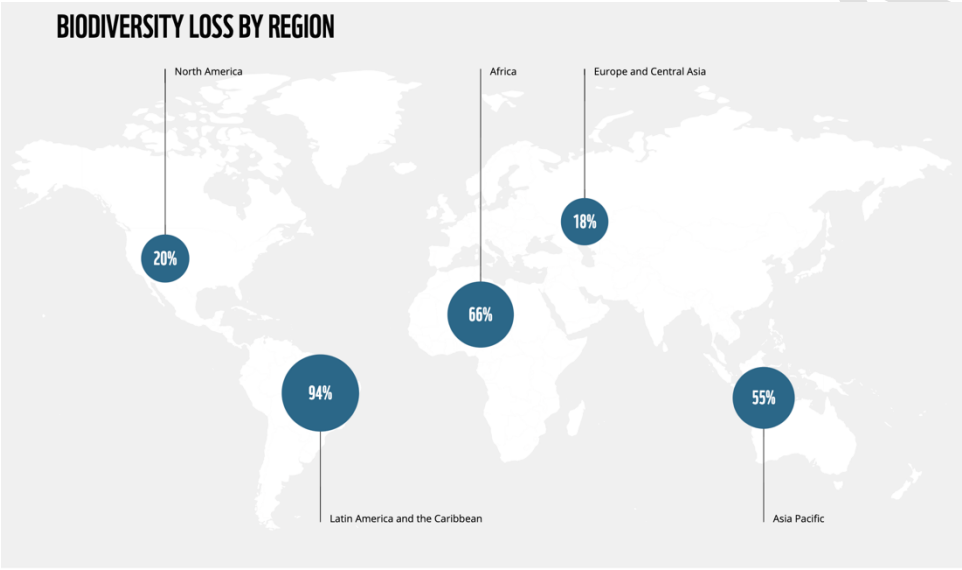
- It is considered the **world's largest privately financed conservation organization**, with over 5 million supporters worldwide working in more than 100 countries and on more than 3,000 projects.

- **Important Reports:** The Living Planet Report has been published every two years since 1998

- **Important Campaigns by WWF**
  - **Earth Hour** - Encourages everyone to switch off non-essential electric lights, for one hour, from 8:30 - 9:30, on a specific day towards the end of March.
    - Earth hour 2020 was held on 28th March.
  - **Debt for Nature Swaps** are financial transactions in which a portion of a developing countries foreign debt is forgiven in exchange for local investments in environmental conservation measures.

2) REPORT: LIVING PLANET REPORT

- The Living Planet Report comprehensive study of trends in global biodiversity and the health of the planet.
- A Living Planet Index (LPI), featuring about 32,000 populations of 5,230 species across the world, showed that vertebrates wildlife populations are plummeting at a particularly staggering rate in tropical regions of the world.
- In last 50 years, there has been 69% decline in the wildlife populations of mammals, birds, amphibians, reptiles and fish.
- **Region with highest decline ->** Latin America and the Caribbean region (-94%); followed by Africa (-66%) and Asia Pacific (-55%)



- **Freshwater species** populations has globally reduced by 83%, confirming that the planet is experiencing a "biodiversity and climate crisis.
    - Habitat loss and barriers to migration routes were responsible for about half of the threats to monitored migratory fish species.
- **WWF has identified six key threats to biodiversity**:
    - Agriculture; Hunting; Logging; Pollution; Invasive Species and Climate Change
- **Recommendations/Suggestions:**
    - Biodiversity crisis and Climate Change has to be dealt with together - instead of two different issues, as they are interwined.

15. INTERNATIONAL CONVENTION FOR THE CONTROL AND MANAGEMENT OF SHIP'S BALLAST WATER AND SEDIMENTS (ALSO KNOWN AS "BALLAST WATER MANAGEMENT CONVENTION")

- Convention was **adopted in Feb 2004 by 74 countries** (now 86 countries are signatories).
    - It **came into force in Sep 2017**.
- It is a maritime treaty which **requires signatory states to ensure** that ships flagged by them comply with standards and procedures for the management and control of ship's ballast water and sediments.
- **Objective**
    - Prevent, minimize, and ultimately eliminate the transfer of **harmful aquatic organisms and pathogens** through the control, and management of ship's ballast water and sediments.

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- **Main Provisions**
  - **General Abilities:** Ships must have **facilities to treat the ballast water** before releasing it in foreign waters.
  - **Reception Facilities:** Under Article 5 Sediment Reception Facilities Parties undertake to ensure that ports and terminals where cleaning or repair of ballast tanks occurs, have **adequate reception facilities for the reception of sediments**.
  - **Research and Monitoring**
    - Article 6 calls for parties individually or jointly to promote and facilitate scientific and technical research on ballast water management; and monitor the effects of ballast water management in waters under their jurisdiction.

- **Note:** India is **not participating** in the convention.

16. INTERNATIONAL TREATY ON PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE (ITPGR)

- **Why in news?**
  - India hosted the 9th session of the Governing Body (GB9) of the ITPGR (Sep 2022)

- **Introduction**
  - This is a treaty which is aimed at:
    - **Conservation and sustainable use of all plant genetic resources for food and agriculture** and;
    - The **fair and equitable sharing of the benefits** arising out of their use, in harmony with the CBD, for sustaining agriculture and food security.
      - **Recognizing the contribution of farmers t**o the diversity of crops that feed the world.
      - Ensuring that the **recipients share the benefits they derive** from the use of genetic materials with the **countries where they have been originated**.
    - Establishing **a global system to provide farmers, plant breeders and scientists with access to plant genetic material**.

- It was adopted by the **31st session of the Conference of Food and Agriculture Organization (FAO) of the UN** on **Nov 3, 2001**.

- **Main Provisions**
  1. **Multilateral System**
     - It is the treaty's innovative solution to access benefit sharing.
     - It puts **64 of the world's most important crops** - crops that together account for 80% of the food we derive from plants - into an **easily accessible global pool of genetic resource**s that is freely available to potential users in the Treaty's ratifying nations for some uses.
  2. **Access and Benefit Sharing**
     - Ratifying nations are provided facilities to access the genetic material for the 64 crops in the Multilateral System for research, breeding and training for food and agriculture.
     - Prevent the recipient of genetic resources from claiming IPR over those resources in the form in which they received them.

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- Those who access genetic materials through the multilateral system agree to share the benefits from their use through the benefit sharing mechanisms established by the treaty.

3. **Farmer's right**
   - The treaty calls for protecting the traditional knowledge of these farmers, increasing their participation in national decision-making process, and ensuring that they share in the benefits from the use of these resources.

4. **Sustainable Use**
   - Most of the world's food comes from four main crops - Rice, Wheat, Maize and Potatoes.
   - However, local crops, not among the main four, are a major food source for hundreds of millions of people and has potential to provide nutrition to countless others.
   - The **treaty helps maximize the use and breeding of all crops and promotes development and maintenance of diverse farming systems**.

- **The Ninth session of the Governing Body (GB9) of the International Treaty on Plant Genetic Resources of Food and Agriculture** (ITPGRFA) was held in New Delhi (Sep 2022)
  - **Key Highlights:**
    - In a historical first, Federation of Seed Industry of India (FSII) contributed Rs 20 lakhs (USD 25,000) to the Benefit Sharing Fund (BSF) as the first collective contribution from Indian seed sector, during the GB-9 meeting.
      - The **BSF** is the funding mechanism of the treaty used for support of capacity building, Conservation and sustainable use projects among the Contracting parties of the Treaty.
    - **India appointed as the co-chair** of the Working Group on "Enhancement of MLS (Multilateral System)"
    - **Consensus on Implementation of Farmers Rights Reached** after extensive negotiation at GB9
    - **India flags issue regarding genebank funding**

17. WORLD SEED VAULTS

- **Introduction:**
  - Seed vaults are places where seeds of various plants are stored to ensure protection of genetic resources and diversity.
    - » They are stored at very low temperatures (at around -18 degree C).
    - » Even at this temperature, seeds have a shelf life and thus seed vaults are regularly updated with fresh, viable samples.

- **Svalbard's Vaults**, at **Spitsbergen**, Norway
  - It stores crop seeds.
  - It is built inside a mountain on the **remote Arctic Archipelago of Svalbard**. It was opened in 2008 with the intention of being **politically neutral and safe location to protect the world's crop diversity**. It is designed to survive nuclear war and world war.

- Samples sent here are the duplicates from seed and gene banks, research facilities, and communities around the world, ranging from large institutions like ICARDA, to the Cherokee Nation, who in 2020, became the first tribe in the U.S. to send important heirloom seeds to Svalbard.
- During the **Syrian war**, scientists duplicated and safely transported genetic resources from International Center for Agriculture Research in the Dry Areas facility in Tal Hadia.

- **Millennium Seed Bank** at the Royal Botanic Gardens, *Kew, **UK*** is the world's largest **wild seed conservation project**.
  - It has recently completed 20 years of its formation.
  - Its vault has been built to withstand bombs, radiation, and floods. It holds **2.4 billion seeds** from 39,681 species, coming from 190 countries and territories.
  - The facility claims that they have contributed to protecting 16% of the world's seed-bearing plants.
  - **After the recent massive bushfire in Australia**, the seed bank sent backup seeds of **clover glycine** (*Glycine latrobeana), a rare, wild pea,* to its partners in Australia so that the plant could be cultivated and used to restore the ecosystem.

- **Other important seed banks**
  - The **Australian Grains Genebank (**AGG)
  - **Vavilov Institute of Plant Industry**, Russia

18. ANTARCTIC TREATY SYSTEM

a. **Antarctic Treaty:**

- It is a treaty that was negotiated during the middle of the Cold War by 12 countries with Antarctic interests. It acts as a **foundation for rule based international order for a continent without a permanent population**. It remains the only example of a **single treaty** that governs a whole continent.

- It is a **remarkably short treaty** and contains only 14 articles. Key provisions include promotion of Freedom of Scientific Research, the use of continent only for peaceful purposes, and the prohibition of military activities, nuclear tests, and the disposal of radioactive waste.
  - The **most important provision** of the treaty is **Article IV**, which effectively seeks to neutralize territorial sovereignty in Antarctica. This means that a limit was placed on making any new claim or enlargement of an existing claim. Further, **no formal recognition** was given to any of the **seven territorial claims** on the continent, by Argentina, Australia, Chile, France, New Zealand, Norway, and the United Kingdom.
  - **Russia, USA, and China -** who are signatory to the conventions but have not made any formal territorial claims - are also bound by the limitations of Article IV.

- **How has the treaty expanded for 60 years?**
  - Though the compact was held for 60 years, there have been tensions from time to time. For e.g. between UK and Argentina.
  - A key reason because of which the treaty has survived is that it has kept **on evolving through a series of additional conventions and other legal protocols**.
    - Various disputes have been addressed through the expansion of the treaty framework with new agreements. This framework is now referred to as the **"Antarctic Treaty System**".

- These measures have been a great success, but tensions have arisen in recent years over the promotion of Southern Ocean Marine Reserves. In 2016, agreement was reached on **Ross Sea Marine Protected Area**, and momentum is building for a broader network of **Southern Ocean Marine Protected Areas**. **China and Russia** have resisted these initiatives.

- **By, 2020** the treaty has **54 signatories**.

- **Changing Circumstances between 1950s to 2020s**
  - Though the treaty has been successful in responding to various challenges so far, the circumstances are radically different now. Antarctic is much more accessible both due to climate change and technological improvement. More countries now have substantive interest in the region when compared to only 12 in the beginning.

19. CONVENTION FOR THE CONSERVATION OF ANTARCTIC MARINE LIVING RESOURCES (CCAMLR)

- **About the CCAMLR**
  - It is part of Antarctic Treaty System. It was entered into force on 7th April 1982 and is headquartered **in Hobart City of Tasmania State, Australia**.
    - The immediate reason for the convention was the concerns related to increased **krill catches** in the Southern Ocean which could have had a serious impact on populations of other marine life which are dependent upon krill for food.
  - It is **aimed** at preserving marine life and the environmental integrity **in and near Antarctica**. It thus wants to ensure sustainable utilization of resources of Southern Ocean and regulates the use of resources in the region.
  - The commission has **26 members** (25 countries + European Union) presently.
  - **Note: India** is a member state.

- **Marine Protected Areas**
  - In 2009, the commission by consensus decided to create **a network of Marine Protected Areas (MPAs)**.
    - It was the first international body to do this on the recommendations from the **United Nations World Summit on Sustainable Development**.

- **Designated or Proposed Marine Protected Areas**

South Orkneys MPA - Designated Designated in 2009, around South Orkneys Island in the Southern Ocean	

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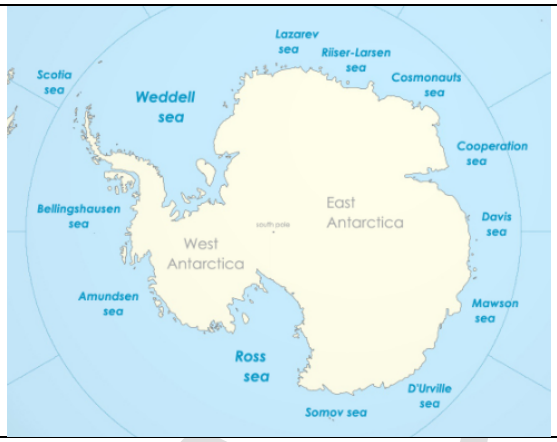
Ross Sea MPA - Designated Designated in 2016	

- **East Antarctica, Weddell Sea and Antarctic Peninsula** are the three others **proposed MPAs** yet to be approved by the commission.
- **East Antarctica** (proposed MPA) will protect blocks of oceans and ocean floor along the East Antarctica, an area rich in cold water corals that provide foraging ground for penguins.
    - It has been proposed by Australia, France, and European Union. It will protect one million square kms of ocean but has been repeatedly been struck down at the meetings of CCAMLR since 2010.
    - Members like **China** and **Russia** have opposed it due to economic and political reasons.
    - **All 26 members** must consent for the creation of Marine Park.
    - **What will be the impact of creation of MPA in East Antarctica?**
        - Ban on fishing in a vast area of the Weddell Sea and parts of Antarctic Peninsula. It will lead to safeguarding of species including penguins, killer whales, leopard seals, and blue whales.
        - It would also play an important role in fighting **climate change** as the seas around Antarctic are very important sink for Carbon dioxide.

- **Weddell Sea** - lies adjacent to Antarctic Peninsula. It made an MVA, it would become the largest nature reserve anywhere in the world.
- **Antarctica Peninsula** (the area to the west of Antarctic Peninsula) is particularly vulnerable to tourism impacts, fishing activities and global warming. About 75% of the Antarctic Krill is located here.

- In Sep 2021, India announced that it is considering to co-sponsor an MPA proposal at the CCAMLR and getting aligned with countries such as Argentina, Brazil, Chile, Korea, New Zealand, South Africa and USA, which are also proactively supporting the MPA proposals.

A) KRILL FISHERY AND ASSOCIATED ISSUES:

- Krill is the most abundant species in the world, with a biomass of 400 million tons in the Antarctic.
- **Significance:**
    - **Main Source of food for ocean wildlife** including whales, penguins and seals, any disruption to krill populations will ripple across the ecosystem.
    - **Note:** Krill is not a fish, it's a **Crustacean** (a type of arthropod).
- **Fighting Climate Change**: Krill are integral in influencing atmospheric carbon levels, and have the capacity to remove upto 12 billion tonnes of carbon every year from the Earth's atmosphere.
- **Competition for krills is increasing** as the human demand for krill products increase.

- **Useful Video:** https://youtu.be/4euvH0K3lsQ
    - **Antarctic Krill Fishery:** Krilling for Oil | Oceans. Inc

20. 6TH MASS EXTINCTION/ HOLOCENE EXTINCTION/ ANTHROPOCENE EXTINCTION

- **Background: Earth's previous five extinction:** Earth is the only known planet to support life. Various kinds of life forms have survived here for at least 3.5 billion years. But it's hospitality doesn't show consistency. In fact, **within the last 500 million years, the natural disasters have caused at least 5 mass extinctions** which wiped out **50-90% of all species on the planet** at the time.

    1. **End-Ordovician, 443 million years ago**
        - A severe ice age led to sea level falling drastically upto 100 meters, which wiped out 60-70% of all species which were prominently ocean dwellers.
        - Then soon after the ice melted leaving the oceans starved of oxygen.
    2. **Late Devonian, 360 million years ago**
        - A messy prolonged climate change event, hit the life in shallow seas very hard, killing 70% of the species including almost all corals.

    3. **Permian-Triassic, 250 million years ago**
        - It has been the biggest and worst mass extinction in last 500 million years. More than 90% of the species perished, including trilobites and giant insects - strongly linked to massive volcanic eruptions in Siberia that caused a savage episode of global warming.
    4. **Triassic-Jurassic, C 200 million years ago**
        - 75% of species were lost, again most likely due to another huge outburst of volcanism. It left earth clear for dinosaurs to flourish.
    5. **Cretaceous - Tertiary, 65 million years ago**
        - A giant asteroid impact on Mexico, just after large volcanic eruptions in India saw the end of 60% of the species that populated the planet including dinosaurs.
        - Mammals, and eventually humans took advantage.

- **6th Mass Extinctions** refers to ongoing extinction of various plants and animal species mostly as **a result of human activity**. Scientists believe that billions of population of mammals, birds, reptiles and amphibians have been lost all over the planet, leading them to say a sixth mass extinction has already progressed further than was thought.
- According to a research published in the journal proceedings of the National Academy of Sciences of the United States of America (PNAS), **the ongoing sixth mass extinction** may be one of the most serious environmental threats to the persistence of civilization.
    - » This extinction is human caused and is more immediate than climate destruction.
    - » The study found that 515 species of terrestrial vertebrates are near extinction.
        - Most of these species are from South America (30%), followed by Oceania (21%), Asia (21%), and Africa (16%) among others.
    - » The current loss of species has been occurring since 1800s.

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- **A study published by University of Hawaii (Jan 2022)**
  - » The current mass extinction has been going on since 16th century. Since then earth has lost 1,50,000 to 260,000 species (around 7.5 to 13 percent of its two million species)
  - » It also said that the Red List is biased and leaves out most invertebrates - a group that has seen a dramatic loss and is the majority of diversity on Earth.
- Some other scientists believe that sixth mass extinction is not already under way, but we are on the edge.
- **Scientists blame the following factors for this**:
  - » **Human Over-population and over-exploitation of resources**
    - Habitat loss and fragmentation represent primary threat for 85% of all species on the IUCN Red list.
    - It includes deforestation for farming, logging and settlement.
  - » **Poaching** in case of large animals prized for their body parts (tiger, elephant, lion etc)
  - » **Pollution** is pervasive in many species, from chemicals like mercury that accumulate in fish to the plastic debris that slowly kill sea turtles, sea birds and cetaceans.
  - » **Introduction of Invasive species**
    - It threatens a variety of native plants and animals around the world by killing them directly or by outcompeting them for food and nest sites.
  - » **Climate Change** has also negatively impacted entire ecosystems
    - An economy based on fossil fuels (that pollute the atmosphere) and are producing global warming with dire consequence for ecosystem.
    - An example of the impact of climate change can be seen in case of Corals. The warming of the water and acidification of oceans (due to high CO_2 in the atmosphere) are the principle reason for corals dying.
- **This mass extinction will have serious ecological, economic and social consequences**
  - » Human civilization is completely reliant on healthy ecosystem for food, water and other resources.

21. IMPORTANT DAYS

1) UN WORLD WATER DAY: 22ND MARCH

- The day is used to advocate for the sustainable management of freshwater resources.
- The **Un World Water Development Report** is released around World Water Day by **UN-Water** every year.

2) WORLD ENVIRONMENT DAY: 5TH JUNE

- The United Nations has designated 5th June as the World Environment Day. The UNEP annually organizes events for World Environment Day, which encourages worldwide awareness and action for the protection of the environment. Since 1974, it has been celebrated every year engaging governments, businesses, celebrities, and citizens to focus their efforts.

3) WORLD OCEAN DAY: 8TH JUNE

- June 8 is the World Ocean Day, the UN day for celebrating the role of oceans in our everyday life and inspiring actions to protect ocean and sustainably use marine resources.
  - » Many countries have been celebrating this day since 1992, following the UN conference on Environment and Development, held in Rio de Janeiro.

» UNGA officially decided this in 2018.

4) EARTH DAY: 22ND APRIL

- The day is celebrated world-wide to demonstrate **support for environment protection**.
- The day was first proposed in **UNESCO conference in 1969** and the first Earth Day Celebrations took place in **1970**.

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NATIONAL CONSERVATION EFFORTS

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2. LAWS DEALING WITH BIODIVERSITY PROTECTION

1) BIOLOGICAL DIVERSITY ACT, 2002

- **Introduction**
  - In order to help it realize the objectives of CBD, India has enacted an **umbrella legislation** called the Biological Diversity Act 2002. India was the **first country**, to pass a law to uphold the CBD nationally.
  - The objective of the act are **conservation**, **sustainable utilization**, and **fair and equitable sharing of benefits** arising out of use of biological resources and associated knowledge.
  - The act extends to whole of India.

- The act works towards biodiversity protection in the following ways:
  - **Regulation of extraction to biological resources**
  - **Protection of Biodiversity Heritage Sites**
  - **Biodiversity Management Committees** play a crucial role in promoting conservation and sustainable use of biological resources within their respective areas and facilitate people's participation in biodiversity conservation.
  - **Conservation of Endangered species**: The act prohibits the transfer of any endangered species, parts, or products without the permission of the State Biodiversity Board (SBB) or the NBA

- **Conservation of Traditional Knowledge** – the act recognizes the importance of traditional knowledge associated with biodiversity conservation and ensures its protection and preservation.

- **The act recognizes the contributions of Indigenous local communities in conservation of biodiversity** and a company using these resources is required to share **0.5% of the sales post tax** to these ILCs. Only those companies whose turnover is more than 3 crore are required to make this payment.

- **Institutional Framework for the implementation of the law**
  - The act is being implemented through three tiered institutional structure
    i. National Biodiversity Authority (at central level)
    ii. State Biodiversity Boards (at state level)
    iii. Biodiversity Management Committees (at local level)

A) NATIONAL BIODIVERSITY AUTHORITY (NBA)

- The central government has established the NBA in exercise of powers conferred by sub-section (1)(4) of Section 8 of BDA, 2002.
- The NBA is Autonomous body and that performs **facilitative, regulatory** and **advisory function** for Government of India on issue of Conservation, sustainable use of biological resource and fair equitable sharing of benefits of use.

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B) BIODIVERSITY MANAGEMENT COMMITTEE (BMC)

- Under section 41(1) of the Act, every local body of the state shall constitute a **Biodiversity Management Committee** within areas of its jurisdiction for the purpose of promoting conservation, sustainable use and documentation of biological diversity including preservation of habitats, conservation of land races, folk varieties & cultivars, domestic stock and breeds of animals and micro-organisms and chronic knowledge relating to biological diversity.
- The **main function** of the BMC is to prepare People's Biodiversity Register (PBR) in consultation with local people. This register shall contain comprehensive information on availability and knowledge of local biological resources, their medicinal or any other use or any other traditional knowledge associated with it.
- They shall **also be responsible for:**
  - Conservation, Sustainable use and access to benefit sharing of biological resources
  - Eco-restoration of the local biodiversity
  - Feedback/Information to the Board, and the NBA in matters of IPRs, traditional knowledge etc.
  - Management of Biodiversity Heritage sites including Heritage trees, animals, micro-organisms, and Sacred Groves.
  - Conservation of traditional varieties/breeds of economically important plant species
  - Biodiversity Education and Awareness building

C) ISSUE OF FAIR AND EQUITABLE SHARING OF BENEFITS ARISING OUT OF USE OF BIOLOGICAL RESOURCES AND ASSOCIATED KNOWLEDGE

- **Introduction**
  - **The Biological Diversity Act, 2002** regulates the extraction of biological resources through the state Biodiversity Boards and the National Biodiversity Authority.
    - Broadly, all foreign entities (companies, institutions and individuals) are within the jurisdiction of NBA while all Indian entities are the subject matter of the state board.
  - **Biological resources** include plants, animals and micro-organisms but exclude those which are normally traded as commodities.
  - **What does the law say about sharing of Benefits?**
    - Before a commercial entity extracts biological resources, it must make **prior approval of the state board or the NBA** and also **undertake to share benefits** arising out of the use of such biological entities within the local community, which has conserved and protected these biological resources. **The benefits** can be in the form of monetary compensation as well as 'joint ownership of IPRs' and/or 'transfer of technology'.
- **Divya Pharmacy vs Union of India case**: Landmark Judgment by Uttarakhand High Court on Dec 28, 2018
  - **Core Issue:** Whether the State Biodiversity Board could impose 'Fair and Equitable Benefit Sharing' as one of the regulatory functions **on the Indian entities** using Biological Resources.

» **Key Highlights of the Judgment:**
  » Indian companies which are extracting biological resources are liable to seek **prior approval** as well as **share part of their revenue** with the local communities that are responsible for conserving and protecting such resources.
    ▫ The court also **referred to international conventions and treaties** such as Nagoya Protocol on Access to Genetic Resources and Fair and Equitable Sharing of Benefits arising from their utilization to the Convention on Biological Diversity.
  » The court held that rights of indigenous and local communities have to be protected, equally from outside as well as from within.
  » The court finally ordered that the **State Biodiversity Board** does have jurisdiction to demand "fair and equitable sharing of benefits' from Divya Pharmacy and, by implication, from all Indian companies.

D) THE BIOLOGICAL DIVERSITY (AMENDMENT) ACT, 2023

- It was introduced in LS by MoEF&CC in Dec 2021 and was finally passed in the house in July 2023 and Rajya Sabha in Aug 2023.

- The amendment intends to encourage the Indian system of medicine; facilitate fast-tracking of research, patent application process; attract more foreign investment in the preservation and commercial utilization of India's biological resources; and decriminalizes all the offences under the act.

- **Key Highlights**:
  i. **Simplify compliance requirements for domestic companies**
  ii. **Exempts AYUSH practitioners, local people, and communities of the area**, including growers and cultivators of biodiversity, from g**iving prior intimation to State Biodiversity Boards** for accessing biological resources for commercial utilization.
  iii. **Users of codified traditional knowledge and AYUSH practitioners** will be **exempted form sharing benefits with local communitie**s
    - **Issue/Criticism:** The term Codified Traditional Knowledge hasn't been defined by the bill or by CBD. A broad interpretation might exempt all local traditional knowledge form benefit sharing requirements.
    - Legal experts also feel that exemption to Ayush practitioners would be detrimental to ecology and go against the principle of sharing commercial benefits with indigenous communities.
  iv. Removes research and bio-survey from the purview of benefit sharing.
  v. Benefit sharing will be based on terms agreed between the user and the local management committee represented by the National Authority
    - **Issue/Criticism:** The bill removes direct role of local communities in determining the benefit sharing provisions.

vi. Companies registered in India and controlled by Indians are now treated as Indian companies, even if they have foreign equity or partnership, thereby reducing the restrictions on them.

vii. **Simplifying the IPR Process**:
- The act specifies that approval of NBA is required before applying for IPR involving biological resources obtained from India, or (ii) sealing of patent.
- The bill says that approval would be required before the approval of IPR instead of before the application itself.
  - It further differentiates between foreign and domestic entities.
    - Foreign entities will require approval from NBA whereas domestic entities will be required to register with NBA. However, at the time of commercialization of IPR, domestic entities will need approval from NBA.

viii. The bill **decriminalizes all offences** under the act and provides for wide range on penalties. Further, it authorizes government officials to hold enquiries and determine penalties.
- **Issue/Criticism:** Such discretion with government official may promote corruption/rent seeking.

ix. The bill allows for foreign investment in research into biodiversity. However, this investment will necessarily have to be made through Indian companies involved in biodiversity research.

x. **A new section - 36(A)** has been added emphasizing on the monitoring of the Biological Resources obtained from foreign countries for use in India as per the provisions of the Nagoya Protocol on access to benefit sharing.

xi. **Section 36(B)** enables state government to develop strategies and plans for conservation and sustainable use of biological diversity.

2) BIODIVERSITY HERITAGE SITES (BHS)

- **About Biodiversity Heritage Sites**
  - They are well defined areas which have **unique, ecologically fragile ecosystems** - terrestrial, coastal, and inland waters and marine, having rich biodiversity comprising of **any one or more of the following component**s:
    i. **Richness of wild as well as domesticated species** or intra-specific categories
    ii. High endemism
    iii. Presence of rare and threatened species, keystone species, **species of evolutionary significance, wild ancestors of domestic cultivated species, or their varieties**
    iv. **Past pre-eminence of biological components represented by fossil bed**s and having significant **cultural, ethical, or aesthetic values** and are important for the maintenance of **cultural diversity**.

- Under **Section 37 of the Biological Diversity Act, 2002 (BDA) the *state government*** *in consultation with local bodies* may notify in the official gazette, areas of biodiversity importance as Biodiversity Heritage Sites (BHS).

- **Biodiversity Heritage Sites of India** (As of Jan 2024)
  i. **Arittapatti Biodiversity Heritage Site**, Madurai, TN
    - This is the first BHS of TN.

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- It has rich biological and historical significance, with the presence of around 250 bird species including 3 flagship raptors species - Laggar Flacon, Shaheen Falcon, Bonelli's Eagle and wildlife like Indian Pangolin, Python, and Slender Loris.

ii. **Asramam**, Kerala, Kollam
- It hosts a **unique diversity of Mangrove species** with diverse flora and fauna.
- It also has rare and endangered heritage trees of ***Syzygium travancoricum*** which is listed as CR in the IUCN list.

iii. **Nallur Tamarind Grove** in Devanhalli, Bengaluru, Karnataka
- The area has some of the oldest tamarind trees, recorded age of the oldest one being 410 years.
- The BHS is spread over 54 acres and comprises of nearly 300 trees.
- The significant component of this popular structure is a group of old plants standing like ageless sentinels. The area has some of the oldest tamarind trees, some more than 400 years old.

iv. **Hogrekan in Chikmagalur, Karnataka**
- The shola vegetation is home to many unique medicinal species.
- It also serves as a "Wildlife Corridor" between Kudremukh and Bhadra WLS.

v. **University of Agricultural Sciences, GKVK Campus in Bengaluru, Karnataka.**
- **Large biodiversity** -> 13 species of mammals, 10 species of reptiles, 165 species of birds and an impressive 530 species of plants.

vi. **Ambaraguda** in Shimoga, Karnataka
- A patch of primitive shola forest, known for many unique and endemic plant species.

vii. **Purvatali Rai, Bicholim, North Goa**
- Sacred grove

viii. **Ameenpur Lake,** Sangareddy, Telangana
- First water body to be recognized BHS.
- A man-made lake more than 300 years old.
- Home to many resident and migratory birds, such as flamingos, egrets, herons, cormorants etc.

ix. **Glory of Allapalli** in Gadchiroli, MHA
- First BHS of MHA
- A patch of **dense original forests.** Forest is pristine and so dense that hardly any sunlight reaches the forest floor.
- The forests dates back 100s of years.

x. **Bambarde Myristica Swamps,** Dodamarg, Maharashtra
xi. **Ganeshkhind Garden**, Maharashtra

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xii. **Landorkhori**, Jalgaon, Maharashtra

xiii. **Schistura Hiranyakeshi** in Amboli, Sindhudurg district

- A species of fish – Schistura Hiranyakeshi – endemic to Amboli was recently recorded for the first time in the western ghats in the local temple pond.

A species of fish — Schistura Hiranyakeshi— endemic to Amboli was recently recorded for the first time in the western ghats in the loca temple pond.

xiv. **Mandasuru, Kandhamal, Odisha**

- Mandasaru gorge is an abode of 1563 species of plants, animals and fungi spread over an area of 528 ha.

xv. **Mahendragiri Hill, Gajapati, Odisha**

- It is situated at an elevation between 700-15001 m above mean sea level in Gajapati district of Odisha.
- With increase altitude, the hill complex demonstrates several micro climatic conditions like tropical shola, tropical semievergreen, tropical moist-deciduous & tropical dry deciduous.
- The diversified vegetation with rich floral diversity **representing 40% of the reported flora of Odish**a.
- The ancient temples of Kunti, Shima, Arjuna and Yudhishthira at Mahendragiri have been declared as protected monuments under the Ancient Monument and Archaeological sites and Remains Act 1958 by the State Government. These monuments provide a sacred and holy background for receiving about one lakh devotees annually every year to worship the deities of the hill.

xvi. **Gandhamardan Hill,** Bargarh and Balangir district, **Odisha** (March 2023)

- An area of more than 18000 hectares of Gandhamardan Hill (Gandhamardan Reserve Forest) (In Bargarh and Balangir district) has been notified as BHS.
- The hill has high floral diversity with more than 1,000 species of plants.

- One angiosperm, Ficus conccina var dasycarpa and one spider, *Peucetia harishankarensis* are endemic to the hill.

- It is considered a treasure trove of medicinal plants and thus an Ayurvedic paradise of Odisha.
- The hill is home to two important temples - Nrusinghanatha Temple located on northern slope and Harishankar temple located on southern slope.
- The place is famous for highly successful people's resistance against bauxite mining there.

xvii. **Naro Hills, Satna Madhya Pradesh**

- It is a unique and varied geology and it supports a large number of ecosystem and species of flora and fauna.

xviii. **Patlakot**, Chhindwara, Madhya Pradesh

- It has a terrain of 1700 feet deep valley and ecosystem of estimated age of 6 million years and species of rare flora and fauna including rare Bryophytes and Pteridophytes.

xix. **Amarkantak**, Anuppur, Madhya Pradesh:

- It is situated in the Maikal mountain ranges which link the Vindhyachal and Satpura mountain ranges. It has a unique terrain of a 1700 feet deep valley and an ecosystem of the estimated age of 6 million years and species of rare flora & fauna including rare bryophytes and Pteridophytes.
- Amarkantak ecological system is the origin of three major rivers - Narmada, Johila, and Sone

xx. **Tonglu BHS,** Darjeeling Forest Division, WB

- 230 hectare site is a medicinal plant conservation area.
- Unchecked foot traffic is a major concern for protection here as the BHS borders Nepal border.

xxi. **Dhotrey BHS**, Darjeeling Forest Division, WB

- Right next to Tonglu
- Rich in medicinal plants
- Threatened by human encroachment

xxii. **Baneshwar Shiva Dighi**, Coochbehar, WB

- It offers refuge to black softshell turtle listed under CR by IUCN.

xxiii. **Chilkigarh Kanak Durga** in Jhargram, WB

- Chilkigarh Kanak Durga is a small **patch of forest ripe with traditional beliefs of local habitats**.
- The site is home to 25 species of animals and more than 380 species of plants, out of which many has medicinal properties.

xxiv. **Char Balidanga** (Nadia), WB (2023)

- It is an island spread across 115 acres. It has tropical riverine vegetation with tall grasses and trees, along with swampy flat land covered with algal mats, which are periodically inundated with tidal ebbs.
- It is home to almost 100 species of birds, apart from golden monitor lizard, and golden jackals.

xxv. **Namthing Pokhari** (Darjeeling) WB (2023)
- It is a natural Himalayan Wetlands. It is home to the **Himalayan Salamandar**.

xxvi. **Amkhoi Wood Fossil Park** (Birbhum), WB (2023)
- It has unique geological and paleo-botanical features.

xxvii. **State Horticulture Research Development Station** (Nadia), WB (2023)
- It hosts indigenous horticulture germplasm of orchard trees.

xxviii. **Birampur - Baguran Jalpai,** Purba Medinipur, WB (2023)
- It is a habitat of red crabs and sand bubbler crabs which are fast disappearing from Bengal coastline due to human encroachment.
- The bushes along side the coast have golden jackals, jungle cats and golden monitor lizards.

xxix. **Haldi Char**, Purba Medinipur, WB (2023)
- It is a wetland which is home to Swarna Godhika (Yellow monitor lizard) - a schedule -1 endemic species. The wetland is most conducive for the species to thrive.
- Note**:** With this WB has 10 BHS (highest in the country)

xxx. **Gharial Rehabilitation Centre,** Lucknow, UP
- Located in Kukrail reserve forest of Lucknow.
- Established for conservation and rehabilitation of CR species of Gharial.

xxxi. **Sacred Grove at Sural Bhatori Monastery**, Pangi Village, Chamba, Himachal

xxxii. **High Altitude Meadows, Hudan Bhatori, Chamba** Himachal
- It is a 108 Bigha high altitude meadow at Muhal Dhar Shinkal in Hudan Bhatori panchayat of Pangi is at an altitude of 3,850m.
- Dominant plants are cranberry, honeysuckle, whitebeam, slender false brome, hairy brome etc.

xxxiii. **Birch-Pine forest patch, Nain Gahar,** in Lahaul's Udaipur

xxxiv. **Tunkyong Dho, Dzongu, Sikkim (2023)**
- It is notified as Sikkim's first biodiversity heritage site.
- It is believed to be one of the oldest natural dho (lake), directly related to the Hee-Youngmingmoo clan of Lepcha community in Dzongu.
- Dzongu valley is a specially protected area for aboriginal/indigenous primitive tribes considered to be the original inhabitant of Sikkim called as Lepchas.

xxxv. **Majuli Island, Assam**

- World's largest river island.
- BHS because of unique ecological and cultural heritage. Home to Assamese - neo-Vaishnavite culture.

xxxvi. **Hajong Tortoise Lake**, Dima Hasao, Assam:

- The lake is a natural habitat of CR freshwate lake 'Black Softshell Turtle" and Endangered "Indian Peacock Softshell Turtle". The site also harbors threatened species like CR Chinese Pangolins.

xxxvii. **Borjuli Wild Rice site**, Sonitpur, Assam:

- This BHS has a good population of wild species of rice - Oryza rufipogon.
- Oryza rufipogon is the progenitor of present day cultivated rice, O. Sativa.

xxxviii. **Khlaw Kur Syiem Kmielng**, Meghalaya

- It is a mosaic of natural habitats along with significant diversity of life forms. It is also an old sacred grove with monolith and religious spots.

xxxix. **Dialong Village** in Tamenglong, Manipur

- Home to the rare and endangered citrus indica, or the **Indian wild orange.** It is the most primitive ancestor to all cultivated citrus fruits in the world.

xl. **Baramura Waterfall**, Khowai, Tripura

- This is the highest natural waterfall in Tripura.
- Critical habitat for rare wildlife, Rich in floristic diversity
- Habitat for many stream water favored fauna

xli. **Unakoti, Tripura**

xlii. **Silarchari Caves, Gomati, Tripura**

- Only natural cave of Tripura.
- Unique habitat for several threatened cave bat species in Tripura

xliii. **Debbari or Chabimura**, Gomati, Tripura

- Unique habitat for threatened plants of Tripura like Dhup tree and cane resources of India

xliv. **Betlingship & its surroundings**, North District, Tripura

- It is the highest peak of Tripura on Jampui Hills, which is famous for a wonderful orange festival.

3) INDIAN FOREST ACT, 1927

- The act was passed to consolidate the then existing laws relating to forest, the transit of forest products, and duties that can be levied on forest product.

- The act provides for three categories of forests:
  i. **Reserved Forest**
    - » The reserved forests can be notified by **states** on any forest land or waste land to which **government has ownership or right**.
    - » They are **strictly protected.** Many activities are such as fresh clearings, tree felling, burning, grazing, quarrying, manufacturing, hunting, shooting etc are **prohibited** in reserved forests.

  ii. **Protected Forest**
    - » Protected forests are also notified on forest lands or waste lands **owned by Governmen**t.
    - » They are **less strictly protected**. The state government can declare any portion of the protected forest as **closed for a term not exceeding 30 yea**rs during which the rights of private person can be suspended and several activities can be prohibited.
    - » **Note: The key difference between reserved forests and protected forests**
      - ▫ Rights to all activities like hunting, grazing etc. are banned in reserved forests unless specific orders are issued otherwise.
      - ▫ Rights to activities like hunting and grazing are sometimes given to communities living on the fringe of the forest, who sustain their livelihood partially or wholly from forest resources or products.

  iii. **Village Forest**
    - The State Government may **assign to any village-community the righ**ts of Government to or over any land which has been constituted a reserved forest, and may cancel such assignment. All forests so assigned shall be called village-forests.
    - These forests are managed by village community with the assistance of the government.
      - State governments may make rules for regulating the management of village forests, prescribing the condition under which the village community may be provided timber or other forest produce or pasture and their duties for the protection and improvement of forest.

- The act also gives **power to central government** to regulate timber production and its transportation.

- It has been **criticized over the years as a**:
  - » **Tool for Colonial overtake** of India's forests for exploitation (specially timber)
  - » **Exploitation, Harassment, eviction** and **loss of livelihood** of tribals.
- **After independence,** the same act (with slight changes) continued and the forest dwellers kept getting harassed, evicted and exploited.

A) 2017 AMENDMENT: EXEMPTION TO BAMBOO GROWN IN NON-FOREST AREAS (CLASS DISCUSSION)

4) FOREST CONSERVATION ACT, 1980 (2023 AMENDMENT)

- **Why in news?**
  - » **MoEF&CC** have published proposed amendments to the Forest Conservation Act, 1980 and have invited feedback from general public (Oct 2021)

- **Introduction**
  - » It was enacted to help conserve the country's forests.
  - » It **strictly restricts and regulates de-reservation of forests** or use of forest lands for non-forest purposes without the prior approval of **central government**.
    - In 1996, the **Supreme Court** in a verdict in **TN Godavarman Thirumulpad vs Union of India** had expanded the definition and scope of forest land to include all areas recorded as forest in government record, irrespective of ownership, recognition and classification. Before this, the act was primarily applicable to reserve forests and national parks.
    - The court also expanded the definition of forests to encompass the "dictionary meaning of forests", which would mean that a forested patch would automatically become a "deemed forest" even if it is not notified as protected, and irrespective of ownership. The order was also interpreted to presume that the act is applicable over plantations in non-forest land.
  - » The Act also covers
    - Requirement for declaring an area as a protected forest, Wildlife Sanctuary or a national park.
    - Maintenance of water supply in springs, rivers and tanks.
- **Forest Conservation Division**
  - » It is mandated to regulate the diversion of forest land for non-forestry purposes through effective implementation of Forest (Conservation) Act, 1980.

A) 1996 SUPREME COURT VERDICT AND EXPANSION OF THE CONSERVATION FUNCTION

- In 1996, the **Supreme Court** in a verdict in **TN Godavarman Thirumulpad vs Union of India** had **expanded the definition and scope of forest land** to include all areas recorded as forest in government record, irrespective of ownership, recognition and classification. Before this, the act was primarily applicable to reserve forests and national parks.
- The court **expanded the definition of forests** to encompass the "**dictionary meaning of forests**", which would mean that a forested patch would automatically become a "**deemed forest**" even if it is not notified as protected, and irrespective of ownership. The order was also interpreted to presume that the act is applicable over plantations in non-forest land.

B) EXEMPTION PROVIDED BY THE SCHEDULED TRIBES AND OTHER FOREST DWELLERS (RECOGNITION OF FOREST RIGHTS ACT, 2006

- In this act, certain exemptions to forest clearance for the forest dwelling scheduled tribes and other forest dwelling communities have been provided.
  - **Section 3** of the act provides that the Central government can provide diversion of forest and for providing certain facilities managed by the government such as for creation of schools, hospitals, anganwadis, fair price shops, roads, electric and telecommunication lines, tanks and other minor water bodies, minor irrigation canals etc.

- This clearance shall be subjected to the condition that the same is **recommended by Gram Sabha.**

- Thus, it can be understood that the 2006 Act brings in **a balance between conservation of forest rights and protection of rights of forest dwelling communities** and even this is achieved only by an elaborate procedure after seeking sanction of various communities.

C) FOREST CONSERVATION (AMENDMENT) ACT, 2023

- Adding of a **preamble** to the act.
- Changing the name to **Van (Sanrakshan Evam Samvardhan) Adhiniyam**, i.e. **Forest (Conservation and Augmentation) Act**.
- The bill provides that **two types of land** will be under the purview of the act:
  i. Land declared/notified as a forest under Indian Forest Act, 1927 or under any other law, or
     - Note: The land which has not been notified will not be included under the purview of the act.
  ii. Land notified as a forest on or after Oct 25, 1980 in a government record.
     - Note: Land which changed from forest use to non-forest use before Dec 12, 1996 will not be included.

- **Exempted Category of Land**:
  - **Under the 1927** Act, decisions regarding diversion of forest land for non-forest purposes are taken by the state government. The **1980 act** requires additional prior approval from central government.

  - **The bill** provides that such approval will not be required when forest land is diverted for constructing
    i. **Strategic Linear Projects** (roads, railways) of national importance and concerning national security within 100 km of India's border.
    ii. **Security related infrastructure** upto 10 hectares,
    iii. **Defence related projects**, a camp for paramilitary forces, or public utility projects as specified by the central government, not exceeding five hectares in a left-wing extremism affected area.

  - The bill also exempts **certain type of land** from the provisions of the act, such as forest land along a rail line or a public road maintenance by the government providing access to a habitation, or to a rail, and roadside amenities upto a maximum size of **0.10 hectare**.

- **Assignment/Leasing of forest land**:
  - The Original act restricts the de-reservation of forests for use of forest and **non-forest purposes**. Such restrictions can be lifted only with the prior approval of central government.
     - The act specifies certain activities that will be excluded from non-forest purposes, meaning that restrictions on the use of forest land for non-forest purposes will not apply. These activities include works related to the conservation, management, and development of forest and wildlife such as establishing check posts, fire lines, and wireless communication.

» The **amendment adds** more activities to the list such as (i) zoos and safaris under WPA, 1972 owned by the government or any authority, in forest areas other than protected areas, (ii) ecotourism facilities, (iii) silviculture operations (enhancing forest growth), and (iv) any other purpose specified by central government.

- **Powers to issue directions**: The 2023 amendment adds that the central government may issue directions for the implementation of the act to any authority/organization under or recognized by Centre, State, or UT.

- **Significance:**
  - » **Increase Plantation in non-forest areas**: The environment ministry says that the application of the act on land covered under dictionary meaning of forests (or deemed forests) has resulted in a "declining tendency in plantations in non-forest lands owing to the apprehension among individuals, organizations, and authorities regarding such plantations being considered forests".
  - » **Removal of mandatory central government approval** for diversion of forests in certain cases is expected to **reduce delays** in the implementation of strategically important projects.

- **Criticism:**
  - » The amendment by providing blanket exemptions from the act for several types of lands and several types of projects is going **contrary to the intent of the 1980 act** which was enacted for prevention of de-reservation of forest lands and large scale deforestation.
  - » Such forest clearance activities will also violate rights of forest dwellers which were secured under the 2006 Act.
  - » The **Apex Court in *T.N. Godavarman Thirumulkpad v. Union of India (UOI) and Ors*** *(AIR 1997 SC 1228),* has given a wider meaning to forest land to broaden the scope of their protection. However, the **2023 bill provides a much narrower interpretation** to the term forest land by inserting section 1A to encompass only two types of land under its ambit.
  - » **Exemption near border area** would cover large parts of the north-eastern region, Uttarakhand and Himachal Pradesh and could lead to loss of biodiversity in biodiversity hotspots.
  - » **The purpose of allowing a zoo** inside a forest is not clear.
    - Even Supreme Court (2023) has remarked that they don't appreciate the necessity of having a zoo inside tiger reserves or national parks.
  - » There is also a **lack of clarity on compensatory afforestation** for this diverted land. Similarly, it doesn't provide for how rehabilitation/resettlement/livelihood opportunities etc. would be provided for tribals affected by this kind of diversion.

5) FOREST SITUATION AND KEY STEPS TAKEN TO PROTECT FORESTS

- **Current Situation of forests in India: As per Indian State of Forest Report 2021,** India's total forest cover is 7.13 lakh sq km (**21.71%** of India's total area). When compared to 2011, there has been an increase of 3.14% in the total area under forest.

- **Concerns:**

» **Decline in Natural Forests:** Though very dense forests have increased by 501 sq km, but it pertains to protected and reserve forests with active conservation activities.
» **Decline in North-East India**: Five states in Northeast - Arunachal Pradesh, Manipur, Meghalaya, Mizoram, and Nagaland have all shown loss in forest cover. Its important for protecting the forest cover of NE as it is natural forest and with only 7.98% of the geographical area, it contributes to **23.75% of India's total forest cover.**
    - **Reasons**:
        - A spate of natural calamities; particularly landslides and heavy rains
        - Anthropogenic factors: Shifting agriculture, pressure of development activities and felling of trees.
» **Vulnerability to Forest Fire:** Around 35.46% of the forest cover in India is prone to forest fires.
    - Between Nov 2020 to June 2021, 3.4 lakh forest fire hotspots were recorded, which is the highest recorded forest fire cases ever.

- **Why forests are crucial? Why is it important to protect forests:**
» **Controlling Global Warming**: Forest restoration will play a huge role in achieving Net Zero climate target. A study in 2017 showed that land-based sinks (natural climate solutions which also includes forests) can provide upto 37% of emission reductions.
» **Protecting Biodiversity**
» **Preventing Desertification**
» **Ensuring Soil Health** (by preventing soil erosion, increasing organic content of soil etc.)
» **Protecting micro-climate** of an area
» **Livelihood** for crores of tribals and forest dwellers
» **Water Security:** Forest restoration is must for water security.
» **Medicinal plants** from forests can solve a number of health issues

- **Key Initiatives in India to Conserve Forests:**
» Forest Conservation Act, 1980
» Compensatory Afforestation Regime
» Various Protected Areas - NP, WLS, Tiger Reserves, Biosphere reserves etc.
» **Green India Mission** launched in 2010 with three objectives:
    - Double the area to be taken up for afforestation/ eco-restoration in India in the next 10 years.
    - Increase the green house removal by India's forests
    - Enhance the resilience of forests/ecosystem.
» **Nagar Van Scheme**
» **Forest Fire Prevention and Management Scheme**
» **India's International commitments**:
    - India has committed to restore 5 million hectares of degraded and deforested land between 2021 and 2030.
    - India also targets creation of 2.5 to 3 billion tonnes of carbon sink by 2030 as part of its INDC. This would require India to increase its tree cover by 12% over the next 10 years.

- **Key International Initiatives:**
» **REDD+** under UNFCCC framework:

» **New York Declaration on Forests** (NYDF) in 2014 by United Nations Climate Summit: Target of restoring 350 million hectares of forests by 2030.
» **The span 2021-2030** is the UN Decade on Ecosystem restoration. It emphasizes on efforts to restore degraded terrestrial ecosystems including forests.
» **Bon Challenge** launched in 2011 focuses on global goal of restoring **150 million hectares** of degraded and deforested landscapes by 2020 and **350 million hectares** by 2030.
» **UN** has proclaimed 21st March as the International Day of Forests in 2012 to celebrate and raise awareness of the importance of forests.
- The year 2022 marks a decade of IDF.

D) SAROJINI FOREST (SAROJINI VAN)

Odisha has named a forest after a tribal women **Sarojini Mohanta** as a tribute to this homegrown changemaker.

Hired for a Daily wage of Rs 315 as a watcher, she has gone beyond the call of duty to create a forest on a denuded path of land in just two years.

When the Principal Chief Conservator of Forest (PCCF) came for an inspection to Bonai, he was left dazed that the **women's dedication led to the survival of 95% of saplings planted in four acres of land**. The PCCF suggested to name the plantation area after her and thus the place was named '**Sarojini Vana**'.

Every plant in the area sprawled over three acres of land appears to be at Sarojini's fingertips; she would know which plant would die if it wasn't watered

6) THE WATER (PREVENTION AND CONTROL OF POLLUTION) ACT OF 1974

- It provides for the prevention and control of water pollution, and for the maintaining or restoring of wholesomeness of water in the country.
- The Act was amended in 1988.
- **The Water (Prevention and Control of Pollution) Cess Act** was enacted in 1977, to provide for the levy and collection of a cess on water consumed by persons operating and carrying on certain types of **industrial activities**.
  - This cess is collected with a view to **augment the resources of the Central Board and the State Boards** for the prevention and control of water pollution constituted under the Water (Prevention and Control of Pollution) Act, 1974. The Act was last amended in 2003.

7) THE AIR (PREVENTION AND CONTROL OF POLLUTION) ACT OF 1981

- Main Objectives
  - To provide for the prevention, control and abatement of air pollution
  - To provide for the establishment of central and State Boards with a view to implement the Act
  - To confer on the Boards the powers to implement the provisions of the Act and assign to the Boards functions relating to pollution
- **Definitions**

- "**Air Pollutants"** means any solid, liquid or gaseous substance [(including noise)] present in the atmosphere in such concentration as may be or tend to be injurious to human beings or other living creatures or plants or properties or environment.

3. ENVIRONMENT (PROTECTION) ACT, 1986

- **Why in news?**
  - » **MoEF** proposes amendments in EPA, 1986 to decriminalize provisions (July 2022)

- **Details about the Act:**
  - » EPA, 1986 was passed under **Article 253 of the Constitution,** which empowers the centre to enact laws to give effect to international agreements signed by the country.

  - » The Act establishes "the framework for **studying, planning, and implementing long-term requirements of environmental safety** and laying down a **system of speedy and adequate response to situations threatening the environment**"

  - » It is an enabling act and **empowers the Central Government to establish authorities** [under section 3(3)] charged with the mandate of preventing environmental pollution in all its forms and to tackle specific environmental problems that are peculiar to different parts of the country.
    - E.g. authorities created under EPA: Central Ground Water Authority (CGWA)

  - » The act defines terms such as environment, environment pollutant, and hazardous substances.
  - » It provides for imprisonment of upto 5 years and or fine of upto Rs 1 lakh for violator of the law.
  - » **Environment Protection Rules 1986**
    - The rules set the standards for emissions or discharge of environment pollutant.
    - Prohibitions and restrictions on the location of industries and the carrying on processes and operations in different areas.
    - Procedure of taking samples

4. WILDLIFE (PROTECTION) ACT, 1972

- **Why in news?**
  - » Wild Life (Protection) Amendment Act, 2022 came into force from 1st April 2023

- The Wildlife (Protection) Act, 1972 was enacted to provide for the protection of wild animals, birds and plants with a view to ensure the ecological and environmental security of the country.
  - » It **defines wildlife** to include any animals, bees, butterflies, crustaceans, fish, and moths; and aquatic or land vegetation, which form part of any habitat.

  - » The act, along with Wildlife Protection Rules, provides for the protection of wild birds, animals and plants and for all matters that are connected to it whether it be their habitat or the waterhole or the forest that sustain them.

- The Act provides for:

» Prohibition of hunting
» Protection and management of wildlife habitats
» Establishment of **protected areas** and reserves such as national parks, wildlife sanctuaries, tiger reserves, conservation reserves, and community reserves.
» Management of zoos etc.

- It defines **five types** of protected areas
  1. National Parks
  2. WLS
  3. Community Reserves
  4. Conservation Reserves
  5. Tiger Reserves

- It also provides for the formation of:
  » NTCA
  » Central Zoo Authority
  » National Board for Wildlife (NBW), an advisory body to help centre of policy decisions.

- **The six Schedules** (Before the 2022 amendment)
  » The act had **six schedules** with varied degree of protection to different kind of animals and plants.
    ▫ **Schedule I and Part II of Schedule II** provided absolute protection and offences under these are prescribed the highest penalties.
    ▫ The Penalties for Schedule III and Schedule IV were less and these animals are protected.
    ▫ Schedule 5: **Vermins** includes animals which can be hunted.
      • Common crow, Fruits bats, mice and Rats only
    ▫ Schedule 6 contains **endemic plants**, which are prohibited from cultivation and planting. The cultivation and trade of specified plants can only be carried out with prior permission of competent authorities. These plants are as follows:
      • Beddomes Cycad -> Medicinal, EN
      • Blue Vanda (Medicinal)
      • Kuth
      • Ladies Slippers Orchids
      • Pitcher Plant
      • Red Vanda
  » **Permitted Hunting of Problematic Wild Animals**
    • Section 11(1)(a) of the WPA authorizes Chief Wildlife Warden to permit hunting of any **problem wild animals only** if it can't by captured, tranquilized or translocated.

E) WILDLIFE PROTECTION (AMENDMENT) ACT, 2022

- The amendment **increases the number of species protected under the law** and i**mplement CITES** effectively.

  » **Rationalizing Schedules**:
    ▫ **Reduce the total number of schedules to four by:**

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» **Schedule for Specially protected animal species**:
    - Schedule 1 (Species with highest level of protection);
        - It contains 600 species of vertebrates and hundreds of species of invertebrates.
    - Schedule 2 (Species with lesser level of protection);
        - It contains 2000 species (including 1,134 species of birds)
» **Schedule for Plant Species:**
    - **Schedule** 3 (Protected Plant Species);
» **Schedule for implementation of CITES**:
    - Schedule 4 (Specimen listed in the Appendices under CITES)
» **Note**: There is no schedule for vermin species.

- **Implementing the obligations of CITES**: The central government will designate:
    - **Management Authority**, which grants export or import permits for trade of specimens
    - **Scientific Authority**, which gives advice on aspects related to impact on the survival of the specimen being traded.

- The amendment empowers central government to **regulate or prohibit** the import/trade/possession of **invasive alien species**.

- **Control of Sanctuaries**: **Increased role of centre.**
    - In the **original act** the sanctuaries are managed and controlled by Chief WildLife Warden who is appointed by the state government. But the **amendment** says that the action of the warden will be **as per the management plans of the sanctuary** which will be prepared as per the guidelines of the central government.

- **Sanctuaries in Special Areas**:
    - For sanctuaries falling under special areas (scheduled areas and areas where forest rights act is applicable), the management plan must be prepared after due consultation with concerned Gram Sabha.

- **Empowers central government to notify conservation reserve** (earlier only state government could do so).

- **Amends section 43 of the principal act** - To permit **transfer or transport of a captive elephant** for a **religious or any other purpose** by a person having a valid certificate of ownership.

- **New Section 42A has been added for surrender of captive animals**: Any person may voluntarily surrender any captive animals or animal products to the Chief Wild Life Warden. No Compensation will be paid for such items. The surrendered item becomes the property of state governments**.**

- **Increased fines and penalties** for violation of the law.

F) WILDLIFE (PROTECTION) LICENSING (ADDITIONAL MATTERS FOR CONSIDERATION) RULES, 2024

- The revised notification came into effect on 16th Jan 2024, the first revision since 1983.
  - » **The 1983 rules**, prohibited issuing license to trade in a wild animal categorized under **Schedule-1 or Part II of Schedule II under the WPA, 1972.** The license was granted in exceptional circumstances with previous approval of central government.
  - » **New Guidelines** says that "no license shall be granted if it related to any wild animals specified in the **Schedule-I** to the Act, except with **previous consultation of the central government**.
    - It mentions additional **matters to consider granting of licenses,** the authorized officers must consider the capacity of the applicant to handle the business concerned in terms of the facilities, equipment and feasibility of premises for the business.
  - » **Note**: The new guidelines doesn't have licensing restrictions for species listed in Schedule-II of the WPA, 1972. It may imply that the license for trading in Schedule - II species can be granted without consulting central government which was required earlier.

- **Analysis**:
  - » **Exclusion of Schedule-II**

5. ZOOLOGICAL PARKS

1) CENTRAL ZOO AUTHORITY

- **About Central Zoo Authority (CZA)**
  - CZA is a statutory body formed under the Wildlife Protection Act, 1972. It is chaired by the environment Minister.
    - » The authority is responsible for regulation of zoos in the country.
    - » It prescribes various standards for the functioning of the zoo and evaluates and assesses the functioning of the zoo.
    - » It is also the authority to recognize or derecognize a zoo.
    - » It makes rules and guidelines for various issues associated with zoos like transfer of animals among zoos including international transfer among zoos.
    - » It consists of a **Chairperson** and **10 members** and a **member-secretary**.
      - Most of the members are officials in environment ministry.
      - Non-government experts are those who are wildlife conservationists or retired forest officers.
  - **Main Objective:** To complement the national effort in conservation of wildlife.

- **Reconstitution of Central Zoo Authority** (July 2020)
  - The environment ministry has reconstituted CZA to include an expert from the **School of Planning and Architecture**, Delhi, and a molecular biologist.

2) NATIONAL ZOOLOGICAL PARK

- Set up in 1959, as per the decision of Indian Board of Wild Life, 1952 (now a statutory body National Board of Wildlife under WPA, 1971)

- Till 2019, it was directly managed by MoEF&CC.
    - From Sep 2019, the Delhi Zoo (i.e. National Zoological Park) is being administered directly by Central Zoo Authority.
        - **Criticism of the move:** CZA is a regulating body. So there is a conflict of interest in this case, where a regulating body is managing the zoo as well.
- It was originally known as Delhi Zoo but in the year 1982 it was given the status of the National Zoological park with the idea of it being the model zoo of the country.

3) RELIANCE INDUSTRIES LIMITED WILL BUILD WORLD'S LARGEST ZOO IN JAMNAGAR (DEC 2020)

It will come up in 280 acres of land near Reliance's refinery at Moti Khavdi near Jamnagar. It will house 100 different species of mammals, birds, reptiles, and amphibians.

4) VANDALUR ZOO (ARIGNAR ANNA ZOOLOGICAL PARK) (AAZP)

- **Why in news?**
    - TN government order to set up museum, theatre at Vandalur Zoo (June 2023)

- **About Vandalur Zoo**:
    - The zoo is located in Vandalur, to southwest of Chennai.
    - It was established in 1855 and was the first public zoo in India.
    - It is spread over 602 hectares and includes a rescue and rehabilitation centre. It is also the **largest zoo** of India.
    - The zoo is situated 7 kms from Tambaram.

- **Details of news**:
    - The TN government has issued an order to set up a museum and a theatre at a cost of Rs 4.3 crores at the AAZP.

5) NANDANKANAN ZOOLOGICAL PARK (NZP)

- It is a large zoo and botanical garden, situated 15 km from Bhubaneshwar. It has been built right inside a forest and set in a completely natural environment.
- **Uniqueness of the zoo**
    - It is the first zoo in India to breed a **white tiger** and **Melanistic tiger**.
    - It is the only conservation breeding center of Indian Pangolins in the world.
    - It is the only zoological park in India to become an institutional member of World Association of Zoos and Aquarium (WAZA).
    - A train 'Puri-New Delhi Express' has been named after Nandan Kanan zoo as **Nandan Kanan express**.

- It is the only zoo to have an open top leopard enclosure.

6. VARIOUS PROTECTED AREAS IN INDIA

- Protected areas are those in which human occupation or at least exploitation of resources is limited. There are several kinds of protected areas, which vary by level of protection depending on the enabling laws of each country or the regulations of the international organization involved.

1) VARIOUS PROTECTED AREAS

Type	Number	Total Area (km^2)	Coverage of the country
National Parks	106	44,402	1.35%
Wildlife Sanctuaries	573	1,27,197	3.87%
Conservation Reserves	123	5585	0.17%
Community Reserves	220	1455	0.04%
Protected Area Total	1022	1,78,640	5.43%

- State with highest number of NP
  - Madhya Pradesh (11)

2) COMPARISON BETWEEN NP AND WLS

NP	**WLS**
They provide protection to entire ecosystem including fauna, flora, landscape and historical entities.	Known for Wildlife conservation. It focuses that population of wildlife and their habitats are mantained substantially
Highly Restricted and Protected - Commercial exploitation of forest produce not allowed - Activities like hunting, grazing, human settlement etc are prohibited - Visit requires official permission from relevant authorities. Limited activities are allowed that too after the permission of Wildlife Warden.	**Relatively lower restriction and protection** - Commercial exploitation of forest produce not allowed - Hunting is prohibited without permission in a sanctuary, but Grazing and movement of cattle may be permitted - No official permission is required to visit a WLS
Boundaries are clearly specified in case of a National Park	**Boundaries** may not be specified
It corresponds to **Category II** of the IUCN protected areas	It corresponds to the **Category IV** of protected areas.

7. NATIONAL PARKS

8. LADAKH

1) HEMIS NATIONAL PARK

- It is a high altitude NP in the eastern Ladakh region.
- **Only NP of India north of Himalayas**.
- It is also the **largest notified protected area of India** (thus also the largest National Park). It is also the **largest NP in South Asia**.
- It is also the second largest contiguous protected area after the Nanda Devi Biosphere Reserve and the surrounding protected area.
- **Rivers**
  - Bound in the north by the banks of Indus river
  - Includes the catchment of Markha, Sumdah and Rumbak.

- **Fauna**
  - Best place to see **snow leopard (VU)** in the wild, it is believed to have **highest density of snow leopard** in the world.
  - Other famous species of animals include **Tibetan Wolf**, **Eurasian Brown bear (LC)**, and the **red fox (LC)**.

- **Flora**
  - The region lies in the **rain shadow area** of the Himalayas and doesn't receive much precipitation.
  - **Hence, dry forests** of Juniper, Populus-Salix forests, subalpine dry birch - fir are present at **lower altitudes**.

Cultural significance

The park houses numerous **Tibetan Gompas and holy chortens** within its boundary.

These include the famous 400 year old **hemis monastry**.

9. J&K – NPS

1) DACHIGAM NATIONAL PARK

- **22 km from Srinagar district**
- **Main Fauna**

- **Hangul:** the park is supposed to contain **last viable hangul population** in the world**.**
- Leopard, Red fox, musk deer, black bear, brown bear, yellow throated marten, Himalayan weasel

2) SALIM ALI NATIONAL PARK (ALSO KNOWN AS CITY FOREST NATIONAL PARK - LOCATED IN SRINAGAR DISTRICT).

- In honour of famous Indian ornithologist Salim Ali (some-times referred as bird man of India)
- Very small: 9 km^2
- **Main Species**
  - Hangul, Musk deer, Himalayan black beer, leopard, Himalayan serow
  - Birds : Paradise flycatcher, Himalayan Monal, and Himalayan snowcock.

3) KISHTAWAR NATIONAL PARK

- **Main species**
  - Snow leopard
  - Markhor
  - Musk deer
  - Brown bear
  - Himalayan black bear

4) KAZINAG (QAZINAG) NATIONAL PARK

- It is a commissioned **future** national park in the Baramulla district in the Indian UT of J&K. It is part of a proposal for a **Trans-Karakoram peace park** with Pakistan.
  - It is located in the northern region of Kashmir and is located on the northern bank of Jhelum River.

- It was created after the Kargil War and based on the increasing pressure to protect the rare **Markhor** wild goat. The national park is being set up in J&K and is the fourth one in state.

- **In India, Markhor is only found in J&K and Kazinag habitats the mammal's largest population.**

10. HIMACHAL PRADESH NPS

1) GREAT HIMALAYAN NATIONAL PARK

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It is a protected area located in Kullu region of Himachal Pradesh. It is spread over an area of 1,171 km square and an altitude between 15,00 and 6,000 meters.

In June 2014, GHNP was added to UNESCO's list of World Heritage Sites. The status was granted under the category of "outstanding significance of biodiversity conservation".

Important Fauna of the park includes some of the most exotic species of animals like snow leopard, blue sheep, Himalayan Brown Bear, Himalayan Tahr, musk deer, etc.

2) OTHER NATIONAL PARKS OF HIMACHAL

Inderkilla, Khirganga, Pin Valley and Col. Sherjung Simbalbara

11. UTTARAKHAND NPS

1) GANGOTRI NATIONAL PARK

- GNP is a national park located in **Uttarkashi district** Garhwal range. This is the **fourth largest NP** in the country (after Hemis, Desert, and Simlipal) with total area of 2390 km^2.
  - The Park provides **majestic beauty of coniferous tree** and **grandeur of glacial world** combined with **lush green meadows**.
  - The **north-eastern boundary** of the Gangotri National Park is along the international boundary with China.
  - **Important Fauna**
    - Snow leopard, ibex, tahr etc.

2) VALLEY OF FLOWERS NATIONAL PARK

- It is a NP located in north Chamoli region of Uttarakhand. It is known for its meadows of endemic alpine flowers and the variety of flora.
- The area is also home to **fauna** such as **musk deer, snow leopard, Brown bear, blue sheep** etc.

3) NANDA DEVI NATIONAL PARK OR NANDA DEVI BIOSPHERE RESERVE

- It is a national park situated around the peak of Nanda Devi (7816 m) in the state of Uttarakhand.
  - It was declared World Heritage site by UNESCO in 1988. Later in 2005, the designation was enhanced to cover the Valley of Flowers too. So, the present UNESCO world heritage is **Nanda Devi and Valley of Flowers National Parks, 2005**.
  - **Both Parks** - Valley of Flowers and Nanda Devi are encompassed in the **Nanda Devi Biosphere** reserve.

4) RAJAJI NATIONAL PARK (TIGER RESERVE)

- Rajaji national park and tiger reserve is spread in **3 districts of UK: Haridwar, Dehradun and Pauri Garhwal**. It is nestled between the Shivalik ranges and the Indo-Gangetic plains.
- The Park has been named after **Rajagopalachari**, a prominent leader of the national freedom struggle and the second and last governor general of Independent India.
- In 2015, Rajaji became the second tiger reserve of UK.
- The Ganga and Song River flows through the park.
- Fauna: The Park is renowned for its elephants, sambar, barking deer, hog deer etc. Tigers and Leopards are prime predators of the park.

5) JIM CORBETT NP

- It is the **oldest/first national Park** in India and was established in 1936 as Hailey National Park to protect Bengal Tiger. It is in the Nainital district of Uttarakhand and has been named after Jim Corbett, a well-known hunter and naturalist. It was also the **first park to come under Project Tiger** initiative (i.e., declared a Tiger Reserve).
- It is also among the few tiger reserves in India which allows overnight stay in the lap of the National Park.

6) GOVIND PASHU VIHAR NATIONAL PARK

- Named after Gobind Ballabh pant.
- Situated in Uttarkashi district and lies in higher reaches of Garhwal Himalayas.
- The **snow leopard project** started by GoI is being managed at this sanctuary.

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12. HARYANA NPS

1) SULTANPUR NATIONAL PARK DETAILS

Details

- Sultanpur National Park (Formerly a bird sanctuary) is located at Sultanpur village (Gurgaon district) on Gurugram Jhajjar Highway, 15 kms from Gurgaon, Haryana.
- Sultanpur National Park is a major attraction for water birds and migratory birds.

2) KALESAR (YAMUNANAGAR DISTRICT)

- **Kalesar National Park** and the adjacent **Kalesar WLS** are protected areas in Yamunanagar district of Haryana state in India.
- It is located contiguous to Rajaji National Park in Uttarakhand.
  - » It is a popular destination for leopards, panthers, elephants, red jungle fowl and bird watching.
- **Vegetation**: The forested area in the Shivalik foothills is covered primarily with Sal with smattering of Semul, Amaltas, and Bahera trees as well.

13. UTTAR PRADESH – NP

1) DUDHWA NATIONAL PARK (TIGER RESERVE)

- DTR is a protected area in Uttar Pradesh that stretches mainly across the **Lakhimpur Kheri and Bahraich districts** and comprises of **Dudhwa National Park**, **Kishanpur WLS,** and **Kataranighat WLS**.
- It's total area is more than 1,000 km^2.
- It shares the north-eastern boundary with **Nepal,** which in large extent is defined by Mohana river.
- **Fauna**: Tigers, leopards, beer, swamp deer, rhinoceros, elephant etc.

14. BIHAR – NP

1) VALMINKI NATIONAL PARK, TIGER RESERVE AND WLS

- It's located on **Indo-Nepal Border** in West Champaran district of Bihar, on the **bank of Gandak**. It is the **only National Park** in Bihar.
- **Nepal's Chitwan National Park** borders the VNP.
- **Gandak and its tributaries** are known to flood the Valmiki Tiger Reserve

15. JHARKHAND – NP

1) BETLA NATIONAL PARK (TIGER RESERVE)

- It is located on the Chota Nagpur Plateau in the **Latehar district** of Jharkhand, India.

- It consists of **Palamau Tiger Reserve** and **Mahuadar Wolf Sanctuary**.
- **Floor:** Sal and Bamboo are the major floral component of the park.
- **Fauna:** Elephants, Sloth bear, Panther, Wolf, Jack etc.

16. WEST BENGAL NPS

1) SUNDARBAN NP

- It is a **national park, tiger reserve, biosphere reserve** in west Bengal.
- It is part of Sundarbans in Ganga Delta and adjacent to Sundarbans Reserve Forest in BD. The Sundarban have also been added to the list of Ramsar Sites.
- **Flora**
  - Mangrove forests - Sundari trees (pneumatophore)

- **Fauna:** Bengal Tiger, Saltwater crocodiles; Fishing cats, leopard cats, wild boar, Pangolin, Chital are also found in Abundance

- **Threatened Species:** Royal Bengal Tiger, Saltwater crocodile, river terrapin, Olive Ridley Sea Turtle, Ganges River Dolphin, Hawksbill turtle and mangrove horsehoe crab.

2) GORUMARA NP

- **Location:** Northern West Bengal Jalpaiguri district, in the Terai region of Himalayan foothills.
- **Physical Features**
  - **M**edium-sized Park (80 square Kms) with grasslands and forests and is known as **Dooars** in West Bengal.
  - The Park is located on the flood plains of **Murti River and Raidak river**. The major river of the park is the **Jaldhaka river,** a tributary of the Brahmaputra River system.
- **Zoological Features:**
  - Primarily known for its population of **Indian Rhinoceros**.
  - Other animals found here include Gaur, Asian Elephant, sloth bear, chital and Sambar deer.
  - Lack of carnivores, only big cat being leopard. Tiger occasionally spotted.
  - **Submontane forest birds** like scarlet minivet, sunbird, Asian paradise suncatcher, and Indian Hornbill.
- **Conservation Focus**
  - Maintain a viable breeding community of Indian Rhinoceros

3) JALDAPARA NP

It is a NP in the foothills of Himalayas in the Northern Bengal and is on the banks of Torsa river.
It has second largest rhino population (after Kaziranga (>2400 rhinos

4) NEORA VALLEY NP

- Kalimpong district, West Bengal
- National Park, IBA site,
- **Fauna**: **Red Panda;** Civet; Black bear; Himalayan Flying Squirrel; Barking deer

5) SINGALILA NP

- Darjeeling district
- Located on the Singalila ridge at an altitude of 7,000 meters.
- **Flora**
  - Thick bamboo, oak, magnolia, and Rhododendron
- **Fauna:** Red Panda; Leopard Cat; Barking deer; Wild boar

6) BUXA NATIONAL PARK

- **Tiger reserve** located inside National Park.
- Notified as tiger reserve in 1983.
- Consists of moist deciduous and evergreen forests.
- **Other Species at Buxa**
  - Clouded leopard, jungle cats and fishing cats.
  - Elephants, gaurs, chital, sambars, barking deers and hog deer.

17. SIKKIM – NP

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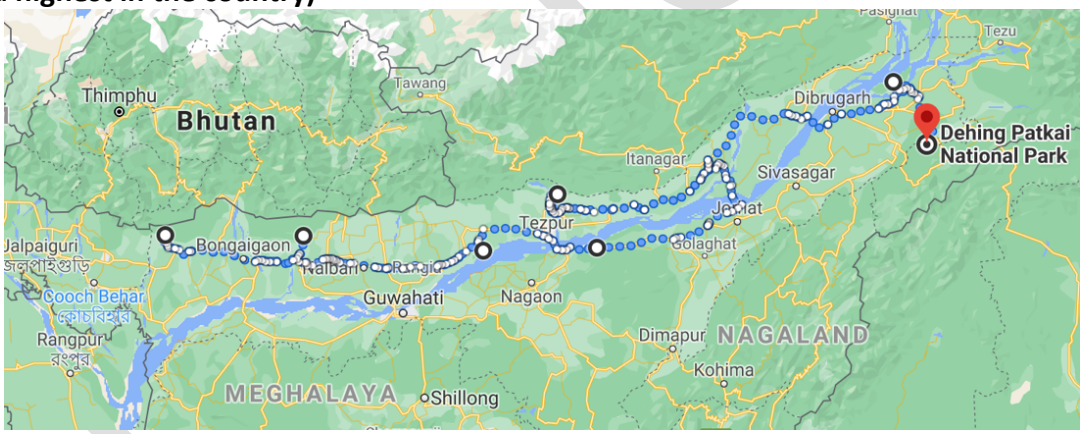
1) KHANGCHENDZONGA NATIONAL PARK (KHANGCHENDZONGA BIOSPHERE RESERVE)

- It is a national park and Biosphere reserve located in Sikkim, India. The total area of the park is 849.5 km^2. It forms the **core of the Biosphere Reserves.**
- It includes a unique diversity of plains, valleys, lakes and glaciers and spectacular snow-capped mountains covered with forests including the world's **third highest peak, Mount Khangchendzonga**.

- The National Park falls in the **Himalayan Global Biodiversity Hotspots** and displays an unsurpassed range of sub-tropical to alpine system.
- It was also inscribed to the **UNESCO World Heritage Sites list** in **July 2016,** becoming the first mixed heritage site in India.
- It was **recently included in UNESCO's MAB program**.
- **Cultural Significance**
  - There are few **lepcha tribal settlements** inside the park.
  - The Park contains **Tholung Monastry**, a gompa located in the park's buffer zone.
- **Neighbouring Protected Area**
  - In the **north** it adjoins the **Qomolangma National Nature Preserve** in Tibet and in the West the **Kanchenjunga Conservation** area in Nepal.
- **Important Fauna:** Musk deer, snow leopard, Himalayan Tahr, red panda, Himalayan Black Bear, Himalayan Blue Sheep etc.

18. ASSAM – NP

- National Parks in Assam - After addition of two national parks in June 2021, Assam now has **7 National Parks (2nd highest in the country)**



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1) RAIMONA NATIONAL PARK

- **Details**
  - It is a national park in Assam, India located in Gossaigaon subdivision of Kokrajhar district. It is located within the **Bodoland Territorial Region**.
  - The area **includes** the northern part of the notified **Ripu Reserve Forest**, which forms the western buffer to the Manas National Park.

- **Boundaries:**
  - Raimona is bounded in the **West** by the **Sankosh river** (along the Assam-WB border) running southwards from the India-Bhutan border.
  - **Saralbhanga** river on the east forms the eastern boundary.
  - **Pekua river** defines the NP's southern boundary.
  - It also shares the contiguous forest patches of the **Phipsoo WLS and the Jigme Singye Wangchuk National Park in Bhutan** creating a transboundary conversion landscape.

- Such secured transboundary ecological landscape will ensure the long-term conversation of endemic species like the **golden langur**, the mascot of Bodoland Territorial Council and the endangered species such as the Asian Elephants, the Bengal Tiger etc.

2) MANASA NATIONAL PARK

- Situated in the **foothills of the Himalayas and extended to Bhutan**, Manas National Park is one of the most sought after tourist destination in entire North East.
- **History**
  - Declared a sanctuary in 1928
  - **World Heritage Site** by UNESCO in 1985
  - World Heritage Site in danger in 1992 - due to poaching and other instability
  - Tag of World Heritage Site in danger removed - 2010.
- **Important Wild life species**
  - One horned Rhino, Wild Buffaloes, little known white winged duck, and Manipur Bush Quail, among others.

- **Pygmy Hog Conservation Program (PHCP)**
  - The Pygmy Hog Conservation Program (PHCP) is a collaboration among Durrell Wildlife Conservation Trust of UK, Assam Forest Department, Wild Pig Specialist Group of International Union for Conservation of Nature and MoEF&CC.
  - It is currently being implemented by **NGOs Aaranyak and EcoSystems** India.
  - Under this initiative **six Hogs** (two males and 4 females) were captured from the Bansbari range of Manas National Park in 1996 for starting the breeding program.
  - **The reintroduction** began in 2008 with Sonai Rupai WLS (35 Hogs), Orang National Park (59) and Barnadi WLS (22).

- With the June 2021 release, the total number of releases in wild under the PHCP program reached **146**, which is more than their total original global population.
- Conservation of Pygmy Hog was initiated by noted naturalist Gerald Durrell and his trust in 1971. Pygmy Hog was brought back from near extinction by the partnership effort, and the efforts are being made towards establishment of a population across the entire range.
- **By 2025**, the PHCP plans to release 60 Pygmy Hogs in Manas.

3) ORANG NATIONAL PARK

- It is located on the northern bank of Brahmaputra in the Darrang and Sonitpur districts of Assam.
- **Famous Fauna:**
  - Great Indian one-horned Rhino; Pigmy Hog; Elephants, wild buffaloes and tigers
  - **Birds: Bengal Florican (CR)** also called Bengal Bustard is one of the flagship species of the park with a population of 30-40
- It is the only stronghold of Rhino on the northern Bank of Brahmaputra.


Location in Assam, India

4) NAMERI NATIONAL PARK

- Nameri is located in Sonitpur district of Assam.
- Shares border with Pakhui WLS of Arunachal Pradesh.

5) KAZIRANGA NATIONAL PARK

» Situated in the Golaghat and Nagaon district of Assam.
» It is a **World Heritage site, a tiger reserve, an IBA** and is most famous for its **one-horned Rhinos.**
» **Fauna**
  - **Great one-horned Rhino:** It hosts 2/3rd of the world's one-horned Rhino population.
  - **Tigers:** It has one of the highest density of tigers among protected areas in the world.
  - **Elephant**, wild water buffalo, swamp deer, Golden Langur
    - Eastern swamp deer (Barasinga) (**VU)**
» **Geographical feature**
  - It is situated on the banks of Brahmaputra (The river lies to its north and west)

» It is crisscrossed by 3 other rivers

6) DIBRU SAIKHOWA NATIONAL PARK AND BIOSPHERE RESERVE

- At Tinsukia and Dibrugarh districts of Assam
- **Rivers**
  - Bounded by Brahmaputra and Lohit rivers in the north and **Dibru river in the South**.
- **Fauna**
  - **White winged duck (EN)**
    - The park was created to protect the white winged duck.
  - Water buffalo
  - Black breasted parrotbill
  - Tiger and capped langur

- **Flora:** The Forest type of Dibru Saikhowa comprises of semi-evergreen forests, deciduous forests, littoral and swamp forests and patches of wet evergreen forests. It is the largest swamp forest in north-east India.

7) DIHING PATKAI NATIONAL PARK

- The national park is a contiguous stretch of forests, starting from **Upper Dihing Forests in the east (under Digboi division of the Tinsukia district)** upto the **Jeypore RF (under the Dibrugarh Division, Dibrugarh district)**.
- It comprises of Pristine forests along the Assam-Arunachal interstate boundary, classified as **Assam Valley Tropical Wet Evergreen Forests**.
  - Dehing-Patkai is sometimes also referred as **'Amazon of the East'**. It is the **only rain forest in Assam** and **also spreads into Arunachal Pradesh**.
  - **Note:** Dehing Patkai forms the largest stretch of the lowland forests in India.

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- Being a **completely virgin forest**, the NP is **very rich in biodiversity**. Rare faunae include Chinese Pangolins, Flying Fox, Wild Pig, Sambar, Barking Deer, Gaur, Serow, and Malayan Giant squirrels.
- It is the **only sanctuary in India** which is home to **7 species of wild cats** - Tiger, Leopard, Clouded Leopard, Leopard Cat, Golden Cat, and Marbled Cat.
    - It is a **part of Dehing Patkai Elephant reserve**.

19. ARUNACHAL PRADESH NPS

1) NAMDAPHA NATIONAL PARK (TIGER RESERVE)

- About
    - It is a protected area in Changlang district of **Arunachal Pradesh** and is a **biodiversity hotspot** in eastern Himalayas.
    - It is crossed from east-to-west by the **Noa Dihing** river that originates in **Chaukan pass**, located on the Indo-Myanmar border.

- **Fauna**
    - **Namdapha Flying Squirrel** was first collected from the park and is described as **endemic** to the park. It is critically endangered and has been recorded only in a single valley within the park.
    - **Dhole, Red Panda, Red Fox** etc are other important mammals found here.
- **Important Tribal Groups** within the park include **Lisu, Chakma, Tangsa**, and **Singpho.**

2) MOULING NP

- Spread primarily in upper Siang and East Siang districts
- The Mouling National Park and Dibang WLS are located fully of partly within **Dihang-Dibang Biosphere Reserve**.

20. MEGHALAYA

1) NOKREK NP, CHERRAPUNJI

- Nokrek National Park is the **core area of the Nokrek Biosphere Reserve** is located in West Garo Hills of Meghalaya, India.
- **UNESCO** added the NP to its list of BR in 2009.
- Along with Balphakram National Park it forms the hotspot of biodiversity in Meghalaya.
- **Important Fauna**
  - Red Panda, Elephant etc.
- It is also an Important Bird Area.

2) BALPHAKRAM NATIONAL PARK

- It is NP near Garo Hills in Meghalaya. It is located at Extreme south of Garo Hills.
- **Fauna**
  - Red Panda, tiger, elephant etc.

21. MANIPUR NPS

1) KEIBUL LAMJAO NATIONAL PARK

- It is a NP in the Bishnupur district of the state of Manipur.
- Its area is 40 Km^2 and is perhaps the world's largest floating park.
- It is an integral component of the Loktak Lake. Loktak lake is also the largest freshwater lake of NE India.
- It has also been declared a **Ramsar wetland site**.
- **Important Fauna**
  - **Brow Antlered Deer** (flagship species), **Hog Deer** etc.

22. OTHER NPS OF NORTH EAST INDIA

Shiroi (Manipur), Murlen (Mizoram), Phawangpui (Blue Mountain) (Mizoram), Intanki (Nagaland), Clouded Leopard (Tripura), Bison (Tripura)

23. RAJASTHAN-NATIONAL PARKS

1) SARISKA NATIONAL PARK (TIGER RESERVE)

- **Location:** Sariska Tiger Reserve is located in the Aravalli Hills, 35 km from Alwar, 250 km SW of Delhi and 110 km NE of Jaipur. It lies in Alwar district of Rajasthan. It was declared as a Tiger reserve in 1978.
- It is a former hunting reserve of Maharaja of Alwar and is home to a variety of flora and fauna.
- The Park has population of tigers, leopards, Nilgai, Sambar, Chital etc.
- It is the **first globally successful reserve to relocate and rehabilitate the tigers**.

- **Other tourist attractions of the reserve**
  - The sanctuary is **strewn with ruins of ancient temples** dating back to the 10th and 11th centuries.
    - Some of the highlights are the ruins of the **Kankwari Fort and the 10th century Neelkanth temples**. The way to the temples is rough but the **architecture and the Khajuraho-like carvings** will simply leave the visitor in awe of the place.
    - **Neelkanth Mahadeva**, houses the ruins of over 300 Hindu and Jain temples constructed between the 8th and 12th Centuries.
    - **Chand Baoli (step well) at Abhaneri** is enormous with 3500 steep steps built by the Nikhumbha dynasty is one of the largest stepwells in the world.
    - **Note: Alwar is a city dotted with heritage buildings**, Forts, tombs and palaces. Some of the important sights not to be missed are Bala Qila, Vijai Mandir Lake Palaces, Fateh jung ki Gumbad, Moti Doongri etc.

2) KEOLADEO GHANA NATIONAL PARK (FORMERLY CALLED BHARATPUR BIRD SANCTUARY)

- **Introduction**
  - » KNP is spread over an area of 28.73 sq km and lies at the confluence of the **Gambhir and Banganga** rivers in **Bharatpur district**.
  - » This bird sanctuary hosts thousands of birds especially during winters.
  - » It is also a **World Heritage Site**.
  - » It is a man-made and man-managed wetland.
  - » Along with Loktak lake, Manipur, KNP is placed on the **Montreux Record** under Ramsar Convention.

- **Threats by Invasive Alien Species: Report** published in Oct 2020
  - » In a new study published in the journal Biodiversity and Conservation, researchers have categorized the site as facing **'high threat' from biological invasion**.
  - » As many as **14 invasive alien species** thrive in the park.
    - 9 plant species
    - 2 fish species (Common Carp and African Cat fish)
    - 2 Mammals (Bovine (Bos Taurus) and Rhesus Monkey (Macaca mulatta))
    - 1 moth species (Parapoynx diminutalis)

3) RANTHAMBORE NATIONAL PARK (TIGER RESERVE), SWAI MADHOPUR

- **Introduction**
  - Ranthambore NP has an area of 392 km^2. It was declared as NP in 1980. It is also a tiger reserve.
  - In 1985, adjacent forests were declared the **Sawai Man Singh Sanctuary** and **Keladevi Sanctuary**.
  - In 1991, tiger reserve was expanded to include Sawai Man Singh and Keladevi sanctuaries.

- **Fauna**
  - Ranthambore is most well-known for its **Bengal tigers** and is one of the best places in India to see these animals in their natural habitat.
    - **Overpopulation of Tigers** in Ranthambore has continuously led to conflicts between tigers.
  - Other fauna includes Indian leopard, nilgai, wild boar, sambar, striped hynea, sloth bear, gray langur, rhesus macaque, mugger crocodile and chital.
- **Flora**
  - The NP is famous for the **largest banyan** tree in India.

4) DESERT NATIONAL PARK (DNP)

- Situated in Western Rajasthan near **Jaisalmer**. It is the second largest national park of India having an area of 3162 km^2.

- Sand dunes form around 20% of the park. The major landforms consist of craggy rocks and compact Salt Lake bottoms, intermedial areas and fixed dunes.

- **Abundance of bird life**
  - The region is a haven for migratory and resident birds of the desert.
    - **Gadsisar Lake** is among the tourist places in Jaisalmer. Thousands of migratory birds come to this place every year.
  - Many eagles, harriers, falcons, and vultures are found here.
  - **The great Indian bustard** is also available in fair numbers.

5) DARRAH NATIONAL PARK (MUKUNDARA NATIONAL PARK)/ TIGER RESERVE

- **Mukundra Hills** National Park is also known as Darrah WLS. It is located near the Kota town of Rajasthan. It consists of large tracts of forests formerly part of the Maharaja of Kota's hunting grounds.
- The national park is a **combination of 3 WLS.**
  - Darrah WLS
  - Chambal WLS
  - Jaswant Sagar WLS
- **In 2013,** it became the **third Tiger Reserve** of the Rajasthan.
- After the death of few tigers in 2020, the NP is left with only 1 tiger.

24. GUJARAT NATIONAL PARK

1) BLACKBUCK NATIONAL PARK, VELAVADAR

- Blackbuck National Park, Velavadar, is situated in the Bhavnagar District of Gujarat state, India.

2) MARINE NATIONAL PARK

- It is situated on the southern shore of Gulf of Kutch in the Devbhumi Dwarka district of Gujarat.
- The national park has 42 islands on the Jamnagar coast. Most of these islands are surrounded by reefs. Out of which 33 islands have coral reef. Some of the best-known islands are **Pirotan, Karubhar, Narara, and Poshitra**.


Marine National Park

3) GIR NATIONAL PARK

- Gir National Park and WLS located in the **Saurashtra Peninsula** of Gujarat, is the only natural habitat of world popular Asiatic Lions.
- **7 major perennial rivers** pass through Gir - Hiran, Saraswati, Datardi, Shingoda, Macchundri, Ghodavadi and Raval.
- **Kamleshwar Dam** is a large water body in the Gir Forest, which is good for marsh crocodile, reptiles and birds.


Location Map

Location	Junagadh, Gir Somnath and Amreli Districts, Gujarat, India

4) VANSDA (BANSDA) NATIONAL PARK

- It is a protected area located in Navsari district of the state of Gujarat.
- There has seen almost no felling of trees since 1952 which has ensured dense forest.
- It is nestled in Western Ghats.


Location Map

Location	Navsari District, Gujarat, India
Nearest city	Vansda

25. MADHYA PRADESH NATIONAL PARKS

1) MADHAV NATIONAL PARK

- It is in the Shivpuri district of Gwalior in NW Madhya Pradesh, India. It is named after Madhav Rao Scindhia, the Maharaja of Gwalior.

Location	Madhya Pradesh, India
Nearest city	Shivpuri around 9km away

2) KUNO NATIONAL PARK

- It was established in 1981 as a Wildlife Sanctuary also known as **Kuno-Palpur WLS**. In 2018, it was given the status of National Park.
- It is part of Kathiawar-Gir dry deciduous forests region.
- In **1990s**, it was being considered for the **Asiatic Lion Reintroduction Program**, which aimed at establishing second lion Population in India.
  - Place of African **Cheetah reintroduction in India**.

3) PANNA NATIONAL PARK (PANNA TIGER RESERVE)

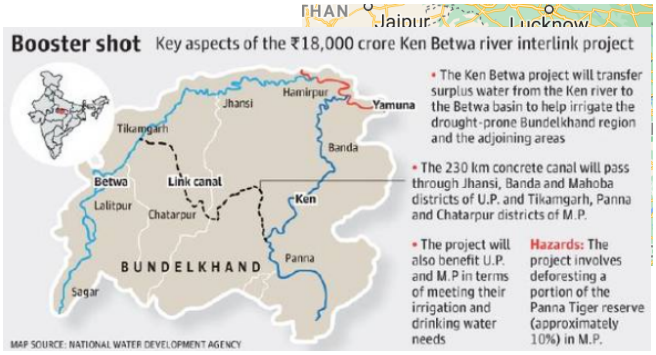
- **About Panna Tiger Reserve/National Park**
  - » It is a TR/NP located in **the Panna and Chattarpur district** of MP and has an area of 542 km^2.
  - » **Ken River** flows from South to North through the Panna tiger reserve.


Location in Madhya Pradesh, India

- **Successful Tiger Relocation**
  - » **Background:** Panna tiger reserve was the second tiger reserve in India after Sariska to **lose all its native tigers**. Though tigers were repopulated in Sariska before Panna, but Panna presently had 3 times the tiger numbers.
  - » **Beginning of Relocation** of tigers started in 2009 when the **T1 tigress** was brought from the Bandhavgarh. Over the years group of 7 founder tigers have mated and produced more than 80 cubs making it a one of the major success stories.
- **River inter-linking and Impact on Panna**
  - » The plan of GoI, and state of MP and UP to interlink **Ken and Betwa** involves construction of 283m long **Daudhan Dam**. This is expected to inundate 400 hectares of Panna Tiger Reserve and environmentalists have raised concerns regarding this.

4) VAN VIHAR NATIONAL PARK

- It is located in **Bhopal**, the capital city of Madhya Pradesh. It is very small around 4.45 km^2.
- It has a status of National Park, but it is managed as **zoological park**, following the guidelines of Central Zoo authority.
- Animals are kept in their natural habitats. Most animals are either orphaned or brought from other zoos. No animal is deliberately captured from the Wild.



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5) SANJAY NATIONAL PARK (TIGER RESERVES)

- **About SNP**
  - Located in **Siddhi district** of Madhya Pradesh. The NP is part of **Sanjay-Dubri tiger reserve**.
- **Note: Guru Ghasidas National Park** is the part of Sanjay National Park which became part of Chhattisgarh on partition of MP. It was renamed to Guru Ghasidas National Park.

6) BANDHAVGARH NATIONAL PARK

- It is located in the Umaria district of MP.
- This park is known for its high tiger density (8 tigers / km^2). It was declared a **Tiger Reserve** in 1993.

7) KANHA NATIONAL PARK (KANHA TIGER RESERVE)

- It is the **largest NP of Madhya Pradesh** and one of the important tiger reserves of India. Today it stretches over an area of 940 km^2 in two districts of Mandla and Balaghat.
  - Total Area: 1949 sq km.
  - Core Zone: 940 sq km
- It was declared a national park in 1955 by merging Hallon and Banjar WLS.
- **Important Fauna:** Tiger; Hard ground Barahsingha (Cervus duvauceli branderi); Gaurs
- **Major achievements**
  - Important national park for tiger tourism.
  - It is also the **only natural habitat of highly endangered hard-ground Barasingha** (Cervus duvauceli branderi)

8) SATPURA NATIONAL PARK (SATPURA TIGER RESERVE)

- Located in the Hoshangabad district of MP. Its name is derived from Satpura Ranges and its covers an area of 524 km^2.
- **Adjoining WLS**
  - **Bori** WLS
  - **Pachmarhi WLS**
- SNP also with Bori and Panchmarhi WLS provides an unique central highland ecosystem.
- **Biodiversity rich NP**
  - Leopard, Sambar, Chital, Nilgai, four horned antelope, black buck, mouse deer, Indian giant squirrel etc.
  - **Previous years** have seen rare sightings of tigers, dholes, Indian gaur, Barahsingha etc.

9) PENCH NATIONAL PARK

- It is in Seoni and Chhindwara districts of MP and includes Pench Tiger Reserve.
- It derives its name from **Pench river** that flows through the park from north to South dividing park into almost equal western and eastern halves.

10) OTHER NATIONAL PARKS OF MP

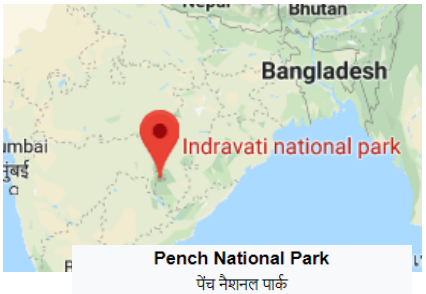
- Dinasour Fossils
- Fossil

26. CHHATTISGARH NATIONAL PARKS

1) GURU GHASIDAS (SANJAY GANDHI) NATIONAL PARK

- This Park is the **result of the carving of Chhattisgarh from Madhya Pradesh** in the year of 2000. After Madhya Pradesh was divided in 2000, a large part of the then **Sanjay National Park** went to Chhattisgarh. Chhattisgarh government renamed this forest area, with an area of 1440.71 km2 falling under its jurisdiction, as Guru Ghasidas National Park.
- **Tiger reserves in Chhattisgarh:** At present Chhattisgarh has **three tiger reserves**:
  - Achanakmar Tiger Reserve in Bilaspur
  - Udanti-Sitanadi Tiger Reserve in Gariaband
  - Indravati Tiger Reserve in Bijapur district
- State government is in the **process of declaring Guru Ghasidas National Park into a tiger reserve**.

2) INDRAVATI (KUTRU) NATIONAL PARK (TIGER RESERVE)



» Indravati National Park is a national park situated in **Bijapur district** of Chhattisgarh state of India. It derives its name from the **nearby Indravati River**.
  - **Note1**: The Bijapur district is Maoist affected district.
  - **Note2:** The forests in the region are also affected by forest fires. Tribals set fire to forests as it makes it easier for them to collect mahua flowers during March-April.

» **Fauna:** It is one of the last populations of **rare wild buffalo** (IUCN: EN)

» **Flora:** Pre-dominance of sal, teak, bamboo, **Mahua** etc.

3) KANGER VALLEY NATIONAL PARK

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Why in news?
Bird watchers recorded 200 bird species in Chhattisgarh's Kanger Valley National Park (Dec 2022)

Bird Species: Bird watchers, and forest department officials counted 200 types of birds in Chhattisgarh's first ever inter-state bird survey conducted in the National park from 25th - 27th Nov 2022.

- The survey unveiled that the valley can potentially host species found in the Himalayas, the Northeast, the Eastern and Western Himalayas.

About Bastar Hill Mynah: It is a subspecies of the common hill mynah which is protected under Schedule 1(b) of the WPA.

It is endemic to the Kanger valley National Park.
The jet black colored bird mimics the human voice exceptionally well. For this reason, it is often found in cages and sold as pets in the market.

It is a national park in the Bastar region of Chhattisgarh.
It is one of the densest national parks and is home to the **Bastar Hill Mynah**, the state bird of Chhattisgarh.
The park gets its name from **Kanger river** which flows along the length of the park

27. ODISHA NATIONAL PARKS

1) SIMLIPAL NATIONAL PARK (TIGER RESERVE)

- It is situated in Mayurbhanj district in the Indian state of Odisha. It is part of the Similipal-Kuldiha-Hadgarh Elephant reserve popularly known as **Mayurbhanj Animal Reserve**, which includes three protected areas - Simlipal Tiger Reserve (2750 km^2), Hadgarh Wildlife Sanctuary (191.06 km^2) and Kuldiha Wildlife Sanctuary (272.75 km^2).
    - **Simlipal derives its name from** the abundance of **Simul** (red silk cotton trees) that bloom here.
    - It is **one of the largest** national parks in India.
    - It is also listed under **UNESCO World Network of Biosphere Reserve**.
    - **Faunal Diversity:** Tigers, Elephants, Gaurs, Chausingha etc.
    - **Issue of Non-declaration as full-fledged National Park**
        - Though the Simlipal has been accorded the status of National Park provisionally long back but is yet to be declared a full-fledged national.
        - **Why not full fledged status?**
            - Families live close to the core area of the forest. Government haven't been able to shift them.

2) BHITARKANIKA NATIONAL PARK

- **Introduction**

- It is a national park located in Kendrapara district of Odisha in eastern India.

- **Core area** of 145 km^2 of the Bhitarkanika WLS spread over 672 Km^2, has been designated as a National Park.
- **Gahirmatha beach Marine Sanctuary** lies to the east, and separates swamp region cover with canopy of mangroves from the Bay of Bengal.
  - The sanctuary is the **second largest mangrove ecosystem** in the country.
- It is also **a Ramsar convention site**.
- **Fauna**
  - **1671 estuarine crocodiles** (saltwater crocodile) were counted living along the Bhitarkanika water bodies.
  - **Other Fauna**
    - White Crocodile, Olive Ridley Sea Turtles, Indian python, King Cobra, black ibis, darters etc.
- **Flora**
  - Mangroves - Sundari, thespia,
  - Grasses like Indigo, Bush etc.
- **Rivers**
  - The NP and WLS is inundated by a number of rivers - **Brahmani, Baitrani**, Dhamra, Pathsala and others
- **3 Protected Areas**
  - The Bhitarkanika National Park
  - The Bhitarkanika WLS
  - The Gahirmatha Marine Sanctuary
    - **Recent Development:**
      - » The Orissa High Court constituted a three-member committee on February 26, 2021 which will submit a report on the conservation of sea turtles in Gahirmatha marine sanctuary. This action followed media reports saying 800 Olive Ridley turtles have died since Jan 2021 due to negligence of state's forest and fisheries department.

28. MAHARASHTRA NATIONAL PARKS

1) GUGAMAL NATIONAL PARK

- Located in Amravati District of Maharashtra, it is part of Melghat Tiger Reserve.

2) PENCH NATIONAL PARK AND TIGER RESERVE

- Pench Tiger reserve is one of the premiere tiger reserves of India and the **first one to straddle across two states - Madhya Pradesh and Maharashtra**.

- The tiger reserve consist of **Indira Priyadarshini Pench National Park,** the **Pench Mowgli Sanctuary** and a buffer.
    - It is the same forest area portrayed in the famous '**Jungle Book**' by Rudyard Kipling.
- The tiger reserve derives its name from the **Pench river** which is its lifeline.

3) NAVEGAON NATIONAL PARK

- It is a national park located in **Gondia district** of Maharashtra.
- It's role as **Bird Sanctuary** is very significant. It is home to **almost 60% bird species** found in whole of Maharashtra.
    - The beautiful **Navegaon lake** is known for its pollution free water and attraction of birds.
    - The area around the lake is known as **Dr. Salim Ali Bird Sanctuary**.

4) TADOBA NATIONAL PARK (TADOBA ANDHARI TIGER RESERVE)

- **Details**
    - It is Maharashtra's **oldest and largest National Park**. It is also one of the 54 tiger reserves in India. It is located in Chandrapur district of Maharashtra.

- The total area of the tiger reserve is 1,727 km^2, which includes the Tadoba National Park, created in 1955.
    - The Andhari WLS was formed in 1986 and was amalgamated with the park in 1995 to establish the present **Tadoba Andheri Tiger reserve**. This is **most famous of MHA's six tiger reserves**.

- **Fauna**
    - **Keystone Species:** The Bengal tiger
    - Other Mammals: Indian leopards, sloth bears, gaur, nilgai , dhole, striped hyena, small Indian civet, jungle cats.

- **Vegetation of the park**
    - Southern tropical dry deciduous
    - Teak is the most common tree.

- **Two lakes and 1 river in the park**
    - Tadoba lake and Kolsa lake.
    - Tadoba river (also **Andhari** river (a minor river in Wainganga basin) flows through the Andheri WLS)

5) SANJAY GANDHI NATIONAL PARK (SGNP) (BORIVALLI)

- It is located in Mumbai, Maharashtra. It is a rare example of a national park situated within a metropolitan and is also one of the most visited parks in the world.
- This is famous for the site of Ancient Kanheri caves.

6) CHANDOLI NATIONAL PARK

- It is a national park spread over Satara, Kolhapur, and Sangli district of Maharashtra. It was established in 2004.
- It is the southern portion of the **Sahyadri Tiger Reserve**.
- It is located near Chandoli dam. It lies **between Koyna WLS** and **Radhangiri WLS**.
  - **Sahyadri Tiger Reserve**
    - It was created in 2007, by including all of **Chandoli Tiger Reserve and Koyna WLS**.
      - **Chandoli Tiger Reserve** forms the southern portion of the reserve.
    - The tiger reserve is known for its population of Tigers and Leopards.

29. TELANGANA NATIONAL PARKS

1) KASU BRAHMANANDA REDDY NATIONAL PARK

- It is located in the Jubilee Hills and Banjara Hills of Hyderabad. It's a small park with a total area of 1.6 km^2.
- The Park also houses the **famous Chiran palace**.
  - It was built in 1960. The entire palace complex is spread over an area of about 400 acres and was given to Prince Mukarram Jahan on his coronation by his Father Prince (Azam Jahan) in 1967.

2) MAHAVIR HARINA VANASTHALI NATIONAL PARK

- It is a deer national park located in Vanasthalipuram, Saheb Nagar, Hyderabad, Telangana.
- It is the largest green lung space in the city of Hyderabad.

3) MRUGVANI NATIONAL PARK

- **Details:**
  - It is a small national park located in Hyderabad. Its total area is 3.6 sq km.

30. ANDRHA PRADESH NATIONAL PARKS

1) PAPIKONDA NATIONAL PARK

- The WLS was upgraded to the National Park Status in 2008.
- The **river Godavari** flows through the park.
- **Important Fauna** include Tigers, Leopards, Sloth bear, small Indian Civet, nilgai, four-horned antelope etc.
- It is located in Papi Hills in the East Godavari and the West Godavari districts.
- It is also an important bird area.

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2) RAJEEV GANDHI (RAMESHWARAM) NATIONAL PARK

- It is located in Rameswaram of **Kadappa district** of Andhra Pradesh, India. It is a small national park of 2.4 sq km and lies on the bank of Penna River.
- **Note:**
  - Few other national parks in the country have been named after Rajeev Gandhi - Mukundara Hills National Park in Rajasthan, Nagarhole National Park in Karnataka etc.

3) SRI VENKATESWARA NATIONAL PARK (PART OF SESHACHALLAM BIOSPHERE RESERVE)

- Located in eastern ghats and spread over Seshachallam Hills of Chittoor district.
- It receives most of its rainfall from north-eastern monsoon.
- **Vegetation:** Dry Deciduous mixed forests with patches of moist deciduous forests.

31. GOA – NATIONAL PARK

1) MOLLEM NATIONAL PARK AND BHAGWAN MAHAVEER WLS

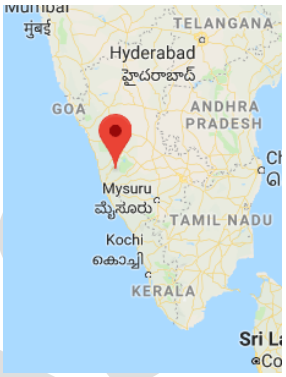
- Located in Western Ghats, Goa, along the eastern border with Karnataka.
- It contains several important temples dating to the Kadambas of Goa, and home to waterfalls, such a **Dudhsagar Falls** and **Tambdi Falls**.
- The park is also home to **nomadic buffalo herders** known as **Dhangar**.

32. KARNATAKA – NATIONAL PARK

1) KALI TIGER RESERVE (ANSHI NATIONAL PARK)

- It is a tiger reserve situated in Uttar Kannada district of Karnataka.
- The park is habitat of Bengal Tiger, Black Panther and Indian Elephants.
- The **Kali river** flows through the Tiger reserve and is the lifeline of the ecosystem and hence the name. The tiger reserve is spread over an area of 13,00 sq km.

2) KUDREMUKH NATIONAL PARK



- Dakshin Kannada district of Karnataka.
- Located in Western Ghats.
- NP divided into four ranges
  - Kudremukh, Kerekatte, Kalasa, Shimoga.
- **Flora**
  - Plantation of eucalyptus, casuarinas etc.
- **Fauna**
  - Tiger, leopard, wild dog, Malabar giant squirrel, common langur, sloth beer, gaur, Porcupine sambar, barking deer etc.
  - **Birds' species**
    - » Malabar Trogon, Malabar Whistling thrush, great pied hornbill, and the imperial pigeon
- **Other attraction**
  - Kadambi waterfall

3) BANNERGHATTA NATIONAL PARK

- Near Bangalore, Karnataka

  In 2002, a portion of the park was made a **biological reserve**. It is a popular tourist destination with zoo, a pet corner, an animal rescue center, a butterfly enclosure, an aquarium etc

4) BANDIPUR NATIONAL PARK

- **About Bandipur Tiger Reserve**
  - Bandipur was established in 1974 as a **tiger reserve** under Project Tiger, is a **national park** located in Chamarajanagar and Mysore district of south Indian state of Karnataka. Bandipur is known for its wildlife and had many types of biomes, but dry deciduous forest is dominant.
  - It is about 80 km^2 from the city of Mysore on the route to a major tourist destination of Ooty. As a result, Bandipur sees a lot of **tourist traffic** and there are a lot of **wildlife fatalities** caused by speeding vehicles that are reported each year. There is a ban on traffic from the hours of dusk to dawn to help bring down deaths of wildlife.
- The national park spans an area of **874 sq km** and protects several species of India's endangered species.
  - Together with adjoining Nagarhole National Park (KAR) (643 sq km), Mudumalai National Park (320 sq km), Wayanad WLS (344 sq km), it is **part of Nilgiri Biosphere Reserve**.
- **Dominant Flora:** Teak, Rosewood, Sandalwood etc.
- **Dominant Fauna:** Tiger, Elephant, Gaur, Sambhar, Chital, Deer, Antelope, Wild Boars etc.

5) NAGARHOLE NATIONAL PARK (TIGER RESERVE) (ALSO KNOWN AS RAJIV GANDHI NATIONAL PARK)

Location in Karnataka, India

- Located in Kodagu and Mysore district of Karnataka. It is located on the north-west of Bandipur National Park.
- It is also part of Nilgiri Biosphere Reserve.
- It is also recognized as **Important Bird Area** (IBA)
- **Important Biodiversity**: **Tigers**, Gaur, Elephants, Indian Leopard etc.
- **Tribes Commonly found in the forest**
    - **Jenu Kurubas** - primary inhabitants - slowly disappearing

33. KERALA – NATIONAL PARKS

1) SILENT VALLEY NATIONAL PARK

- **Introduction**
    - It is the **core of Nilgiri International Biosphere reserve** and is part of Nilgiri Sub-Cluster (6000 km^2), Western Ghat World Heritage Site recognized by UNESCO in 2007.

    - It consists of **undisturbed tracts of Southwestern Ghats Mountain rain forest**s and tropical moist evergreen forests of India.
- **Location**: Nilgiri Hills, within the **Palakkad district of Kerala**, South India.
- **Important Water Bodies**
    - **River Kunthi** (Kunthipuzha) descends from the Nilgiri Hills above an altitude of 2000 m and traverses the entire length of the valley finally rushing down to the plains through a deep gorge.
        - It is a tributary of Thuthapuzha which in turn is tributary of Bharathapuzha river (second largest river of Kerala after Periyar River)
- **Important Animal Species**
    - Lion Tailed Macaque, Nilgiri Langur, Malabar Giant Squirrel, Nilgiri Tahr etc.
    - Silent valley Bush frog (Raorchestes silent valley), first described in 2016, is named after the park.

2) ERAVIKULAM NATIONAL PARK

- It is a 97 km^2 national park located along Western Ghats in the Idukki district of Kerala.
- It was the first National Park in Kerala (Now Kerala has 6 National Parks)
- It is a **UNESCO World Heritage Site**.
- It is the national park with **highest numbers of endangered Nilgiri Tahr**.
- **Other important species** found in Eravikulam National Park includes **Tiger, lion tailed macaque, gaur, leopard, Dhole etc.**
    - **Elephants** also make seasonal visit.

3) PAMPADUN SHOLA NATIONAL PARK

- Located in **Idukki** District, it is the **smallest National Park** of Kerala.
- The Park protects a moderate amount of montane evergreen forest that is associated with the wildlife rich Eravikulam National Park.
- **The keystone species** here are highly elusive and endangered, endemic small carnivore - the Nilgiri Marten, Leopards, and Indian Wild Dogs.

4) MATHIKETTAM SHOLA NATIONAL PARK

It is a small NP in **Idukki district** of Kerala state, South India.

5) ANAMUDI SHOLA NATIONAL PARK

It is a small NP in the **Idukki District** of Kerala.
It consists of Mannavan Shola, Idivara Shola, and Pullardi Shola, covering a total area of 7.5 km2.

6) PERIYAR NATIONAL PARK AND WLS

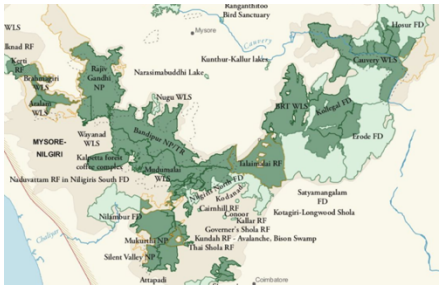
- Also, an **Elephant Reserve and Tiger Reserve**
- Protected area in districts of Idukki and Pathanamthitta in Kerala, India.
- Area of **925 Km^2** , Core area of 305 Km^2 was declared as the Periyar National Park in 1982.
- The park forms the **major watershed** of **two important rivers,** the **Periyar and the Pamba**.
- It is often called the **Periyar Wildlife Sanctuary** or **Thekkady**. It is located in the Cardamom hills and Pandalam hills or the South Western Ghats along the border of Tamil Nadu.

34. TAMIL NADU – NATIONAL PARKS

1) GUINDY NATIONAL PARK

- A very small national park (2.70 km2), located in **Chennai**.
- The park is an extension of the grounds surrounding Raj Bhavan, formerly known as the '**Guindy Lodge**' - the official residence of the Governor of TN.

2) MUDUMALAI NATIONAL PARK, WLS AND TIGER RESERVE



- It lies on the north-western side of the Nilgiri hills, **Nilgiri** district. It is located northwest of Coimbatore city in **TN**. It shares its boundaries with state of Karnataka (Bandipur) and Kerala (Wayanad WLS).
- It is part of the **Nilgiris Biosphere Reserve**
- The **Mysore Ooty Highway** runs through the park.
- **Moyar river** separates **Bandipur and Madumalai**. This river flows along the border of Kerala and TN.

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- It is part of Nilgiri Biosphere reserves.

3) MUKURTHI NATIONAL PARK (EARLIER KNOWN AS NILGIRI TAHR NATIONAL PARK)

- It is a NP located in the western corner of the Nilgiri Plateau and north-western corner of TN.
- The Park was created to protect **its key stone species Nilgiri Tahr**.
  - Other important fauna of the park includes Tiger, Elephant etc.
  - Other threatened species of the park is Nilgiri Tahr, Nilgiri Marten, Nilgiri Langur etc.
- The park is characterized by **montane grasslands** and **shrublands** interspersed with Sholas in a high altitude area of high rainfall, near freezing temperature and high winds.
- Park is part of Nilgiri Biosphere Reserve and as part of **Western Ghats** it is also a UNESCO World Heritage site.
- **Culture**
  - **Toda tribe** of the region have harvested firewood from Shola and graze their hill buffaloes in the hill for centuries.

4) ANAMALAI TIGER RESERVE/ INDIRA GANDHI WLS AND NP

- Anamalai Tiger reserve, earlier known as Indira Gandhi WLS & NP is a protected area located in the Anaimalai hills of **Coimbatore district and Tiruppur district** of **Tamil Nadu**.
- **Important Mammals**
  - Bengal tiger, Indian Elephant, and Indian Leopard, Nilgiri Tahr and lion tailed macaque

5) GULF OF MANNAR NATIONAL PARK

- It is a NP which consists of 21 small islands and adjacent coral reefs in the Gulf of Mannar in the Indian Ocean.
- It is also the **core area of Gulf of Mannar BR** which also includes a 10 km buffer zone around the park, including the populated coastal area.

35. ANDAMAN AND NICOBAR ISLANDS

1) BASICS: UNDERSTANDING THE DISTRIBUTION OF ISLANDS IN A&N

- The **mains Islands** that come under the Andaman & Nicobar Islands are:
  - » **North Andaman, Middle Andaman, South Andaman**, **Little Andaman**, **Car Nicobar, Little Nicobar, and Great Nicobar**.
    - They are protruded parts of the oceanic fold mountains formed during tertiary epoch. Here are more than 350 islands of which only 38 are inhabited.
    - **Port Blair** - the capital of A&N Islands is situated in South Andaman.
    - **The Indira Point,** the southernmost point of India is the southern point of Great Nicobar Island.
    - **The Barren Island** which is India's only active volcano is situated in the east of Middle Island.
    - **Narcondam Island** (situated in north eastern part of North Andaman) is a volcanic island.
    - **10 degree channel** (10 degree N Latitude) separates Andaman and Nicobar Islands.
    - **Duncan Pass** is between South Andaman and Little Andaman.
    - **Coco Strait** - is between Coco Islands (Myanmar) and North Andaman.
    - **Saddle Peak** is the highest peak of A&N Islands (North Andaman, 738 m). It is followed by **Mt. Thuiller** (Great Nicobar, 642 m)

2) MAHATMA GANDHI MARINE NATIONAL PARK

- It is national park on Andaman Island. It belongs to southern Andaman administrative district.
- **Two major island groups in the park:** Labyrinth Island and the Twin Island.

3) MOUNT HARRIET NATIONAL PARK

- **A national park in A&N islands**
  - **Mount Harriet** (383 m / 1,257 ft) is part of the park and is the third highest peak in the A&N archipelago next to saddle peak (in North Andaman - 732 m) and Mount Thullier (568 m in Great Nicobar.
  - **Important Faunal Species** are **Andaman Wild Pigs**, **Shrews** (Andaman and Jenkins), Saltwater Crocodile, turtles etc.
  - The park is also a butterfly hotspot.

4) OTHER IMPORTANT NATIONAL PARKS OF A&N ISLANDS

- Campbell Bay National Park
- Galathea Bay National Park
- Rani Jhansi National Park
- Saddle Peak National Park

36. WILDLIFE SANCTUARY

- The Wildlife (Protection) Act of 1972 provided for the declaration of certain areas by the **state government** as wildlife sanctuaries if the area was thought to be of adequate ecological, geomorphological and natural significance.
    - There are more than 500 WLS in India. Out of these Tiger reserves are governed by Project Tiger.
- In some cases central government can also declare an area to be WLS.
- **Human activities**
    - Some restricted human activities are allowed in WLS as specified in the Wildlife (Protection) Act of 1972.

1) CHANGTHANG WLS

The Changthang WLS (or the Changthang Cold desert WLS) is a high altitude WLS located in the Ladakhi adjunct of the Changthang plateau in the Leh district of the Union territory of Ladakh.

It is one of the few places in India with a population of Kiang or *Tibetan Wild Ass*, as well as the rare, Black-necked crane.

India's **first night sky reserve** is being developed here.

2) MAHARANA PRATAP SAGAR SANCTUARY

Introduction

- It is a lake sanctuary in the Kangra district of HP, spread over across 450 sq km.
- The sanctuary is locally known as Pong dam Lake and is located about 60 km southwest of Dharmshala.
- It is one of the 80 International Wetland sites declared in India by the **Ramsar Convention**.
- The reservoir is also leading source of fish in Himalayan states.
- **Birds**
    - The Lake is popular for the birds like Surkhabs, red necked grebes, terns etc.
    - Thousands of migratory ducks from Siberia come here every year.
- **Animal**
    - Barking deer, Sambar, wild boars, leopards and oriental small clawed otters.

3) NANDHAUR WLS

- **About the WLS**
  - The sanctuary is located **near the Nandhaur river in Kumaon, UK** and spread over an area of **269.5 sq km**. It was created in 2012. The sanctuary is part of Terai Arc Landscape (TAL), a forest zone that stretches from Uttarakhand in India and extends in Nepal.

  - **Flora**
    - Primarily a **Sal** forest. Contain other 100 species of trees, over 30 species of shrubs etc. **Shisham, Bamboo, Teak and Chir pine** are important trees.
  - **Fauna**
    - Tiger, leopards, elephants, sloth bears etc.
  - **Tiger Population in Nandhaur** is increasing and so is the demand for declaring Nandhaur as a **Tiger reserve**

4) TAL CHAPPAR SANCTUARY

Location: Churu district of Northwestern Rajasthan in the Shekhawat Region.
Important Features:

- Known for Blackbucks and is also home to variety of birds.
- It has almost flat tract and interpersed shallow low-lying areas. It has open grassland with ***scattered Aracia*** and ***Proposis*** which gives it appearance of a typical Sawana.
- **Tal**: The rain water flows through shallow low lying areas and collect in small seasonal water ponds.
- **Fauna**: It is famous for **blackbucks** and is home to a variety of **birds**.


Location in Rajasthan, India

Updates (Dec 2022): The Sanctuary got **protection from plan to reduce its size**.

- The Rajasthan government had planned to reduce the size of ESZ around it.
- But, **the Rajasthan High Court**, has intervened through a **suo motu PIL** to protect the sanctuary. It took into cognizance of reports that its area was going to be reduced to three sq km under pressure from mine owners and stone crusher operator. The court ordered a "**complete prohibition**" on any action to reduce the WLS area.

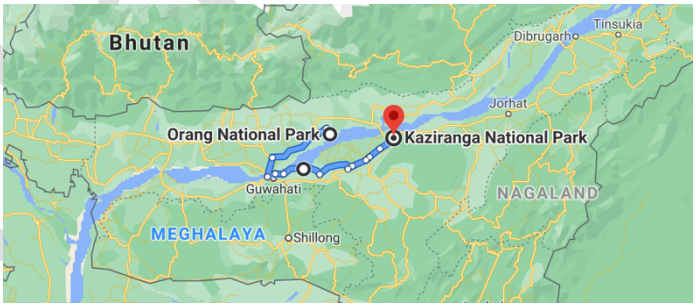
5) MAHANANDA WLS

- It is situated in the foothills of Himalayas between the **Tista and Mahananda River**, in the **Darjeeling district** of WB.

6) POBITARO WLS

- **Introduction :**
  - It is located in Morigaon district of Assam, 30 km east of Guwhati.
  - It is known for dense population of the Great-Indian one-horned Rhino and is also called **Mini-Kaziranga**.
    - 102 rhinos in 16 km^2. Pobitaro has the world's densest population of one horned Rhino. The WLS has exceeded its Rhino bearing capacity.
    - **Rhino Breeding program** is running successfully within the sanctuary under the Indian Rhino Vision 2020.
  - It covers flat flood plains and a hillock (Raja Mayong).
- **Boundaries**
  - Its boundary is made by GrangaBeel on South and the river Brahmaputra on North.

- **Biodiversity**
  - One-horned Rhino, leopard, wild boar, Barking deer, wild buffaloes etc.
  - Home to 200 migratory birds and various reptiles.
  - It is also an Important Bird Area.



7) TALLEY VALLEY WLS

- Talley valley WLS is located in Arunachal Pradesh. It is also a biodiversity hotspot.
- Talley is a plateau with a height of 24,00 meters. It is covered with dense forest of silver fir, pine etc.
- Rivers like Pange, Sipu, Karing, and Subansiri flows through the reserved forest and WLS.

8) PAKKE TIGER RESERVE (PAKHUI TIGER RESERVE/WLS)

Pakke tiger reserve/ Pakhui Tiger reserve is located in Pakke Kasang district of Arunachal Pradesh.

It had won the India Biodiversity Award 2016 in the category of 'Conservation of threatened species' for its **Hornbill Nest Adoption Programme**'.

Rivers: It is bound by Kameng river in the west and Pakke river in the east.

Adjoining Protected Areas: The sanctuary adjoins Nameri National Park of Assam in the South. West of Kameng river lies Sessa Orchid Sanctuary and Eaglenest WLS.

- **Pakke Paga Hornfill Festival** (PPHF)
  - **9th edition** of **the PPHF** was held in Jan 2024 in the town of **Seijosa in Arunachal Pradesh's Pakke Kessang district**. It gave a call for protection and conservation of **hornbill**s.
    - » **Theme** for 2024: 'Domutoh Domutoh, Paga hum Domutoh, translates to 'Let Our Hornbills Remain' in Nyishi, emphasizing the critical need to preserve the iconic birds.
    - » **Note: Seijosa** is located near the Pakke tiger reserve, which is home to four species of hornbills - Wreathed, Great Indian, Oriental Pied, and Rufous Necked.
      - The area is traditionally homeland to the **Nyishi people**, the largest tribal group of Arunachal Pradesh.
  - **The first ever PPHF** was held on Jan 16-18, 2015 with the aim to recognize the role played by the **Nyishi in conserving the hornbills**. The aim was to recognize the role played by the **Nyishi** in conserving hornbill in PTR.
    - » **Note**: The Nyishi had formerly hunted hornbills and used their bills to craft traditional headgear. They had later turned into hornbill conservationists.
  - PPHF was declared a **state festival** by the then-Arunachal Pradesh CM Prem Khandu in 2019

9) DAMPA TIGER RESERVES

- It is the largest WLS in Mizoram and was notified in 1985. It was declared a tiger reserve in 1994.
- **Location**
  - It is situated in the western part of Mizoram state, at the international border with Bangladesh.
- **Important Fauna**
  - It is natural home of leopards, Indian Bison, barking deer, sloth bear, gibbons, langur, slow loris, etc.

10) NATIONAL CHAMBAL SANCTUARY (OR THE NATIONAL CHAMBAL GHARIAL WLS)

- **About National Chambal Sanctuary**
  - It is a tri-state protected area in northern India for the protection of the Gharial (CR), the Red Crowned Roof Turtle (CR) and Ganges River Dolphin (EN).

- It is **located** on Chambal river on the tripoint of Rajasthan, Madhya Pradesh and Uttar Pradesh.
- It has sanctuary status under the WPA, 1972.
- All three states have separately notified this for territories in their states.
- **Declaration of area around the Chambal Sanctuary as Eco-sensitive zone (March 2020)**
  - Central government has notified an area to an extent of zero to two kms around the sanctuary as Eco-Sensitive Zone.

11) HAZARIBAGH WLS

- In Jharkhand
- **Biodiversity**
  - The sanctuary and its fringe forests have more than 400 deer, mainly the large sambar and the Spritely and spotted Chital species that are protected under Wild Life Law.
  - The sanctuary is also home to Hyenas, sloth bears, black bears, Nilgai, several types of monkeys, snakes and 180 species of birds.

12) SATKOSIA TIGER RESERVE

- **About Satkosia Tiger Reserve**
  - It is a tiger reserve located in the Angul district of Orissa, India covering an area of 988 km^2.
  - **Satkosia Gorge WLS** was created in 1976 with an area of 796 km^2.
  - **Satkosia Tiger Reserve** was designated in 2007, and comprise the **Satkosia WLS** and the adjacent **Baisipalli Wildlife Sanctuary**.

- **River**
  - It's located where the Mahanadi River passes through a 22 km long gorge in the Eastern Ghats mountains.

- **Forest type**
  - Eastern Highlands **moist deciduous forests** ecoregion. The major plant community includes mixed deciduous forests including Sal and Riverine Forest.

13) NALABANDA BIRD SANCTUARY

- **About Nalabanda Bird Sanctuary**
  - The Nalabanda island is **part of the Chilika Lake**, India's largest brackish water lagoon. The island gets partially submerged during Monsoon. As the monsoon recedes in winter, water levels decrease, and the island is gradually exposed.
- Birds flock to the island in large numbers to feed on its extensive mudflats. It is the largest wintering ground for migratory waterfowl found anywhere on the Indian sub-continent.

- Some rare and endangered species listed in the IUCN Red List inhabit the lagoon for at least part of their life cycle.