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Volume - 2

NON - TECHNICAL

General Knowledge and Science

SIERRA INNOVATIONS

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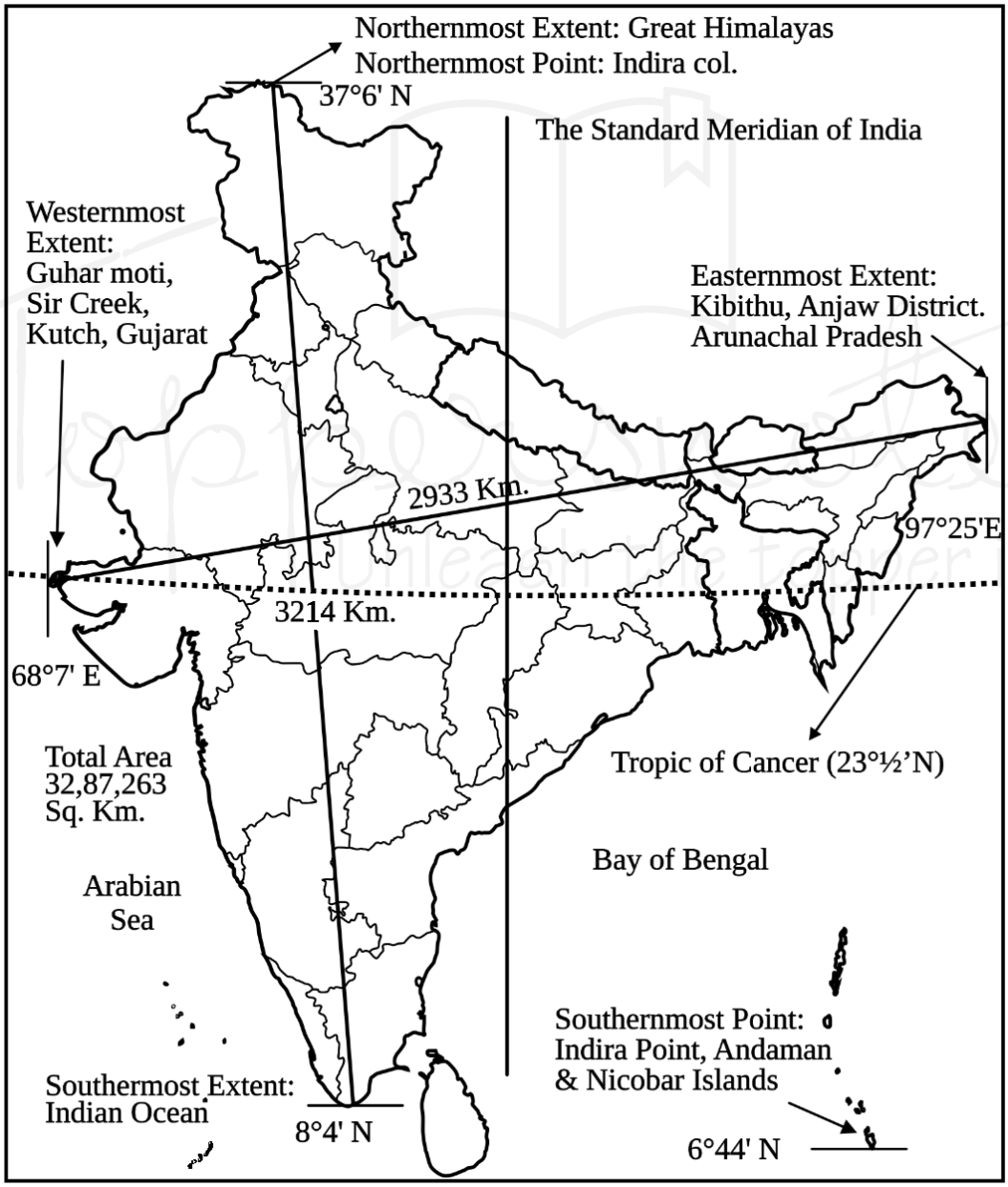
1 CHAPTER

Geographical Setting of India

- The Indian subcontinent, located in South Asia, is surrounded by water on three sides. To its south lies the Indian Ocean, to the west the Arabian Sea, and to the east the Bay of Bengal. In the north, India is connected to the Himalayas.

India in the World

- **Located in Asian Continent → A South Asian Country**
- **It represents about 17.5% of the world's population (census 2011)**
- **2.4% of the total geographical area of the world**
- **Seventh Position in terms of Area (after Russia, Canada, United States of America, China, Brazil and Australia)**



India as a Geographical Unit

1. **Geographical Extent**
   - ✓ **Latitudinal Spread:** 8° 4′ N (southern tip) to 37° 6′ N (northern tip).
   - ✓ **Longitudinal Spread: 68° 7′ E** (western edge) **to 97° 25′ E** (eastern tip).
   - ✓ **North-South distance:** 3214 km
   - ✓ **East-west distance:** 2933 km
   - ✓ **Total area of India** - 32,87,263 sq.km
2. **Border Details**
   - ✓ **Total Land Border Length:** 15,106.7 km shared with neighboring countries.
   - ✓ **Total Coastline Length:**
     - Approx. 7,516.6 km along the mainland, islands, and bays.
     - Revised coastline (including tidal inlets): 11,098 km.
     - Territorial Waters: Extend 12 nautical miles (22.2 km) from the coast.
   - ✓ Comprises 28 states and 8 Union territories
   - ✓ **Total International Neighbors:** 7 (land); 9 (including maritime)

DID YOU KNOW?

- The Indian Ocean hosts big-power military bases due to its vital trade routes, chokepoints, and strategic geopolitical benefits
- The southernmost part of India is the Indira Point is located on the island of Andaman and Nicobar.
- The southernmost point of the Indian mainland is Kanyakumari (also known as Cape Comorin), located in the state of Tamil Nadu. This is where the Indian Ocean, the Bay of Bengal, and the Arabian Sea meet.
- The westernmost point of India is the small village of Guhar Moti in the Kutch district of Gujarat
- The easternmost point of India is Kibithu, located in Arunachal Pradesh
- The northernmost point of India- Indira COL

Neighboring Countries of India & Bordering States

Country	Border States	Length	Other Important Fact
Bangladesh	West Bengal, Assam, Meghalaya, Tripura, Mizoram	4,096.1	Fifth longest land boundary in the world.
China	J&K, Himachal Pradesh, Uttarakhand, Sikkim, Arunachal Pradesh	4,056	
Pakistan	Jammu & Kashmir, Punjab, Rajasthan, Gujarat, Ladakh	3,323	Among India's neighboring countries, Pakistan has the highest number of "million-plus" cities, including Karachi, Lahore, Faisalabad, and Rawalpindi — each with a population exceeding one million.
Nepal	Bihar, Uttarakhand, Uttar Pradesh, Sikkim, West Bengal	1,690	India shares an open border with Nepal.
Myanmar	Arunachal Pradesh, Nagaland, Manipur, Mizoram	1,643	Rohingya displacement issue.
Bhutan	Sikkim, Arunachal Pradesh, Assam, West Bengal	699	
Afghanistan	Ladakh (POK)	106	**Shortest Border:** With Afghanistan (via PoK) Called Wakkan Corridor.

3. **Maritime Neighbors**
   - ✓ **Maldives**
     - **Official Language:** Dhivehi
       - ☞ Belongs to the Indo-Aryan language family.
       - ☞ Originated from the ancient Sinhalese language.
       - ☞ Written in the Thaana script, which is read from right to left.
   - ✓ **Sri Lanka**
     - Sri Lanka is separated from India by the Palk Strait and the Gulf of Mannar. It lies between the coast of Tamil Nadu (India) and the Jaffna district (Sri Lanka).
     - The strait is named after Robert Palk, former Governor of Madras.
     - The Palk Strait is bounded by Pamban Island (India), Adam's Bridge (Ram Setu), and the Gulf of Mannar (Sri Lanka).
4. **Key Parallels and Meridians**
   - ✓ **Tropic of Cancer:**
     - Divides India into 2 climatic zones
       - ☞ Tropical Zone: South of the tropic
       - ☞ Subtropical Zone: North of the Tropic
     - Passes through 8 states → Gujarat, Rajasthan, MP, Chhattisgarh, Jharkhand, West Bengal, Tripura & Mizoram
   - ✓ **Standard Meridian:**
     - Defines Indian Standard Time.
     - It crosses UP, Chhattisgarh, Odisha, MP & Andhra Pradesh.
     - Despite India's wide east–west spread, the entire country follows a single time zone for administrative convenience and uniformity.

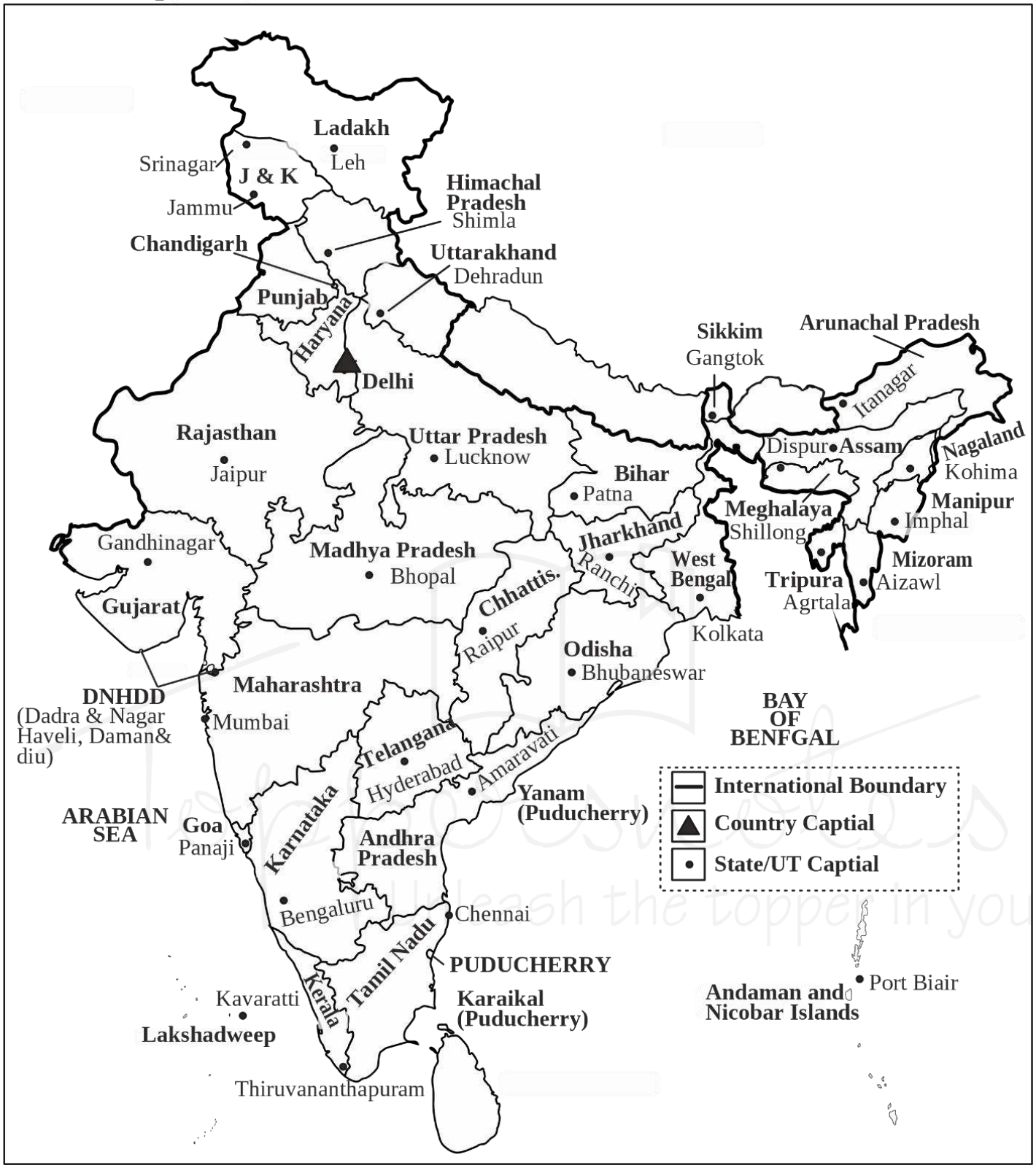
The Greenwich Meridian, or 0° longitude:

- ➢ India follows its own Standard Meridian located at 82.5° East longitude, which passes near Mirzapur in Uttar Pradesh.
- ➢ This meridian is used to determine Indian Standard Time (IST), which is 5 hours and 30 minutes ahead of Greenwich Mean Time (GMT+5:30).
- ➢ India's longitudinal extent is approximately **30°,** stretching from Gujarat in the west to Arunachal Pradesh in the east. Due to this, there is a **time difference of about two hours (104 minutes or 1 hour 44 minutes)** between the eastern and western extremes.

Important International Boundary lines

Boundary Line	**Between Countries**
Radcliffe Line	India and Pakistan
MacMohan Line	India and China
Durand Line	Pakistan and Afghanistan
49th Parallel	USA and Canada (longest border)
38th Parallel	North Korea and South Korea
Hindenburg Line	Germany and Poland
Maginot Line	France and Germany
Oder-Neisse Line	Germany and Poland

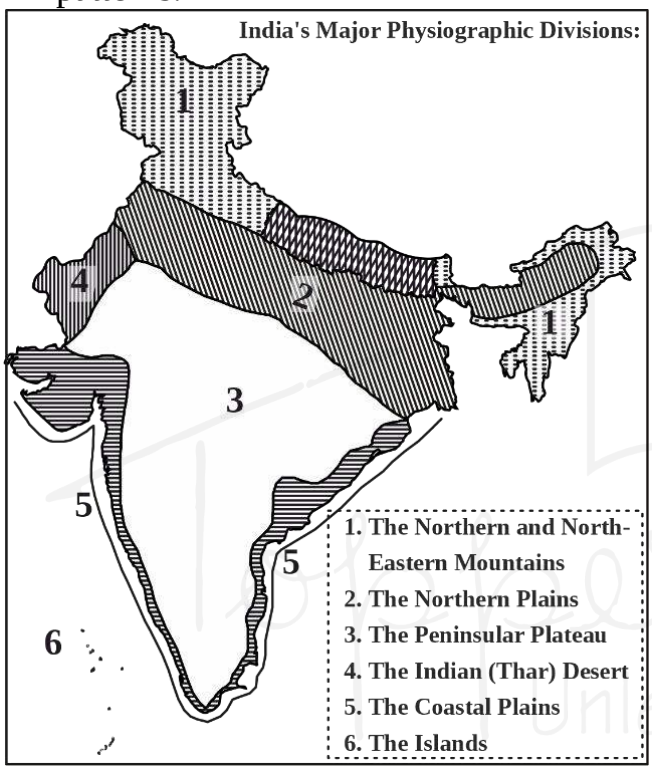
States & capitals



2 CHAPTER

Structures and Physiography of India

- India's physical landscape is shaped by diverse geological structures and physiographic divisions formed over millions of years. This varied terrain influences climate, agriculture, biodiversity & human settlement patterns.



The Northern and North-Eastern Mountains

- Comprise the **Himalayas** and **North-Eastern Hills**.
- **Himalayas:**
  - ✓ Comprising parallel ranges: Trans-Himalaya, Greater Himalaya (Himadri), Middle Himalaya (Himachal), Shivalik. Which extend in an arc shape for about **2,400 km** from west to east.
  - ✓ **Orientation:** NW–SE (main ranges), E–W (Sikkim), N–S (Nagaland, Mizoram).
  - ✓ Act as climatic, physical, drainage, and cultural barriers.
  - ✓ The Himalayas are a type of **young fold mountains**.
  - ✓ According to the **Plate Tectonic Theory**, the Himalayas were formed by the **compression of sediments** of the **Tethys Sea**.
  - ✓ In India, the **Himalayas and the Northern Plains** are **newly formed landforms**.

Hindukush

- The Hindukush Mountain range is **not included among the major mountain ranges of India**.
- It is an approximately **800-kilometre-long mountain range** that passes through **Afghanistan, northern Pakistan, and Tajikistan**.
- **Tirich Mir**, located in the **Chitral district of Pakistan**, is the **highest peak** of this range.

Subdivision-

A. North–South Division of the Himalayas (longitudinal range)

Division	Characteristics	Peaks
Great Himalayas	i. Highest, most continuous belt (mean elevation ~6,100 m) steep south face; asymmetrical fold	**Major Peaks**: Everest (8,848 m),

(Himadri, Inner Himalayas)	structural convex profile ending abruptly at Nanga Parbat (8,126 m) in the west and Namcha Barwa (7,782 m) in the east. ii. The **Greater Himalayas** and the **Lesser Himalayas** are separated by the **Main Central Thrust (MCT)**.	Kanchenjunga (8,586 m), Lhotse, Cho Oyu, Makalu, Dhaulagiri (Nepal), Nanda Devi (7816 m, Uttarakhand), Trishul, etc.
Lesser Himalayas (Middle Himalayas)	i. Elevations between 3,500 m & 4,500 m ii. Rugged uplands interspersed with large valleys (Kashmir, Kullu, Kangra).	Nag Tibba, Mahabharat Lekh, Dhauladhar Range (Himachal Pradesh)
Shiwaliks (Outer Himalayas)	i. Low relief (900–1,100 m) ii. **Medium Width (10 to 50 km)** iii. Wide alluvial valleys, known as **"Doons"** (e.g., **Dehradun** – the largest Doon, **Kotli Doon**, **Patlidun**), are **longitudinal valleys** located between the **Lesser Himalayas** and the **Shivalik Hills**. iv. **Seasonal streams (Chos)** flow through these regions.	

Mount Everest

- Its height is **8,850 meters**
- This peak is located on the **border between Nepal and the Tibet Autonomous Region of China**.
- **Mount Everest** is the **highest peak of the Himalayan Mountain range** and is considered the **tallest point on Earth**.

Kangchenjunga

- **Kangchenjunga**, located in **India (Sikkim)**, is the **third-highest mountain in the world**, with a height of **8,586 meters (28,169 feet)**.
- It was **officially declared the third-highest mountain in the world in since 1856**.
- It is situated in the **eastern Himalayas**, on the **border between India and eastern Nepal**. **Kangchenjunga** consists of **five peaks** and is known in **Sikkim as the "Five Treasures of Snow."**

Saltoro Kangri

- It is the **highest peak of the Saltoro range**, a subrange of the **Karakoram Mountain range**.
- It is located near the **Actual Ground Position Line (AGPL)** and forms part of the boundary between the **Indian and Pakistan-controlled areas** in the **Siachen Glacier region**.
- **Saltoro Kangri** lies in a **disputed area between India and Pakistan**, specifically in the **Siachen Glacier region of the Karakoram range**.
- The region holds **extreme strategic importance**, which is why both countries maintain a **military presence**, making it **one of the highest battlefields in the world**.

B. East–West Division of the Himalayas

Division	Characteristics	Peaks / Ranges
Kashmir / Northwestern Himalayas	i. Kashmir Valley (Tectonic) with Dal and Wular lakes ii. Pangong Tso in Ladakh iii. Karewas (lacustrine benches) famous for saffron cultivation iv. The **Pir Panjal range** passes through the states of **Jammu & Kashmir** and **Himachal Pradesh**, and it is the **longest mountain range**.	➢ **Key Ranges:** Karakoram, Ladakh, Zaskar (Saser Kangri), Pir Panjal (from north to south in order) ➢ **Major Peaks**: K2 (8611 m, India's highest peak, POK), Nanga Parbat, Gasherbrum, Rakaposhi
Himachal & Uttarakhand Himalayas	➢ The entire region comprising the **Himadri, Himachal, and Shivalik ranges** is broadly known as the **Kumaun Himalayas**. ➢ In **Himachal Pradesh**, the **Kangra** and **Kullu** valleys are located. ➢ This region lies **between the Sutlej and Kali rivers**. ➢ Valley of Flowers	➢ **Key Ranges**: Great Himalayas, Dhauladhar, Nag Tibba subranges & Shiwaliks. ➢ **Major Peaks**: Kamet (7756m), Nanda Devi, Kedarnath, Trishul, Bandarpunch (A **major tributary** of the **main course of the Yamuna River**.).
Nepal Himalayas	i. Highest continuous Himalayan section ii. Renowned tea gardens along the southern foothills. iii. Located **between the Kali and Teesta rivers**.	➢ **Key Ranges**: Mahabharat and Churia ranges. ➢ **Major Peaks**: Everest, Annapurna, Dhaulagiri, Makalu.
Darjeeling & Sikkim Himalayas	i. Famous tea plantations ii. Exceptional orchid diversity iii. Home to the Lepcha tribe.	➢ **Key Ranges**: Kanchenjunga, adjacent folds of the Mahabharat range. ➢ **Major Peak**: Kanchenjunga (8,586 m).
Arunachal Himalayas or Asam Himalayas	➢ It is located **between the Teesta River in the west and the Dihang River in the east** (called **Siang River** or **Tsangpo** in Tibet). ➢ The **Brahmaputra River** marks the **easternmost boundary of the Himalayas**.	➢ **Key Ranges**: Patkai Bum, Naga Hills, Abor Hills. ➢ **Major Peaks**: Namcha Barwa, Kangtu.

C. Purvanchal himalayas

- ✓ The eastern extension of the Himalayas in Northeast India, curving southward beyond the Dihang Gorge, forming a series of hill ranges running mostly north–south.

Sub-Range	Composition & Structure	Characteristics & uses	Highest Peak	Other Features
Patkai Bum	Highly dissected hills cloaked in dense rainforest	Forms international boundary between Arunachal Pradesh & Myanmar	—	Biodiversity hotspot
Naga Hills	Predominantly igneous and metamorphic rocks	Acts as watershed between India and Myanmar	Mount Saramati	Jhum cultivation by indigenous Naga tribes
Manipur Hills	Sedimentary layers with clay deposits	Southward continuation of the Naga range	—	—
Barail Range	Folded deposits separating it from Naga Hills	Characterized by narrow valleys and mid-elevations	Mount Tempu (Manipur)	—
Mizo (Lushai) Hills	Unconsolidated sediments of the molasse basin	Known locally as "Blue Mountain" region	Phawngpui (2,157 m)	Rich tribal cultures and continuous jhum farming

- ✓ **Meghalaya**
  - **Garo, Khasi, and Jaintia Hills**, formed during the **Malwa Plateau period**.
  - These hills are named after the **tribes that predominantly inhabit them**.
  - **Mawsynram**, located in the **Khasi Hills of Meghalaya**, is famous for receiving the **highest annual rainfall on Earth**. The **distinct topographical structure of the Khasi Hills** promotes the **orographic uplift of monsoon clouds**, resulting in **extremely heavy rainfall**.
  - The **capital of Meghalaya, Shillong**, is situated in the **Khasi Hills**.
  - Due to its **natural beauty and greenery**, Meghalaya is also referred to as the **"Scotland of the East."**

Prominent Himalayan Glaciers

Glacier Name	Location	Important Features
Siachen	Karakoram ranges	Nubra Valley of Himalayas; 2nd longest glacier outside Polar region largest glacier of trans-Himalayas
Biafo	Karakoram	Flows into the Shigar River
Gangotri	Uttarakhand	Origin below Chaukhamba Peak; also known as 'Gomukh'
Hispar	Gilgit-Baltistan	World's longest glacial system
Zemu	Sikkim/Nepal	Largest glacier of Eastern Himalaya; feeds River Teesta

Sonapani	Lahaul & Spiti, HP	Longest glacier in the Pir Panjal range. A glacier stream is a tributary to the Chandra River, which later merges with the Bhaga River to form the Chenab.
Milam	Uttarakhand	Major source of River Gori Ganga (Saryu); biggest glacier in Kumaon Himalaya
Chong Kumdan	Karakoram, Ladakh	Feeds Shyok River due to potential blocking
Diamir	POK	Known as the 'King of Mountains'
Rupal	Kashmir	In Greater Himalayas; flows north eastward
Bhillans, Thajivas, and Prui	Jammu and Kashmir	

Prominent Himalayan Passes

Pass Name	State / UT	Location / Border	Importance
Zoji La	Jammu & Kashmir, Ladakh	Greater Himalayas	Connects Srinagar–Leh; vital for defence
Banihal Pass	Jammu & Kashmir	Pir Panjal Range	**Jawahar Tunnel** passes **beneath it**; **Srinagar–Jammu route**; a **pass connecting the rest of India to Kashmir**.
Khardung La	Ladakh	Ladakh Range	Road to Siachen; one of highest motorable roads
Chang La	Ladakh	Ladakh Range	Connects Leh to Pangong Lake
Fotu La	Ladakh	Zanskar Range	Highest point on Srinagar–Leh highway
Namika La	Ladakh	Zanskar Range	On Kargil–Leh route
Baralacha La	Himachal Pradesh	Zanskar Range	On Leh–Manali highway
Shipki La	Himachal Pradesh	India–Tibet Border (Kinnaur)	Historic silk route for trade.
Mana Pass	Uttarakhand	Chamoli District	Road to Kailash–Mansarovar; Indo-China route
Niti Pass	Uttarakhand	Chamoli District	Old trade route to Tibet
Lipulekh Pass	Uttarakhand	Pithoragarh District	Kailash–Mansarovar Yatra route; India–Nepal–Tibet tri-junction
Nathu La	Sikkim	Indo–China Border	A border trade post with China; one of the highest motorable roads in the world and a mountain pass in the Himalayan peaks, connecting Sikkim with the Tibet Autonomous Region of China.

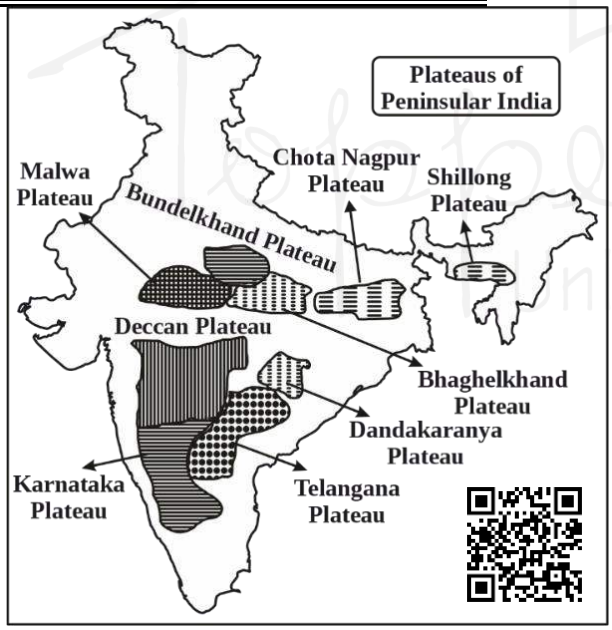
Jelep La	Sikkim	Near Kalimpong	Trade route to Lhasa in historical times
Sella Pass	Arunachal Pradesh	Tawang District	Connects Tawang to rest of state; Sella tunnel world's Longest twin lane tunnel above 13000 feet altitude.
Bum La	Arunachal Pradesh	Near Tawang	Indo–China sensitive military pass
Dipher Pass	Arunachal Pradesh	East Kameng	Eastern Himalayas, remote and strategic
Khunjerab Pass	(POK)	Gilgit–Baltistan (Pak-Occupied Kashmir)	On China–Pakistan border; on CPEC route
Lanak La	Ladakh (Disputed Border)	Aksai Chin region (Indo-China)	Disputed India–China border crossing
Lekhapani	Arunachal Pradesh	Eastern tip near Assam-Arunachal	Historic WW-II route via Stilwell Road; strategic for eastern sector
Rohtang Pass	Himachal Pradesh	Pir Panjal Range	Connects **Kullu Valley** to **Lahaul and Spiti valleys**; separates **Chenab and Beas basins**
Debsa Pass	Himachal Pradesh	-	Located between **Kullu and Spiti districts**
Dihang Pass	Arunachal Pradesh	-	Connects **Arunachal Pradesh** to **Myanmar**
Khyber Pass	Pakistan–Afghanistan		Connects **Peshawar (Pakistan)** to **Jalalabad (Afghanistan)**; part of the **ancient Silk Road trade network**
Muling La Pass & Mangsha Dhura Pass	Uttarakhand	Greater Himalayas	Connects **Uttarakhand** to **Tibet**

The Northern Plains

- Formed by alluvial deposition from Indus, Ganga & Brahmaputra.
- **Size:** About 3,200 km long and 150–300 km wide.
- Divided into: (from north-south)
  - ✓ **Bhabar** (rocky, porous belt near base of Shiwaliks)
  - ✓ **Tarai** (marshy, re-emergent rivers-Dudhwa National Park located)
  - ✓ **Alluvial Plains**:
    - **Khadar** – newer alluvium, floodplain deposits, fertile
    - **Bhangar** – older alluvium, calcareous in nature

- The **plain formed by river erosion** is known as the **Peneplain**.
- **Ganga–Brahmaputra Plains**
  - ✓ A **highly flood-prone plain**.
  - ✓ The **Ganga Plain** is located between the **Ghaggar and Teesta rivers**.
  - ✓ This region contains the **Sundarbans**, the **world's largest delta**, and the vast **Ganga plains**, which are **densely populated**.
  - ✓ The **northernmost point** of the **Ganga Delta** is **Farakka**.
  - ✓ The **Sundarbans Forest** is famous for its **mangrove vegetation**.
  - ✓ In the plains, **ox-bow lakes (Gokhur lakes)** are a common feature.
  - ✓ **Alluvial terraces (Bhangar)** are a prominent feature of the **upper and middle Ganga plains**.
  - ✓ **River islands**, such as **Majuli (Assam)**, are among the **largest river islands in the world**.

The Peninsular Plateau



- **India's largest and oldest landmass**, which originated from **Gondwana Land**, and is an **extremely stable and rigid terrain**.
- **Elevation:** Ranges between 150–900 m.
- **Slope:** Tilts eastward, with black soil in the northwest.
- **Dominance of black soil in the north-western region**.
- The **Narmada River** divides the **peninsular plateau** into two distinct regions: the **Malwa Plateau** in the north and the **Deccan Plateau** in the south.
- **Divisions:**
  - ✓ **Deccan Plateau**
  - ✓ In **South India**, the **Deccan Plateau**, composed of **basalt rocks**, is a **triangular landform** situated between the **Western Ghats** and **Eastern Ghats**.
  - ✓ The **Deccan Traps** were formed at the **end of the Cretaceous period**.
  - ✓ This **peninsular region** extends **south of the Narmada River** and is **bounded to the north by the Satpura and Vindhya ranges**.
  - ✓ Rivers flowing from the Deccan Plateau have created **numerous deep valleys**, dividing it into several smaller plateaus, including the **Maharashtra Plateau**, **Karnataka Plateau**, and **Andhra Pradesh/Telangana Plateau**.
  - ✓ The **black soil region** of the peninsular plateau is called the **Deccan Trap**, which is a **vast igneous province of west-central India**.
  - ✓ This region is famous for its **fertile black soil (Regur soil)**, which is **ideal for cotton cultivation**.
  - ✓ The black soil is **rich in calcium carbonate, magnesium, potash, and lime**, but is **deficient in nitrogen and organic matter**.
  - ✓ Its **moisture-retaining capacity** makes it **suitable for dry farming** as well.

Karnataka Plateau

- The **Karnataka Plateau**, also called the **Mysore Plateau**, is located **south of the Maharashtra Plateau**.

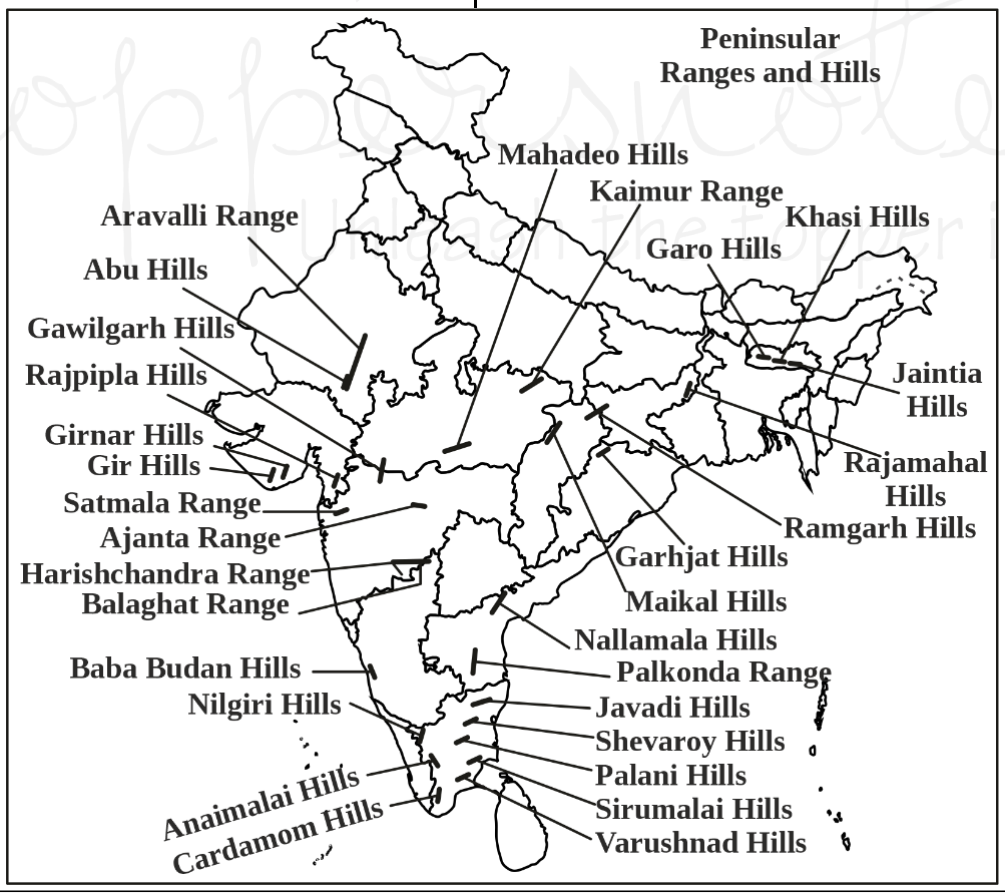
- The Karnataka Plateau is divided into **two parts – 'Malnad' and 'Maidan'**. **"Malnad"** means **"hilly country"** in the Kannada language and is characterized by **dense forests and deep valleys**.
- In contrast, the **Maidan region** consists of **rolling plains and low granite hills**.

- **Western Ghats**:
  - ✓ Known locally as the Sahyadri (Maharashtra), the Nilgiri Hills (Karnataka and Tamil Nadu), and the Anaimalai and Cardamom Hills (Kerala's Malabar Coast).
  - ✓ Average height ~1,500 m; becomes higher and more continuous toward the south.
  - ✓ Spread across **Kerala, Tamil Nadu, Karnataka, Goa, Maharashtra, Gujarat (Dhinodhar Hills)**.
  - ✓ Source of major rivers: **Godavari, Krishna, Kaveri**.
  - ✓ **Highest peaks: Anamudi (2,695 m)**, **Doddabetta (2,637 m), Ooty (2,240 m)**, **Pushpagir (1,712 m)** in the Nilgiris.
  - ✓ Famous hill stations: **Ooty (the second-highest hill station above sea level), Munnar, Kodaikanal (located in the Palani Hills).**
  - ✓ **"Kudremukh,"** the **third-highest peak of Karnataka**, is located in the **Chikkamagaluru district**. This **distinctive peak** is **shaped like a horse's face**.
  - ✓ **Nilgiris (Blue Mountains)**
    - The **Nilgiri mountain range** is located at the **tri-junction of Tamil Nadu, Kerala, and Karnataka** in South India.
    - It is part of the **Western Ghats**, which run **parallel to the western coast of the Indian Peninsula**.
    - The **highest peak** of this range is **Doddabetta (Nilgiri Mountains)**, with an elevation of **2,637 meters (8,652 feet)**.
    - The Nilgiris are also famous for **tea and coffee plantations**, producing **high-quality tea and coffee**.
  - ✓ **Kalsubai**
    - **Kalsubai** is the **highest peak of Maharashtra**, located in **Akola Taluk, Ahmednagar district**. The river Godavari emerge from here.
    - This **northern peak of the Sahyadri mountain range** has an elevation of **1,646 meters (approximately 5,400 feet)**.
    - It is also called the **"Everest of Maharashtra"**. A **small temple of Goddess Kalsubai** is located at the summit, which is **religiously significant to the local people**.
  - ✓ **Taramati Peak**
    - **Taramati Peak** is **one of the two major peaks of Harishchandragad**.
    - It is situated at an elevation of **1,431 meters (4,695 feet) above sea level** and is considered **the sixth-highest peak in Maharashtra**.
    - Located on the **Harishchandragad plateau**, it offers an **excellent trekking experience** for both **beginner and expert hikers** due to its **natural beauty and challenging trails**.

Various passes in the Western Ghats, called Ghat sections – Thal Ghat, Bhore Ghat, and Pal Ghat (from north to south)

- **Thal Ghat** – A mountain pass near **Kasara town in Maharashtra**, located on the **Mumbai–Nashik route**.
- **Bhore Ghat** – A mountain route situated on the **Western Ghats**, connecting **Palsadri and Khandala by railway** and **Khopoli and Khandala by road** in Maharashtra.
- **Pal Ghat (Palakkad Pass)** – This pass is **approximately 32 km wide across the Western Ghats**, located on the **Kerala–Tamil Nadu border**, serving as a **major communication route** between the two states.

- **Eastern Ghats:**
  - ✓ Broken, lower, heavily eroded hill chain running through **Odisha, Andhra Pradesh, Tamil Nadu, Karnataka, Telangana**.
  - ✓ Average height: 600 m
  - ✓ Principal ranges (north to south): **Mahendragiri** (highest peak – Odisha -1501m), **Nallamala Hills** (Srisailam temple), **Velikonda**, **Palkonda**, **Javadi**, **Shevaroy**, **Pachamalai**, **Sirumalai Hills**.
  - ✓ At the Nilgiris, Eastern and Western Ghats meet, forming a corridor with Sathyamangalam Tiger Reserve (Tamil Nadu).
  - ✓ **Devmalai Peak**, with an elevation of **1,672 meters**, is the **highest peak of Odisha**. It is located in the **Chandragiri–Pottangi subrange of the Eastern Ghats**. **Devmalai** is found in the **Koraput district of southern Odisha**, near **Koraput town**.
  - ✓ The **Eastern Ghats** run **parallel to the eastern coast**, between the **Mahanadi and Vaigai rivers**, extending **from the Mahanadi valley southwards to the Nilgiris**.



31 CHAPTER Biology

The Cell

- **Simplest and most basic unit** of life.
- **Discovered:** Robert Hooke (1665)
- All living things made up of cells- **structural, functional, and biological unit of life**.
- Has the **ability to duplicate itself** on its own.
- aka **"building blocks of life."**

Cell Structure and its components

Cell Organelles

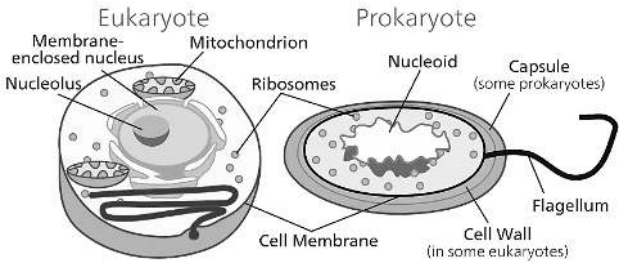
- Present within a cell & **perform certain specific functions to carry out life's processes.**

Plasma / Cell Membrane	• **Outermost covering** of the cell • **Separates contents of cell** from its **external environment.** • **A selectively permeable membrane** as it allows entry and exit of some materials in and out of the cell.
Cell Wall	• **ONLY** in **plants** • **Outside** the **plasma membrane.** • Mainly **composed of cellulose.** ○ **Cellulose:** A complex substance - provides structural strength to plants.
Cytoplasm	• **Jelly-like substance** present between **cell membrane & nucleus.** • **Fluid content inside plasma membrane.** • **Contains** many specialised **cell organelles** (mitochondria, golgi bodies, ribosomes, etc)
Nucleus	• **Contains chromosomes** that contain **information** for **inheritance** of features from parents to next generation in form of DNA • Plays a **central role** in **cellular reproduction**. • **Nuclear membrane**- a **double-layered** covering on nucleus. ○ **Allows transfer** of **material** from **inside** nucleus **to its outside**, i.e., to cytoplasm.
Nucleolus	• **Ribosome synthesis site regulating cellular activity** and **reproduction**.
Gene	• **Unit of inheritance** in living organisms.
Protoplasm	• **Entire content of a living cell** [cytoplasm + nucleus]. • aka **living substance of the cell.**
Chromosomes	• **Rod-shaped structures** • Visible **only when** the **cell is about to divide**. • Contain **information for inheritance of features** from parents to next generation in the form of DNA (deoxyribo nucleic acid) • **Composed** of **DNA** and **Protein**.
DNA molecules	• Contains **information necessary for constructing and organising cells**. • Functional segments of DNA - **genes.**
Vacuoles	• **Empty structure in cytoplasm** • Act as storage sacs for solid or liquid contents. • **Common in plant cells.** • **Smaller in animal cells**. • **Substances stored-** amino acids, sugars, various organic acids and some proteins.

Endoplasmic Reticulum	● A **large network of membrane-bound tubes and sheets**. ● **2 types :** **1. Rough endoplasmic reticulum [RER]** ○ **Has ribosomes** attached to its surface. ○ **Ribosomes** - sites of **protein manufacture**. **2. Smooth endoplasmic reticulum** ○ Helps in the **manufacture of fat molecules**, or lipids, important for cell function. ○ Some of these proteins and lipids **help in building the cell membrane k/a membrane biogenesis.** ● Serve as **channels for transport of materials** between various regions of cytoplasm or between the cytoplasm and the nucleus. ● Also functions as **a cytoplasmic framework** providing a **surface for some biochemical activities of cells.**
Golgi Apparatus/ Complex	● A **system of membrane-bound vesicles** arranged **parallel** to each other in **stacks** called **cisterns**. ● **Packages** and **dispatches material synthesised near ER** to **various targets** inside and outside the cell. ● **Stores**, **modifies** and **packages products** in vesicles. ● Involved in the **formation** of **lysosomes**. ○ **Membrane-bound sacs** filled with digestive enzymes. ○ Kind of **waste disposal system** of the cell. ○ **Help** to **keep** the **cell clean** by **digesting** any **foreign material** as well as **worn-out cell organelles**.

Mitochondria	● Aka **powerhouse of the cell.** ● **Energy required** for various chemical activities **is released** by mitochondria in the form of **ATP** (Adenosine Triphosphate) molecules. ● 2 **membranes:** ○ **Outer membrane- porous** ○ **Inner membrane - deeply folded.** ■ **Folds** create a **large surface area** for **ATP-generating chemical reactions**.
ATP	● aka **energy currency of the cell.** ● **Body uses energy** stored in **ATP** for **making new chemical compounds** and for mechanical work.
Ribosomes	● **Site of protein synthesis.** ● **Polyribosomes or Polysomes:** Several **ribosomes may attach to a single mRNA and form a chain.** ● **Prokaryotes- ribosomes are associated with the plasma membrane of the cell.**
Cilia and Flagella Cilia	● **Hair-like outgrowths of the cell membrane.** ● **Cilia - small structures which work like oars**, **causing** the **movement of either the cell or the surrounding fluid.** ● **Flagella** - comparatively **longer** and responsible for cell movement. ● **Prokaryotic bacteria have flagella but structurally different from eukaryotic flagella.**
Centrosome and Centrioles	● Centrosome- **an organelle** usually containing 2 **cylindrical structures called centrioles.** ● **Surrounded by amorphous pericentriolar materials**. ● **Both** the **centrioles** in a centrosome **lie perpendicular** to each other

Types of Cells

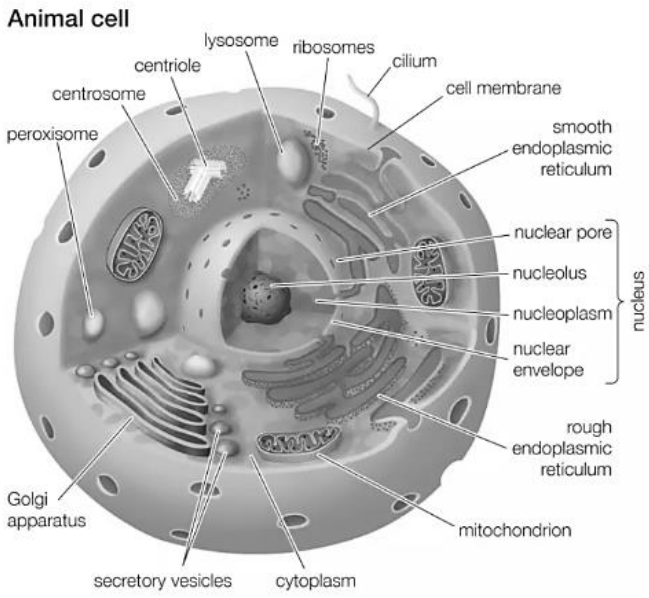


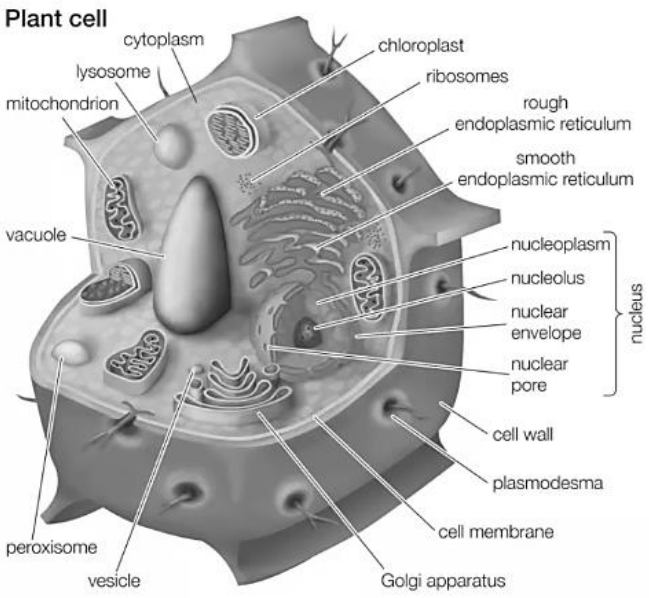
Prokaryotic Cell	Eukaryotic Cell
• **Primitive/undeveloped nucleus.**	• Has **true or developed nucleus**
• **Size** - 0.2 - 2.0 micrometers	• **Size**- 10- 100 micrometers.
• **Simpler** in **structure**	• **More complex**
• **Organelles not membrane-bound**	• **Organelles membrane bound** & specific in function.
• **DNA** arranged in **circular** shape	• **DNA linear** in shape
• **Cytoplasm present**, but **lacks** in most **cell organelles**.	• Consists of **both cytoplasm** and **organelles**
• **Cell wall present**. • Made of mucopeptide or peptidoglycan	• Usually, **absence of cell** wall here. • Made of cellulose
• **Cell division** - binary fission, transduction, conjugation, and transformation	• **Cell division** - mitosis
• **Mitochondria absent**	• Mitochondria **present**.
• **Endoplasmic reticulum not present**.	• Endoplasmic reticulum **present**.
• **Ribosome present**	• Ribosome **present**

• **Plasmids** commonly **found**.
  ○ A **small, circular, double-stranded DNA** molecule **distinct** from a **cell's chromosomal DNA**.
  ○ **Naturally exist in bacterial cells.**
	• **Plasmids** very **rarely found**

• **Only asexual reproduction**.	• **Both sexual** and **asexual** reproduction.
• Have a **single origin** of **replication**	• Have **multiple origins** of **replication**
• Only 1 **chromosome**.	• **Many chromosomes** present
• **Eg.** Bacteria and Archaea.	• **Eg**. Plant and animal cells.

Plant and Animal Cells





	Animal Cell	Plant Cell
Nucleus	Present	Present
Cilia	Present	Very rare
Shape	Round (irregular shape)	Rectangular (fixed shape)
Chloroplast	NO chloroplasts	Chloroplasts present
Cytoplasm	Present	Present
Endoplasmic Reticulum	Present	Present
Ribosomes	Present	Present
Mitochondria	Present	Present
Vacuole	One or more small vacuoles (much smaller than plant cells).	One large central vacuole taking up 90% of cell volume.

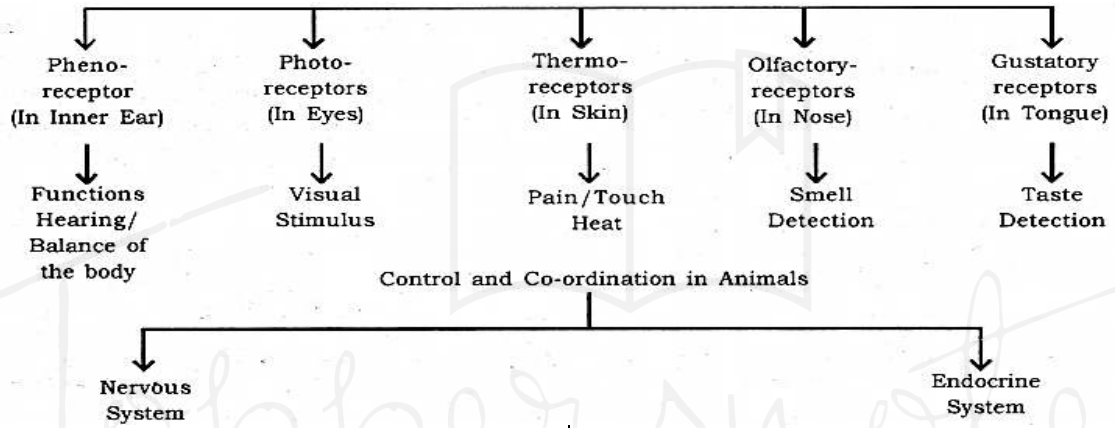
Control and Coordination

In animals

Nervous system and hormonal system are **responsible** for **control** and **coordination**.

Receptors:

- **Specialized tips of nerve fibres** that **collect information** to be **conducted by nerves**.
- **In** the **sense organs** of the animals.



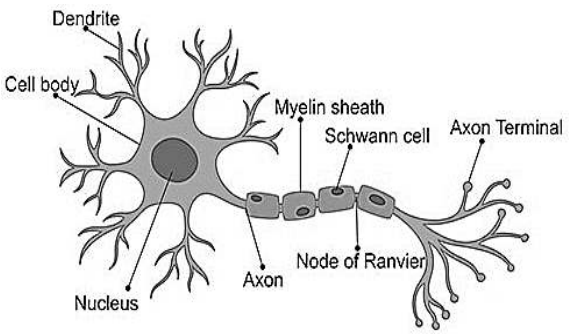
- **Types**:

1. **Nervous System**

- A **highly complex regulatory system** in animals.
- **Coordinates actions** & **transmits sensory information** and **signals** to/from the different parts of body.
- **Neuron** - **structural** and **functional unit** of entire system.
- **Functions:**
  - **Receives information** from the **environment**.
  - Receive the information from the **various body parts**.
  - **Act accordingly** through muscles and glands.
- **Movement**- **ability** of an organism **to move** a **particular body part**.
- **Locomotion** - **ability** of an organism **to move** its **whole body** from one place to another.

Neuron

- **Structural and functional unit of the nervous system**
- **Coordinates and controls the complex actions** in animals.
- **Specialized cells** responsible for **transmission** of **nerve** impulses.
- **3 parts-**

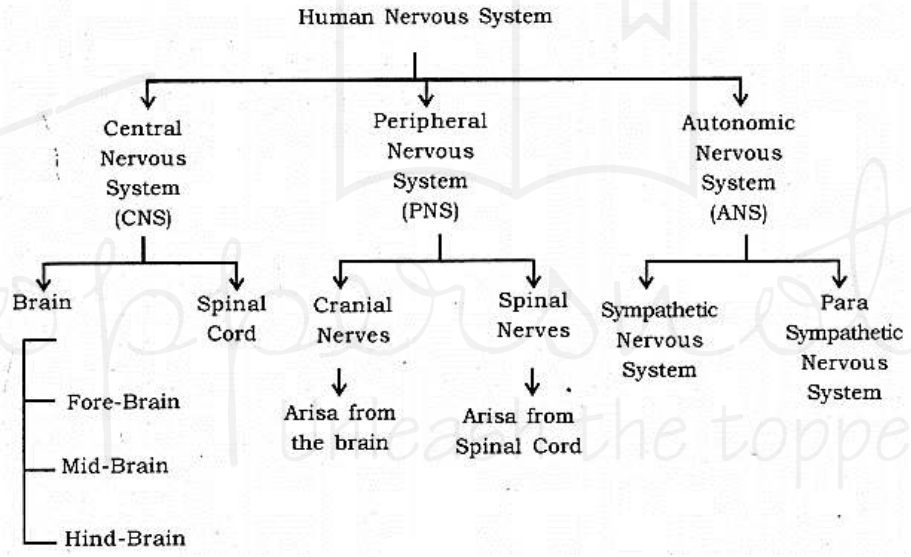


1. **Axon-**
   - **Tail** of the **neuron**.
   - **Ends** in **fine hair-like structures** k/a **axon terminals** which rely on nerve impulses
   - **Axons** - **myelinated** or **unmyelinated**.
   - **Impulse transmission is** faster in **myelinated neurons**.

2. **Cyton/soma/cell body-**
    - **Star-shaped** having various **hair-like structures** k/a **dendrites** which **receive** the **nerve impulses**
3. **Myelin Sheath-**
    - An **insulating sheath** on **axon**.
    - **Insulates axon against nerve impulse** from its **surroundings**.
    - **Dendrites receive** the **impulse** from other neurons.
    - **Cyton** or Soma cells **process** the **impulse-transmitted** to the **Axon**. Gets transmitted either to other neurons or to muscles for taking necessary action.

- **Types :**
    1. **Sensory** neurons- Receive the signals from a sense organ
    2. **Motor** neurons- Send the signals to a gland or muscle
    3. **Relay** or association neuron- Relay signals between a motor neuron and sensory neuron.
- **Synapse**
    - A **microscopic gap** between **two adjacent neurons**.
    - A **point contact between terminal branches** of **axon** of one neuron and with the dendrite of another neuron.
    - **Convert electric signals** into **chemicals** that can cross over gap between axon and dendrite.
    - **Chemical message** is **passed** to **next neuron** and **converted back** to the **electrical signal** for **interpretation**.
- **Neuromuscular Junction:**
    - **Point where** a **muscle fibre comes** in **contact with** a **motor neuron** carrying nerve impulse from the control nervous system.

Human nervous system

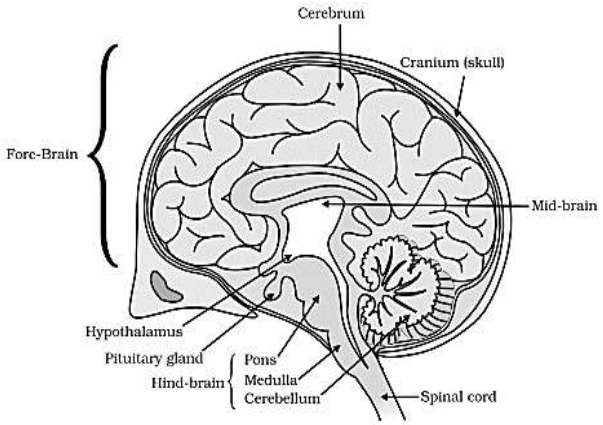


1. **Central Nervous System:**

- **Brain + spinal cord.**
- **Brain controls** all the **functions** in the human body.
- **Spinal cord** works as **relay channel** for **signals between brain** and **peripheral nervous system**.

Human Brain

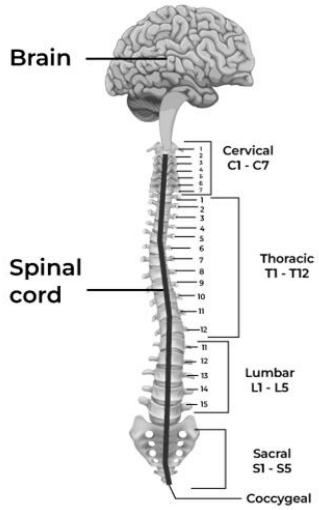
- A **highly complex organ** mainly **composed** of **nervous tissue**.
- **Tissues highly folded** to **accommodate** a **large surface area** in **less space**.
- **Covered by** a **3-layered system** of **membranes** k/a **meninges**.



- **Cerebrospinal fluid** filled **between meninges cushions** the **brain** against mechanical shocks.

- **3 parts:**
  1. **Fore-brain:**
     - **Composed** of the **cerebrum**.
     - **Cerebrum**- **Largest part** in human brains.
     - Divided into **2 hemispheres** k/a cerebral hemispheres.
     - **Functions**:
       - **Controls voluntary** motor actions.
       - **Site** of **sensory perceptions**, like tactile and auditory perceptions.
       - **Site** of **learning** and **memory**.
  2. **Mid-brain:**
     - **Composed** of the **hypothalamus**.
     - **Hypothalamus**- lies at the **base** of the **cerebrum**.
     - **Controls sleep** and **wake cycle** (circadian rhythm) of the body.
     - **Controls** the urges for **eating** and **drinking**.
  3. **Hind-brain:**
     - **Composed** of **cerebellum**, **pons**, **medulla**, **oblongata**.
     - **Cerebellum**- lies **below cerebrum** and at back of whole structure.
       - **Coordinates** the **motor functions**.
       - **Eg**. riding a bicycle, ensures perfect coordination between pedalling and steering control.
       - **Controls posture** and **balance**.
       - **Controls** the **precision** of **voluntary action**.
     - **Medulla**: **Forms brain stem**, along with the pons.
       - **Lies at the base of brain** and **continues** into **spinal cord**.
       - **Controls** various **involuntary functions**, like hear beat respiration, etc.
       - **Controls involuntary actions**.
       - **Eg**: Blood pressure, salivation, vomiting.
     - **Pons**:
       - **Relays impulses** between **lower cerebellum** and **spinal cord**
       - **Regulates respiration**.

Spinal cord:



2. **Controls reflex actions** and conducts messages between different parts of body and brain.
3. **Reflex Action**:
4. **Sudden** and **involuntary response** to **stimuli**.
5. **Helps organisms** to **quickly adapt** to an **adverse circumstance** that could cause bodily harm or even death.
6. **Eg**. Pulling our hands away immediately after touching a hot or cold object.
7. **Reflex Arc**:
8. **Path** through which nerves signals, **involved** in a **reflex action**, travel.

   Receptor → **Sensory neuron** → **Relay neuron** → **Motor neuron** → **Effector** (muscle)
9. **Peripheral Nervous System:**
   - **Cranial nerves** + **spinal nerves**.
   - **12 pairs** of **cranial nerves** coming out of brain and go to the organs in the head region.
   - **31 pairs** of **spinal nerves** coming out of spinal cord and go to the organs which are below the head region.
10. **Autonomous Nervous System:**
    - **Composed** of a **chain of nerve ganglion** which **runs along spinal cord**.
    - **Controls** all the **involuntary actions** in the **human body**.
      - **2 parts** :

      A. Sympathetic Nervous System:
        - **Increases activity** of an **organ** as required.
        - **Eg.** during running, there is an increased demand for oxygen by the body - fulfilled by an increased breathing rate and increased heart rate.

      B. Parasympathetic Nervous System:
        - **Decreases** the **activity** of an organ and thus has a calming effect.
        - **Eg.** during sleep, breathing rate slows down and so does the heart rate.
        - Helps in the **conservation of energy**.