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(IAS Academy by IAS Officers)

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MESSAGE FROM THE DIRECTOR

Dear Aspirant,

This book is dedicated to YOU, the untiring civil service aspirant who has the drive and commitment to persevere towards clearing this exam which is considered as one of the toughest exams in the world.

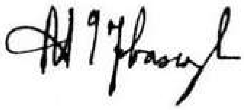
We congratulate you on choosing this book for "**Geography**". Our attempt here is to simplify important concepts without losing the key points. Hence, we hope you will find this book useful in your civil services journey.

About this book

This book is a distillation of the expertise of the faculty at Officers IAS academy, explained in simple and easy to understand language. What you get to study in this book has been painstakingly collated by our faculty through their years of teaching and mentoring thousands of aspirants.

A strong zeal from you to clear this exam combined with our coaching and textbook will, I am sure help you scale great heights.

I wish you the very best in the most important endeavour of your life.



R. A. Israel Jebasingh

(IAS, 2004 Batch All India Rank 59)

Director of Officers IAS Academy

HOW TO USE THIS BOOK?

Hello Aspirant!

There is a subtle difference between putting in effort and putting in the right and focussed effort. That difference could determine whether you get into the civil services or not! This statement becomes highly relevant during the UPSC Main Examination stage.

Aspirants know that every mark scored or missed in the Main examination determines their presence as well as their place in the All-India Rank list. Unlike the Preliminary examination, Main exams are fairly predictable. But with Mains, completing the examination on time becomes the biggest challenge.

Even with persistent efforts, aspirants generally tend to struggle in completing the Mains Syllabus. And even when the syllabus is covered, there is a struggle in recollecting appropriate points during the examination.

Such challenges are faced by all UPSC Mains Candidates. This is because of the sheer mindboggling number of topics, dimensions, and links with current affairs that aspirants have to sift through in their mind before writing an answer – something that is indeed a herculean task.

We in the R&D team of the Officers IAS Academy, have been pondering over this challenge, and have found a solution.

Our R&D team spent a year meticulously combing through the ***past 47 years'*** Mains General Studies question papers, to identify all possible topics and dimensions ever covered for each subject in an UPSC Main examination. Our researchers, then set out to prepare a series of books for each of the 'Main exam subjects' (pertaining to GS1, GS2, & GS3) where all relevant content is covered in a scientific and precise manner. Aspirants can confidently use these books to 'complete' the UPSC Main Exam syllabus effectively and efficiently.

Please note, we do not advocate the use of these 'Mains Harvest' books as 'Standard' sources. However, instead of reading endless number of books for the UPSC preparation, aspirants can focus on the standard books (NCERTs) for foundational knowledge and then devout the rest of their time in studying the Officers IAS Academy's Mains Harvest books.

For you, dear aspirants, we have practically 'harvested' the 'essence' of the UPSC main examination to produce the 'Mains Harvest' book series. Use them well!

Thanking and wishing you all the very best in your preparations,

R&D Team,

Officers IAS Academy, Chennai.

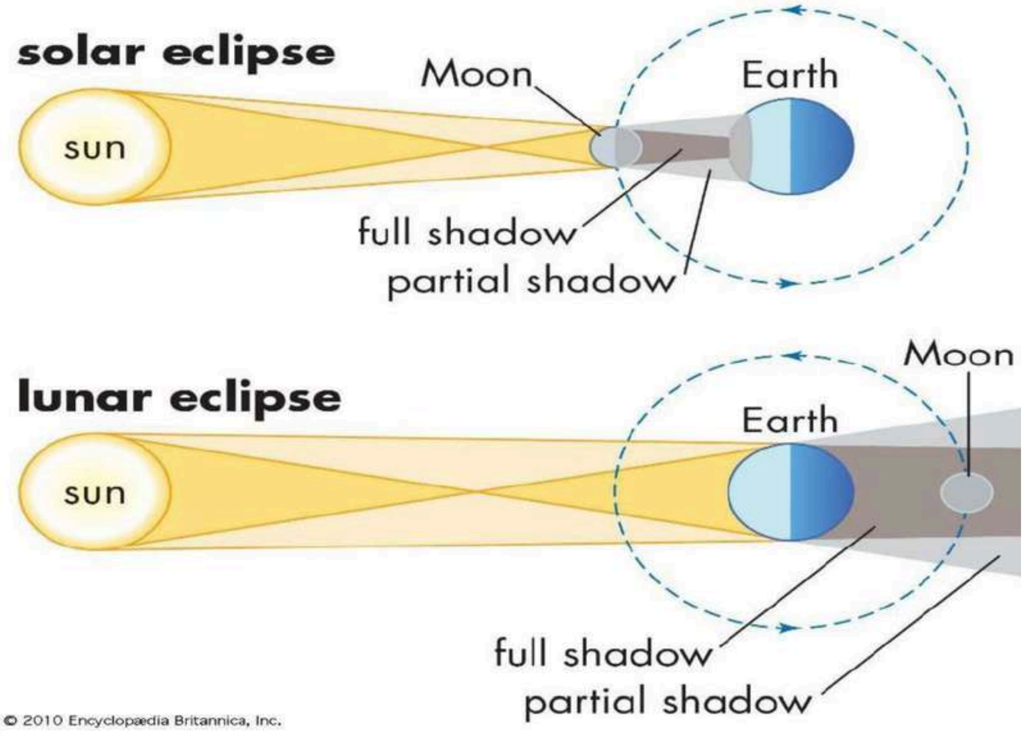
Contents

SOLAR SYSTEM

1.ECLIPSE

WHAT IS AN ECLIPSE?

An eclipse occurs when one heavenly body such as a moon or planet moves into the shadow of another heavenly body. There are two types of eclipses on Earth.



LUNAR ECLIPSE

The Moon moves in an orbit around Earth. At the same time, Earth orbits the Sun. Sometimes Earth moves between the Sun and the Moon. When this happens, Earth blocks the sunlight that normally is reflected by the Moon. (This sunlight is what causes the Moon to shine.) Instead of light hitting the Moon's surface, Earth's shadow falls on the Moon. This is an eclipse of the Moon, or a lunar eclipse. A lunar eclipse can occur only when the Moon is full.

TYPES OF LUNAR ECLIPSE

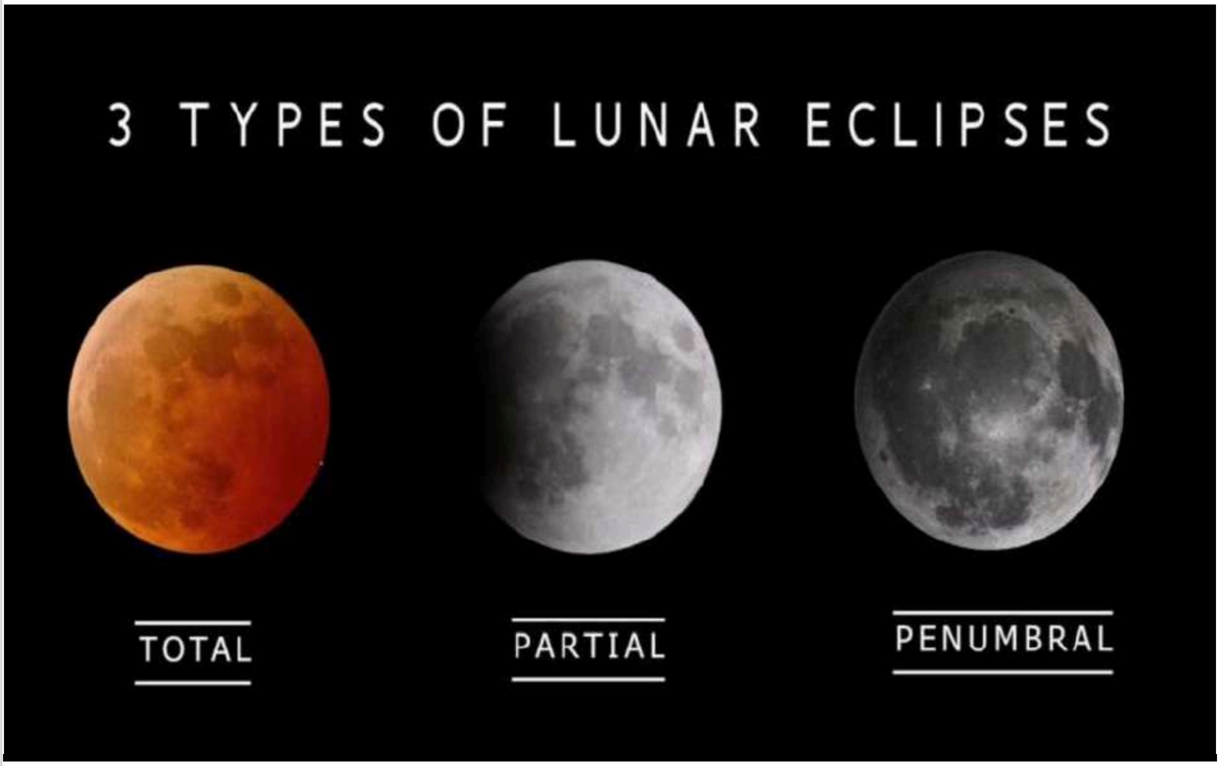
A lunar eclipse can be seen from Earth at night. There are three types of lunar eclipses:

1. Total lunar eclipse.
2. Partial lunar eclipse.
3. Penumbral eclipse.

A total lunar eclipse occurs when the Moon and the Sun are on exact opposite sides of Earth. Although the Moon is in Earth's shadow, some sunlight reaches the Moon. The sunlight passes through Earth's atmosphere, which filters out most of the blue light. This makes the Moon appear red to people on Earth.

A partial lunar eclipse happens when part of the Moon enters Earth's shadow. In a partial eclipse, Earth's shadow appears very dark on the side of the Moon facing Earth. What people see from Earth during a partial lunar eclipse depends on how the Sun, Earth and Moon align.

A penumbral lunar eclipse happens when the Moon travels through the faint penumbral portion of Earth's shadow.



What is a supermoon?

The moon's orbit around the earth is distinctly elliptical. The point when the moon is closest to the earth is called Perigee and the point when it is farthest from it is called Apogee. When a full moon occurs at its perigee, it is called a supermoon. It is a rare event, as it has to satisfy two conditions – the moon must be closest to the earth and it should be a full moon. At this point, the moon is observed to be 30% brighter and appears 14% larger.

What is a Blood Moon?

When the Moon is completely covered by Earth's shadow it will darken, but doesn't go completely black. Instead, it takes on a red color, which is why total lunar eclipses are sometimes called red or blood moons. Sunlight contains all colors of visible light. The particles of gas that make up Earth's atmosphere are more likely to scatter blue wavelengths of light while redder wavelengths pass through. This is called Rayleigh scattering, and it's why the sky is blue and sunrises and sunsets are often red. In the case of a lunar eclipse, red light can pass through the Earth's atmosphere and is refracted – or bent – toward the Moon, while blue light is filtered out. This leaves the moon with a pale reddish hue during an eclipse.

A lunar eclipse usually lasts for a few hours. At least two partial lunar eclipses happen every year, but total lunar eclipses are rare. It is safe to look at a lunar eclipse.

SOLAR ECLIPSE

Sometimes when the Moon orbits Earth, the Moon moves between the Sun and Earth. When this happens, the Moon blocks the light of the Sun from reaching Earth. This causes an eclipse of the Sun, or a solar eclipse. During a solar eclipse, the Moon casts a shadow onto Earth.

TYPES OF SOLAR ECLIPSE

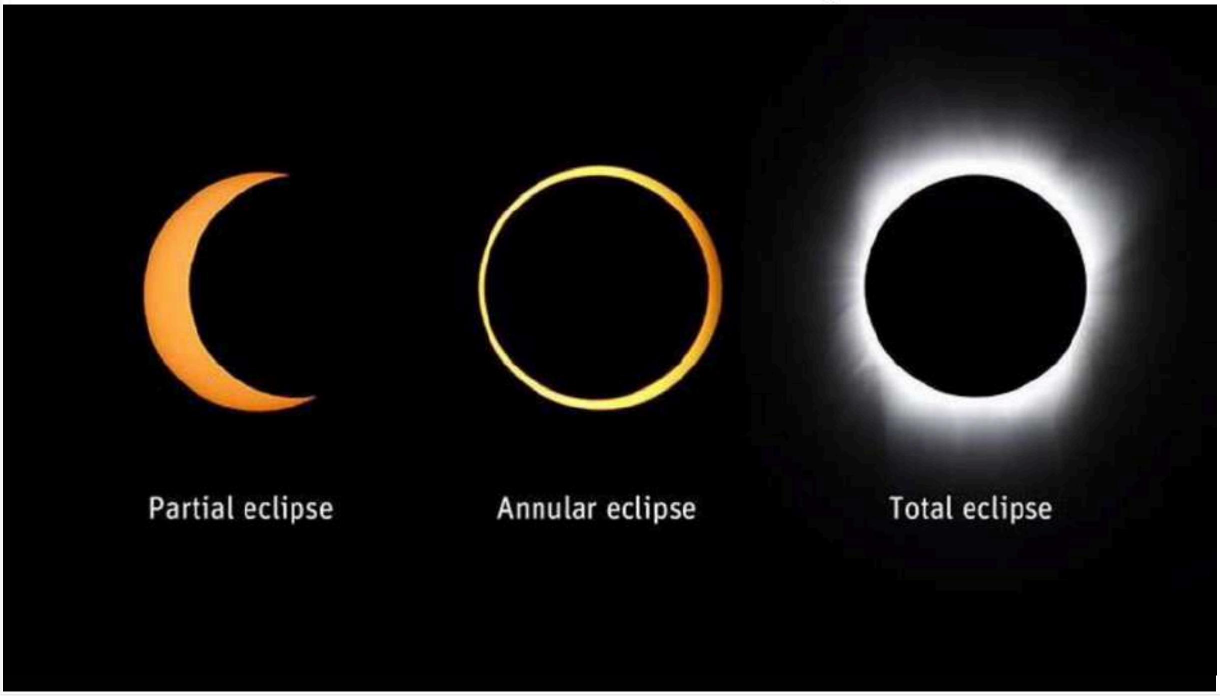
There are 4 different types of solar eclipses. How much of the Sun's disk is eclipsed, the eclipse magnitude, depends on which part of the Moon's shadow falls on Earth.

A total solar eclipse happens when the Moon passes between the Sun and Earth, completely blocking the face of the Sun. People located in the center of the Moon's shadow when it hits Earth will experience a total eclipse. The sky will darken, as if it were dawn or dusk. Weather permitting, people in the path of a total solar eclipse can see the Sun's corona, the outer atmosphere, which is otherwise usually obscured by the bright face of the Sun. A total solar eclipse is the only type of solar eclipse where viewers can momentarily remove their eclipse glasses (which are not the same as regular sunglasses) for the brief period of time when the Moon is completely blocking the Sun.

An annular solar eclipse happens when the Moon passes between the Sun and Earth, but when it is at or near its farthest point from Earth. Because the Moon is farther away from Earth, it appears smaller than the Sun and does not completely cover the Sun. As a result, the Moon appears as a dark disk on top of a larger, bright disk, creating what looks like a ring around the Moon.

A partial solar eclipse happens when the Moon passes between the Sun and Earth but the Sun, Moon, and Earth are not perfectly lined up. Only a part of the Sun will appear to be covered, giving it a crescent shape. During a total or annular solar eclipse, people outside the area covered by the Moon's inner shadow see a partial solar eclipse.

Hybrid Solar Eclipse occurs Because Earth's surface is curved, sometimes an eclipse can shift between annular and total as the Moon's shadow moves across the globe.



During a solar eclipse, the Moon casts two shadows on Earth.

1. The umbra: This shadow gets smaller as it reaches Earth. It is the dark center of the Moon's shadow. People standing in the umbra will see a total eclipse.
2. The penumbra: The penumbra gets larger as it reaches Earth. People standing in the penumbra will see a partial eclipse.

Solar eclipses happen every 18 months somewhere on Earth. Unlike lunar eclipses, solar eclipses last only a few minutes.

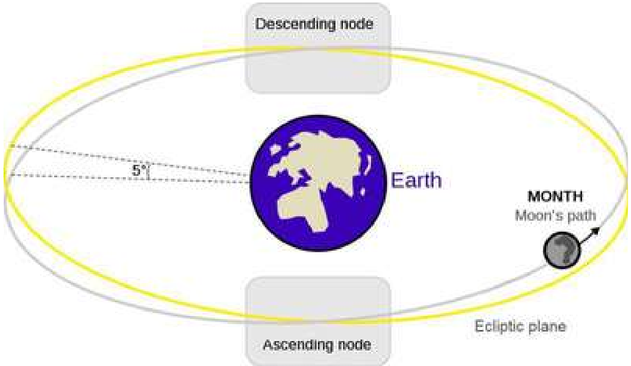
DIAMOND RING EFFECT

The diamond-ring effect occurs at the beginning and end of totality during a total solar eclipse. As the last bits of sunlight pass through the valleys on the moon's limb, and the faint corona around the sun is just becoming visible, it looks like a ring with glittering diamonds on it. It is a most lovely sight, which typically merely lasts a second or so. The highly transient diamond ring effect really shows that the universe is not as static as it looks like.

Why does every New Moon not cause a solar eclipse?

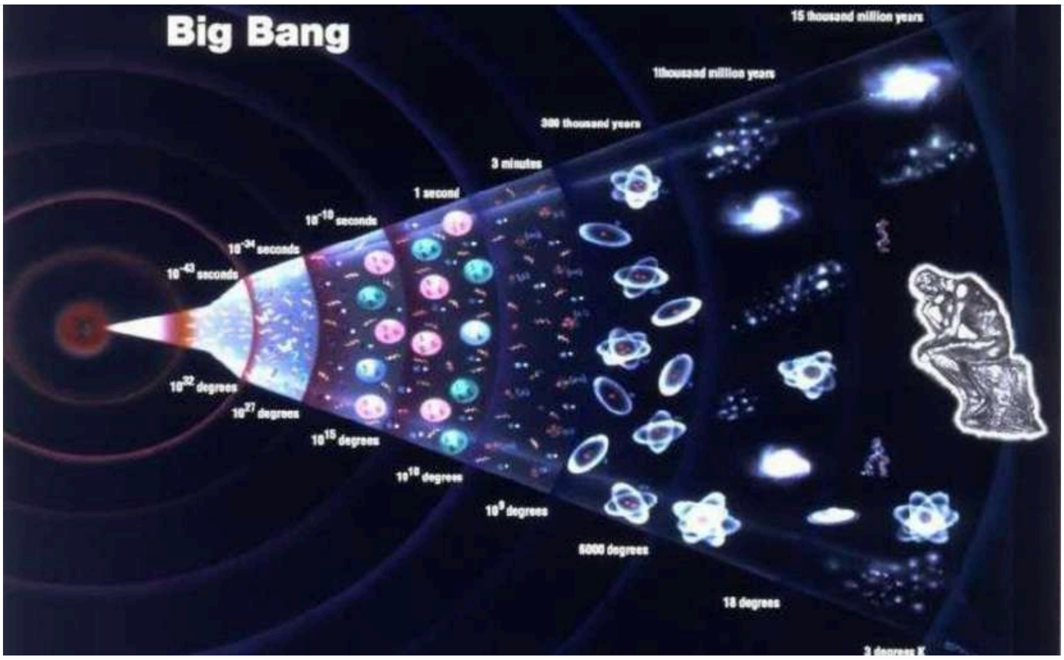
The reason is that the moon's orbit around Earth is inclined to Earth's orbit around the sun by about 5 degrees. Twice a month the moon intersects the ecliptic – Earth's orbital plane – at points called nodes. And if the moon is going from south to north in its orbit, it's an ascending node. If the moon is going from north to south, it's a descending node.

If the full moon or new moon sweeps appreciably close to one of these nodes, then an eclipse is inevitable.



2.ORIGIN OF UNIVERSE

BIG BANG THEORY



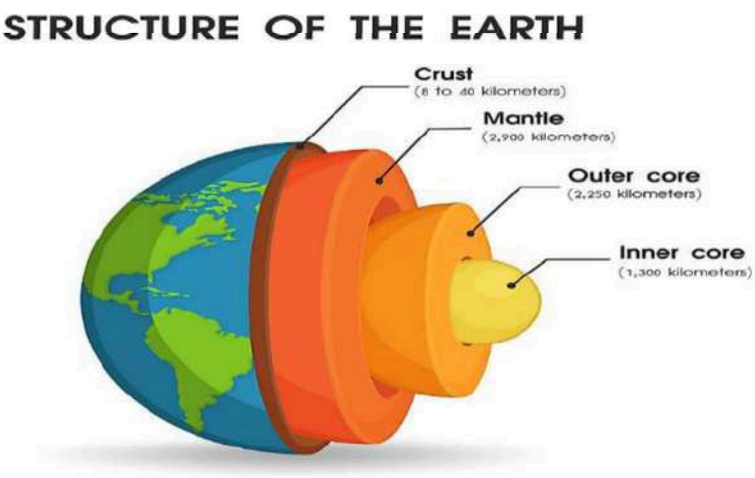
- Georges Lemaître, (1894-1966), Belgian cosmologist, stated that the expansion of the observable universe began with the explosion of a single particle at a definite point in time.
- Around 13.7 billion years ago, everything in the entire universe was condensed in an infinitesimally small singularity, a point of infinite denseness and heat.
- Suddenly, an explosive expansion began, ballooning our universe outwards faster than the speed of light. This was a period of cosmic inflation that lasted mere fractions of a second
- When cosmic inflation came to a sudden and still-mysterious end, the more classic descriptions of the Big Bang took hold. A flood of matter and radiation, known as "reheating," began populating our universe with the stuff we know today: particles, atoms, the stuff that would become stars and galaxies and so on.
- This all happened within just the first second after the universe began, when the temperature of everything was still insanely hot, at about 10 billion degrees Fahrenheit (5.5 billion Celsius).
- The cosmos now contained a vast array of fundamental particles such as neutrons, electrons and protons — the raw materials that would become the building blocks for everything that exists today.

Evolution of Earth

The earth has a layered structure. From the outermost end of the atmosphere to the centre of the earth, the material that exists is not uniform. The atmospheric matter has the least density. From the surface to deeper depths, the earth's interior has different zones and each of these contains materials with different characteristics.

Evolution of Lithosphere

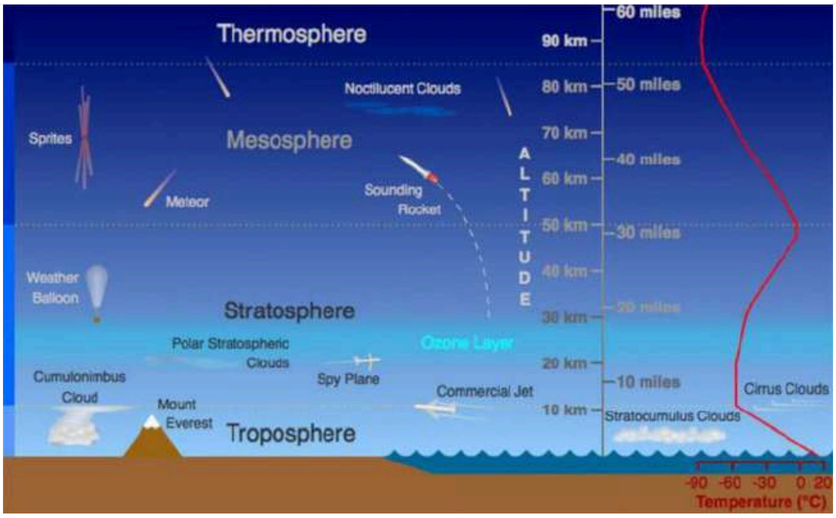
- The earth was mostly in a volatile state during its primordial stage. Due to gradual increase in density the temperature inside has increased. As a result the material inside started getting separated depending on their densities.
- This allowed heavier materials (like iron) to sink towards the centre of the earth and the lighter ones to move towards the surface. With passage of time it cooled further and solidified and condensed into a smaller size.
- This later led to the development of the outer surface in the form of a crust. During the formation of the moon, due to the giant impact, the earth was further heated up. It is through the process of differentiation that the earth forming material got separated into different layers.
- Starting from the surface to the central parts, we have layers like the crust, mantle, outer core and inner core. From the crust to the core, the density of the material increases.



Evolution of Atmosphere and Hydrosphere

- The present composition of earth's atmosphere is chiefly contributed by nitrogen and oxygen. There are three stages in the evolution of the present atmosphere.

- The first stage is marked by the loss of primordial atmosphere. In the second stage, the hot interior of the earth contributed to the evolution of the atmosphere. Finally, the composition of the atmosphere was modified by the living world through the process of photosynthesis. The early atmosphere, with hydrogen and helium, is supposed to have been stripped off as a result of the solar winds.
- This happened not only in the case of the earth, but also in all the terrestrial planets, which were supposed to have lost their primordial atmosphere through the impact of solar winds. During the cooling of the earth, gases and water vapour were released from the interior solid earth. This started the evolution of the present atmosphere. The early atmosphere largely contained water vapour, nitrogen, carbon dioxide, methane, ammonia and very little of free oxygen.
- The process through which the gases were outpoured from the interior is called degassing. Continuous volcanic eruptions contributed water vapour and gases to the atmosphere. As the earth cooled, the water vapour released started getting condensed. The carbon dioxide in the atmosphere got dissolved in rainwater and the temperature further decreased causing more condensation and more rains.
- The rainwater falling onto the surface got collected in the depressions to give rise to oceans. The earth's oceans were formed within 500 million years from the formation of the earth. This tells us that the oceans are as old as 4,000 million years. Sometime around 3,800 million years ago, life began to evolve. However, around 2,500-3,000 million years before the present, the process of photosynthesis evolved.
- Life was confined to the oceans for a long time. Oceans began to have the contribution of oxygen through the process of photosynthesis. Eventually, oceans were saturated with oxygen, and 2,000 million years ago, oxygen began to flood the atmosphere.

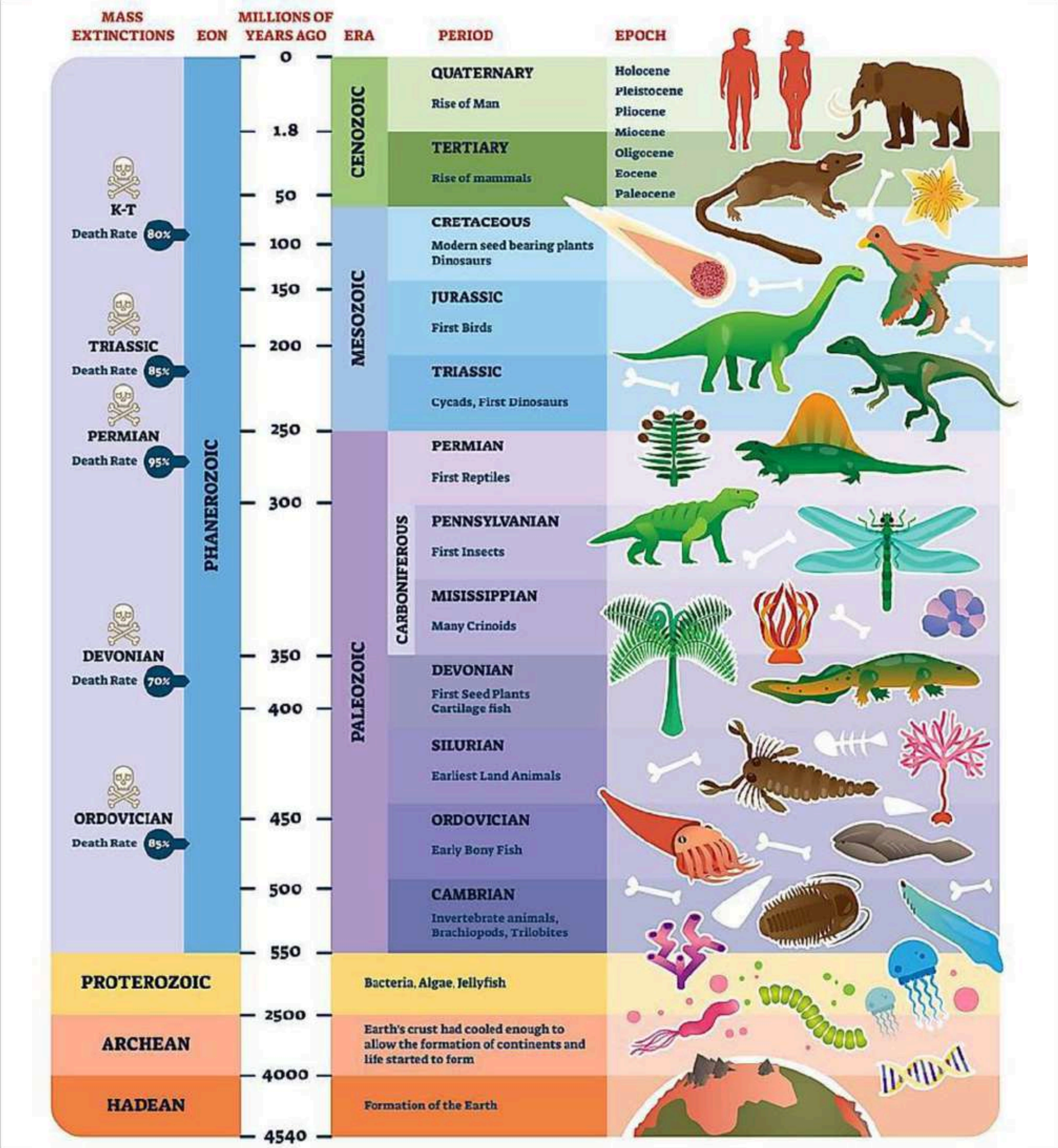


Origin of life

- The last phase in the evolution of the earth relates to the origin and evolution of life. It is undoubtedly clear that initially the earth or even the atmosphere of the earth was not conducive for the development of life.
- Modern scientists refer to the origin of life as a kind of chemical reaction, which first generated complex organic molecules and assembled them. This assemblage was such that they could duplicate themselves converting inanimate matter into living substance. The record of life that existed on this planet in different periods is found in rocks in the form of fossils.

- The microscopic structures closely related to the present form of blue algae have been found in geological formations much older than some 3,000 million years. It can be assumed that life began to evolve sometime 3,800 million years ago.
- The summary of evolution of life from unicellular bacteria to the modern man is given in the Geological Time Scale.

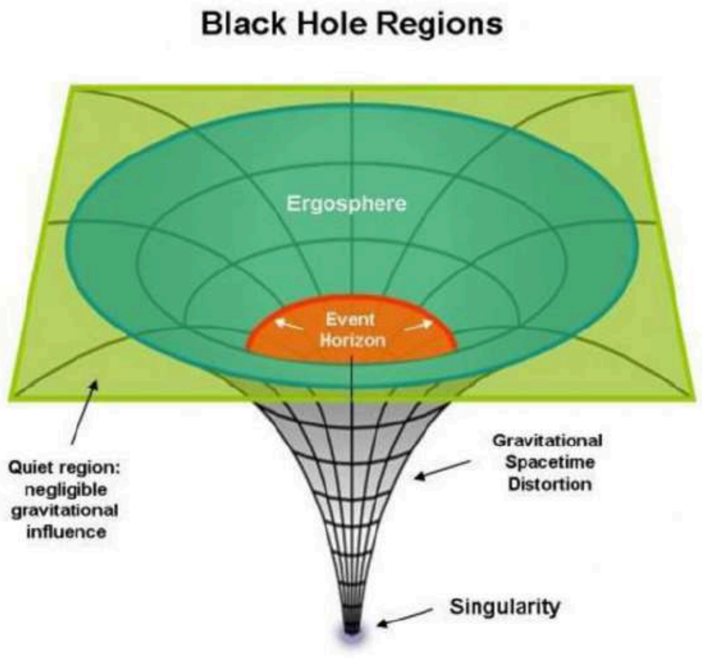
Geological time scale



What Is a Black Hole?

A black hole is a region in space where the pulling force of gravity is so strong that light is not able to escape. The strong gravity occurs because matter has been pressed into a tiny space. This compression can take place at the end of a star's life. Some black holes are a result of dying stars.

Because no light can escape, black holes are invisible.



STRUCTURE OF BLACK HOLE

- There are two basic parts to a black hole: the singularity and the event horizon.
- The event horizon is the "point of no return" around the black hole. It is not a physical surface, but a sphere surrounding the black hole that marks where the escape velocity is equal to the speed of light.
- One thing about the event horizon: once matter is inside it, that matter will fall to the center. With such strong gravity, the matter squishes to just a point – a tiny, tiny volume with a crazy-big density. That point is called the singularity. It is vanishingly small, so it has essentially an infinite density.
- It's likely that the laws of physics break down at the singularity. Scientists are actively engaged in research to better understand what happens at these singularities, as well as how to develop a full theory that better describes what happens at the center of a black hole.

How Big Are Black Holes?

Black holes can come in a range of sizes, but there are three main types of black holes. The black hole's mass and size determine what kind it is.

Primordial black holes

The smallest ones are known as primordial black holes. Scientists believe this type of black hole is as small as a single atom but with the mass of a large mountain.

Stellar black holes

The most common type of medium-sized black holes is called "stellar." The mass of a stellar black hole can be up to 20 times greater than the mass of the sun and can fit inside a ball with a diameter of about 10 miles. Dozens of stellar mass black holes may exist within the Milky Way galaxy.

Supermassive black holes

The largest black holes are called "supermassive." These black holes have masses greater than 1 million suns combined and would fit inside a ball with a diameter about the size of the solar system. Scientific evidence suggests that every large galaxy contains a supermassive black hole at its centre. The supermassive black hole at the center of the Milky Way galaxy is called Sagittarius A. It has a mass equal to about 4 million suns and would fit inside a ball with a diameter about the size of the sun.

How Do Black Holes Form?

Primordial black holes are thought to have formed in the early universe, soon after the big bang.

Stellar black holes form when the center of a very massive star collapses in upon itself. This collapse also causes a supernova, or an exploding star, that blasts part of the star into space.

Scientists think supermassive black holes formed at the same time as the galaxy they are in. The size of the supermassive black hole is related to the size and mass of the galaxy it is in.

How are black holes identified?

- A black hole can not be seen because of the strong gravity that is pulling all of the light into the black hole's center. However, scientists can see the effects of its strong gravity on the stars and gasses around it. If a star is orbiting a certain point in space, scientists can study the star's motion to find out if it is orbiting a black hole.
- When a black hole and a star are orbiting close together, high-energy light is produced. Scientific instruments can see this high-energy light.
- A black hole's gravity can sometimes be strong enough to pull off the outer gases of the star and grow a disk around itself called the accretion disk. As gas from the accretion disk spirals into the black hole, the gas heats to very high temperatures and releases X-ray light in all directions.

Could a Black Hole Destroy Earth?

Black holes do not wander around the universe, randomly swallowing worlds. They follow the laws of gravity just like other objects in space. The orbit of a black hole would have to be very close to the solar system to affect Earth, which is not likely.If a black hole with the same mass as the sun were to replace the sun, Earth would not fall in. The black hole with the same mass as the sun would keep the same gravity as the sun. The planets would still orbit the black hole as they orbit the sun now.

Will the Sun Ever Turn Into a Black Hole?

The sun does not have enough mass to collapse into a black hole. In billions of years, when the sun is at the end of its life, it will become a red giant star. Then, when it has used the last of its fuel, it will throw off its outer layers and turn into a glowing ring of gas called a planetary nebula. Finally, all that will be left of the sun is a cooling white dwarf star.

3.PLANETS IN OUR SOLAR SYSTEM

There are more planets than stars in our galaxy. The current count orbiting our star: eight. The inner, rocky planets are Mercury, Venus, Earth, and Mars. The outer planets are gas giants Jupiter and Saturn and ice giants Uranus and Neptune. Beyond Neptune, a newer class of smaller worlds called dwarf planets reign, including Pluto. Thousands more planets have been discovered beyond our solar system. Scientists call them exoplanets (exo means "from outside").

MERCURY

The smallest planet in our solar system and nearest to the Sun, Mercury is only slightly larger than Earth's Moon. From the surface of Mercury, the Sun would appear more than three times as large as it does when viewed from Earth, and the sunlight would be as much as seven times brighter. Despite its proximity to the Sun, Mercury is not the hottest planet in our solar system – that title belongs to nearby Venus, because of its dense atmosphere.

Because of Mercury's elliptical – egg-shaped – orbit, and sluggish rotation, the Sun appears to rise briefly, set, and rise again from some parts of the planet's surface. The same thing happens in reverse at sunset.

VENUS

Venus is the second planet from the Sun and is Earth's closest planetary neighbor. It's one of the four inner, terrestrial (or rocky) planets, and it's often called Earth's twin because it's similar in size and density. These are not identical twins, however – there are radical differences between the two worlds.

Venus has a thick, toxic atmosphere filled with carbon dioxide and it's perpetually shrouded in thick, yellowish clouds of sulfuric acid that trap heat, causing a runaway greenhouse effect. It's the hottest planet in our solar system, even though Mercury is closer to the Sun. Surface temperatures on Venus are about 900 degrees Fahrenheit (475 degrees Celsius) – hot enough to melt lead. The surface is a rusty color and it's peppered with intensely crunched mountains and thousands of large volcanoes. Scientists think it's possible some volcanoes are still active.

Venus has crushing air pressure at its surface – more than 90 times that of Earth – similar to the pressure you'd encounter a mile below the ocean on Earth.

Another big difference from Earth – Venus rotates on its axis backward, compared to most of the other planets in the solar system. This means that, on Venus, the Sun rises in the west and sets in the east, opposite to what we experience on Earth. (It's not the only planet in our solar system with such an oddball rotation – Uranus spins on its side.)

EARTH

Our home planet is the third planet from the Sun, and the only place we know of so far that's inhabited by living things. While Earth is only the fifth largest planet in the solar system, it is the only world in our solar system with liquid water on the surface. Just slightly larger than nearby Venus, Earth is the biggest of the four planets closest to the Sun, all of which are made of rock and metal.

MARS

Mars is the fourth planet from the Sun – a dusty, cold, desert world with a very thin atmosphere. Mars is also a dynamic planet with seasons, polar ice caps, canyons, extinct volcanoes, and evidence that it was even more active in the past.

JUPITER

Fifth in line from the Sun, Jupiter is, by far, the largest planet in the solar system – more than twice as massive as all the other planets combined.

Jupiter's familiar stripes and swirls are actually cold, windy clouds of ammonia and water, floating in an atmosphere of hydrogen and helium. Jupiter's iconic Great Red Spot is a giant storm bigger than Earth that has raged for hundreds of years.

JUNO MISSION

In Roman mythology, it's said that the mighty god Jupiter would cloak himself in clouds to hide his mischievous deeds. Only his wife, the goddess Juno, could peer through the shroud and see his true self.NASA's Juno spacecraft has certainly lived up to its namesake. By gazing beneath Jupiter's swirling bands, Juno has been able to view the planet's inner workings in a way no other probe has.

Juno seeks to understand Jupiter's past by studying its present mysteries. Using a suite of highly sensitive instruments, the probe has shed new light on Jupiter's powerful storm systems, its magnetic field and much more.

Since Jupiter is believed to be the oldest planet in our Solar System, understanding its origins and internal processes could help explain the formation of our entire cosmic neighbourhood.

When did Juno launch and when did it reach Jupiter?

Juno launched on August 5, 2011. It blasted off from the Cape Canaveral Air Force Station on board an Atlas V rocket. The spacecraft travelled roughly 3 billion kilometers (nearly 2 billion miles) before arriving at Jupiter on July 4, 2016.

What has Juno discovered so far?

In its time at Jupiter, Juno has revealed literal and figurative new depths to the gas giant. The planet's violent storms seem to be more chaotic and compelling than previously thought: for example, the spacecraft has spotted a cluster of cyclones and anti-cyclones at Jupiter's north pole. In fact, Juno has found evidence of "Earth-sized storms" at both of Jupiter's poles, according to NASA.

Although Juno can't observe Jupiter's core directly, the spacecraft has provided scientists with evidence that the planet's core is larger and "fuzzier" than previously thought. Researchers now hypothesize Jupiter has a diluted core rather than a solid, compact centre.

Juno has also detected multiple kinds of lightening on Jupiter, providing scientists with new insight into the planet's atmosphere. Juno's findings suggest that some of Jupiter's weather is radically different from Earth's; on our planet, for example, most lightning comes from water clouds. But Juno has found that at least one type of Jovian lightning is formed high up in the planet's atmosphere, where temperatures are far too cold for water. Instead, this kind of "shallow lightning" is thought to be caused by ice crystals and ammonia colliding.

When does the Juno mission end?

Although Juno's primary mission ended in July 2021, it began its extended mission the following month. During the extended mission, Juno is exploring even more of the Jupiter system, including some of the planet's most intriguing moons: Ganymede, Europa, and Io. Juno will also investigate Jupiter's atmosphere and rings in greater detail.

Juno will never return to Earth. According to NASA, Juno's mission will officially end in September 2025, or until the spacecraft can no longer function. Until then, the spacecraft will continue to send data that will undoubtedly inspire future exploration of the Jovian system.

SATURN

Saturn is the sixth planet from the Sun and the second-largest planet in our solar system. Adorned with thousands of beautiful ringlets, Saturn is unique among the planets. It is not the only planet to have rings – made of chunks of ice and rock – but none are as spectacular or as complicated as Saturn's. Like fellow gas giant Jupiter, Saturn is a massive ball made mostly of hydrogen and helium.

TITAN

Saturn's largest moon Titan is an extraordinary and exceptional world. Among our solar system's more than 150 known moons, Titan is the only one with a substantial atmosphere. And of all the places in the solar system, Titan is the only place besides Earth known to have liquids in the form of rivers, lakes and seas on its surface.

Titan is larger than the planet Mercury and is the second largest moon in our solar system. Jupiter's moon Ganymede is just a little bit larger (by about 2 percent). Titan's atmosphere is made mostly of nitrogen, like Earth's, but with a surface pressure 50 percent higher than Earth's. Titan has clouds, rain, rivers, lakes and seas of liquid hydrocarbons like methane and ethane. The largest seas are hundreds of feet deep and hundreds of miles wide. Beneath Titan's thick crust of water ice is more liquid—an ocean primarily of water rather than methane. Titan's subsurface water could be a place to harbor life as we know it, while its surface lakes and seas of liquid hydrocarbons could conceivably harbor life that uses different chemistry than we're used to—that is, life as we don't yet know it. Titan could also be a lifeless world.

URANUS

Uranus is the seventh planet from the Sun, and has the third-largest diameter in our solar system. It was the first planet found with the aid of a telescope, Uranus was discovered in 1781 by astronomer William Herschel, although he originally thought it was either a comet or a star.

NEPTUNE

Dark, cold, and whipped by supersonic winds, ice giant Neptune is the eighth and most distant planet in our solar system. More than 30 times as far from the Sun as Earth, Neptune is the only planet in our solar system not visible to the naked eye and the first predicted by mathematics before its discovery. In 2011 Neptune completed its first 165-year orbit since its discovery in 1846. NASA's Voyager 2 is the only spacecraft to have visited Neptune up close. It flew past in 1989 on its way out of the solar system.

QUESTIONS

1) What is the diamond ring effect observed during a total solar eclipse? How is it caused?
2) Astronomers have, of late, been discussing 'black hole'. What is a 'black hole'?
3)Why has Saturn's Titan been in the news recently?
4)How does the Juno mission of NASA help to understand the origin and evolution of the earth?

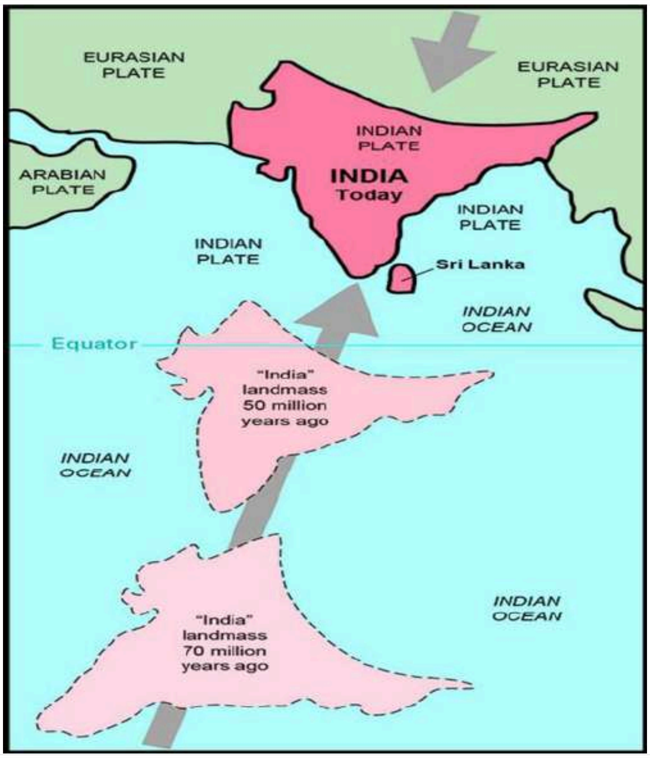
SALIENT FEATURES OF WORLD PHYSICAL GEOGRAPHY

1.HIMALAYAS

Formation of himalayas

The Himalayas: Two continents collide

- Among the most dramatic and visible creations of plate-tectonic forces are the lofty Himalayas, which stretch 2,900 km along the border between India and Tibet. This immense mountain range began to form between 40 and 50 million years ago, when two large landmasses, India and Eurasia, driven by plate movement, collided.
- Because both these continental landmasses have about the same rock density, one plate could not be subducted under the other.
- The pressure of the impinging plates could only be relieved by thrusting skyward, contorting the collision zone, and forming the jagged Himalayan peaks.
- About 225 million years ago, India was a large island still situated off the Australian coast, and a vast ocean (called Tethys Sea) separated India from the Asian continent. When Pangaea broke apart about 200 million years ago, India began to forge northward. By studying the history -- and ultimately the closing-- of the Tethys, scientists have reconstructed India's northward journey.
- About 80 million years ago, India was located roughly 6,400 km south of the Asian continent, moving northward at a rate of about 9 m a century.
- When India rammed into Asia about 40 to 50 million years ago, its northward advance slowed by about half. The collision and associated decrease in the rate of plate movement are interpreted to mark the beginning of the rapid uplift of the Himalayas.
- The Himalayas and the Tibetan Plateau to the north have risen very rapidly. In just 50 million years, peaks such as Mt. Everest has risen to heights of more than 9 km. The impinging of the two landmasses has yet to end. The Himalayas continue to rise more than 1 cm a year.



Himalaya's west to east division:

The North and Northeastern Mountains

- The North and Northeastern Mountains consist of the Himalayas and the Northeastern hills.The Himalayas consist of a series of parallel mountain ranges. Some of the important ranges are the Greater Himalayan range, which includes the Great Himalayas and the Shiwalik. The general orientation of these ranges is from northwest to the southeast direction in the northwestern part of India. Himalayas in the Darjiling and Sikkim regions lie in an east west direction, while in Arunachal Pradesh they are from southwest to the northwest direction. In Nagaland, Manipur and Mizoram, they are in the north south direction.The approximate length of the Great Himalayan range, also known as the central axial range, is 2,500 km from east to west, and their width varies between 160-400 km from north to south. It is also evident from the map that the Himalayas stand almost like a strong and long wall between the Indian subcontinent and the Central and East Asian countries.

Himalayas are not only the physical barrier, they are also a climatic, drainage and cultural divide. There are large-scale regional variations within the Himalayas. On the basis of relief, alignment of ranges and other geomorphological features, the Himalayas can be divided into the
following sub-divisions:

(i) Kashmir or Northwestern Himalayas

(ii) Himachal and Uttarakhand Himalayas

(iii) Darjiling and Sikkim Himalayas

(iv) Arunachal Himalayas

(v) Eastern Hills and Mountains.

Kashmir or Northwestern Himalayas

It comprises a series of ranges such as the Karakoram, Ladakh, Zaskar and Pir Panjal. The northeastern part of the Kashmir Himalayas is a cold desert, which lies between the Greater
Himalayas and the Karakoram ranges. Between the Great Himalayas and the Pir Panjal range,
lies the world famous valley of Kashmir and the famous Dal Lake. Important glaciers of South
Asia such as the Baltoro and Siachen are also found in this region. The Kashmir Himalayas are
also famous for Karewa formations, which are useful for the cultivation of Zafran, a local variety of saffron. Some of the important passes of the region are Zoji La on the Great Himalayas,
Banihal on the Pir Panjal, Photu La on the Zaskar and Khardung La on the Ladakh range. Some of the important fresh lakes such as Dal and Wular and salt water lakes such as Pangong Tso and Tso Moriri are also in this region. This region is drained by the river Indus, and its tributaries such as the Jhelum and the Chenab. The Kashmir and northwestern Himalayas are well-known for their scenic beauty and picturesque landscape. The landscape of the Himalayas is a major source of attraction for adventure tourists. Famous places of pilgrimage such as Vaishno Devi, Amarnath Cave, Charar -e-Sharif, etc. are also located here and a large number of pilgrims visit these places every year.

Srinagar, capital city of the union territory of Jammu and Kashmir is located on the banks
of Jhelum river. Dal Lake in Srinagar presents an interesting physical feature. Jhelum in the
valley of Kashmir is still in its youth stage and yet forms meanders – a typical feature associated
with the mature stage in the evolution of fluvial landforms.

The southernmost part of this region consists of longitudinal valleys known as 'duns'. Jammu
dun and Pathankot dun are important examples.

The Himachal and Uttarakhand Himalayas

This part lies approximately between the Ravi in the west and the Kali (a tributary of

Ghaghara) in the east. It is drained by two major river systems of India, i.e. the Indus and the Ganga. Tributaries of the Indus include the river Ravi, the Beas and the Satluj, and the tributaries of Ganga flowing through this region include the Yamuna and the Ghaghara.

The northernmost part of the Himachal Himalayas is an extension of the Ladakh cold desert, which lies in the Spiti subdivision of district Lahul and Spiti. All the three ranges of Himalayas are prominent in this section also. These are the Great Himalayan range, the Lesser Himalayas (which is locally known as Dhaoladhar in Himachal Pradesh and Nagtibha in Uttarakhand) and the Shiwalik range from the North to the South. In this section of Lesser Himalayas, the altitude between 1,000-2,000m specially attracted to the British colonial administration, and subsequently, some of the important hill stations such as Dharamshala, Mussoorie, Shimla, Kaosani and the cantonment towns and health resorts such as Shimla, Mussoorie, Kasauli, Almora, Lansdowne and Ranikhet, etc. were developed in this region.

The two distinguishing features of this region from the point of view of physiography are the 'Shiwalik' and 'Dun formations'. Some important duns located in this region are the Chandigarh-Kalka dun, Nalagarh dun, Dehra Dun, Harike dun and the Kota dun, etc. Dehra Dun is the largest of all the duns with an approximate length of 35-45 km and a width of 22-25 km. In the Great Himalayan range, the valleys are mostly inhabited by the Bhotia's. These are nomadic groups who migrate to 'Bugyals' (the summer glasslands in the higher reaches) during summer months and return to the valleys during winters. The famous 'Valley of flowers' is also situated in this region. The places of pilgrimage such as the Gangotri, Yamunotri, Kedarnath, Badrinath and Hemkund Sahib are also situated in this part.

The Darjiling and Sikkim Himalayas

They are flanked by Nepal Himalayas in the west and Bhutan Himalayas in the east. It is relatively small but is a most significant part of the Himalayas. Known for its fast-flowing rivers such as Tista, it is a region of high mountain peaks like Kanchenjunga (Kanchengiri), and deep valleys. The higher reaches of this region are inhabited by Lepcha tribes while the southern part, particularly the Darjiling Himalayas, has a mixed population of Nepalis, Bengalis and tribals from Central India. The British, taking advantage of the physical conditions such as moderate slope, thick soil cover with high organic content, well distributed rainfall throughout the year and mild winters, introduced tea plantations in this region. As compared to the other sections of the Himalayas, these along with the Arunachal Himalayas are conspicuous by the absence of the Shiwalik formations. In place of the Shiwaliks here, the 'duar formations' are important, which have also been used for the development of tea gardens. Sikkim and Darjiling Himalayas are also known for their scenic beauty and rich flora and fauna, particularly various types of orchids.

The Arunachal Himalayas

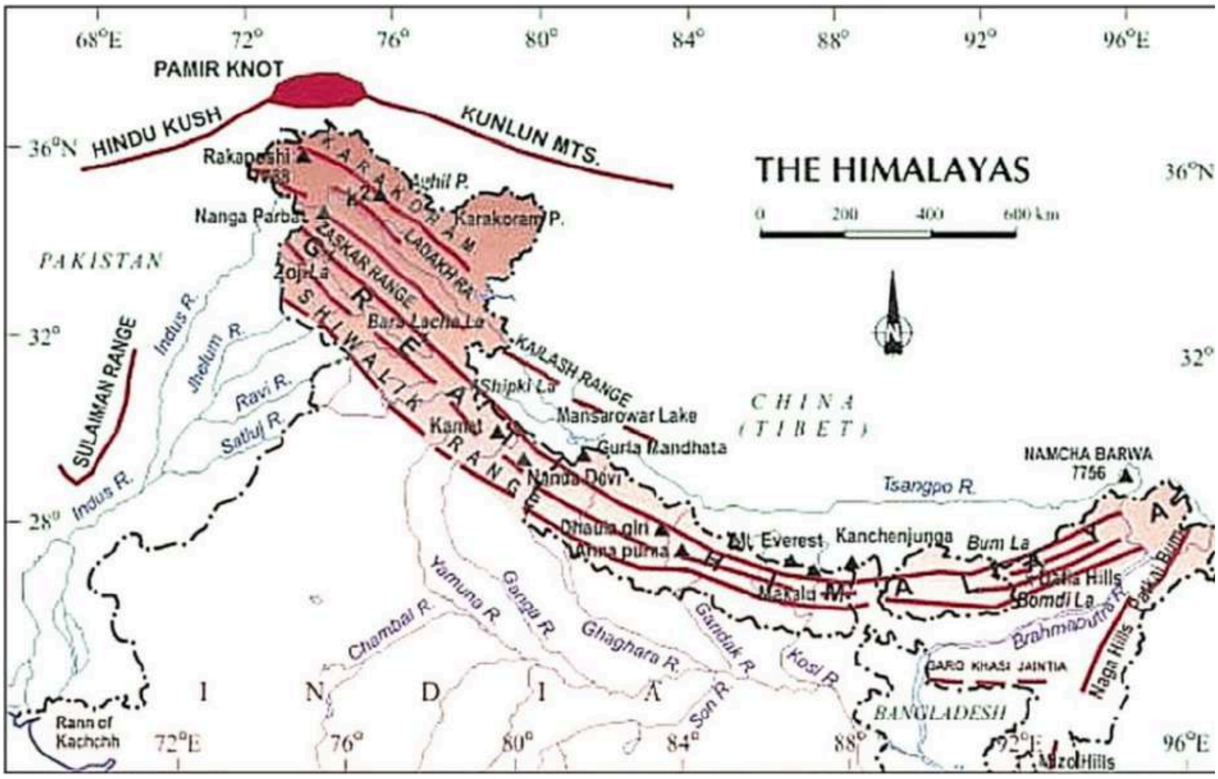
These extend from the east of the Bhutan Himalayas up to the Diphu pass in the east. The general direction of the mountain range is from southwest to northeast. Some of the important mountain peaks of the region are Kangtu and Namcha Barwa. These ranges are dissected by fast-flowing rivers from the north to the south, forming deep gorges.Bhramaputra flows through a deep gorge after crossing Namcha Barwa. Some of the important rivers are the Kameng, the Subansiri, the Dihang, the Dibang and the Lohit. These are perennial with the high rate of fall, thus, having the highest hydro-electric power potential in the country. An important aspect of the Arunachal Himalayas is the numerous ethnic tribal community inhabiting in these areas. Some of the prominent ones from west to east are the Monpa, Abor, Mishmi,Nyishi and the Nagas. Most of these communities practise Jhumming. It is also known as shifting or slash and burn cultivation. This region is rich in biodiversity which has been preserved by the indigenous communities. Due to rugged topography, the inter -valley transportation linkages are nominal. Hence, most of the interactions are carried through the duar region along the Arunachal-Assam border.

The Eastern Hills and Mountains

These are part of the Himalayan mountain system having their general alignment from the north to the south direction. They are known by different local names. In the north, they are known as Patkai Bum, Naga hills, the Manipur hills and in the south as Mizo or Lushai hills.

These are low hills, inhabited by numerous tribal groups practicing Jhum cultivation.Most of these ranges are separated from each other by numerous small rivers. The Barak is an important river in Manipur and Mizoram.The physiography of Manipur is unique by the presence of a large lake known as 'Loktak' lake at the centre, surrounded by mountains from all sides. Mizoram which is also known as the 'Molassis basin' which is made up of soft unconsolidated deposits. Most of the rivers in Nagaland form the tributary of the Brahmaputra. While two rivers of Mizoram and Manipur are the tributaries of the Barak river, which in turn is the tributary of Meghna; the rivers in the eastern part of Manipur are the tributaries of Chindwin, which in turn is a tributary of the Irrawady of Myanmar.

North to south division:



Trans-himalayas:

- Also called as tibetan himalayas
- The Zaskar, the Ladakh, the Kailas and the Karakoram are the main ranges.
- Karakoram range - adobe of some of the greatest glaciers of the world

- Mount K2-second highest peak in the world and highest in the indian union

Greater himalayas:

Also known as inner himalaya, central himalaya, or himadri

Features:

- Hog back structure
- Syntaxial bend is seen here (nanga parbat-namcha barwa)
- It has important peaks ex: himalayas
- It has important passes also ex:shipkila, baralacha la

Middle or lesser himalayas:

- Between shiwalik and greater himalayas
- Important ranges of middle himalayas are pir panjal(jammu and kashmir),dhalo dhar range(himachal pradesh), mussorie range and nag tibba range(uttarakhand),mahabharat lekh(nepal)

Shiwalikh range:

- Also known as outer himalayas
- Shiwalik range are covered by thick forest cover

ROLE OF HIMALAYAS IN INDIAN CLIMATE

Himalayas and south west monsoon:

The lofty Himalayas in the north along with its extensions act as an effective climatic divide. The towering mountain chain provides an invincible shield to protect the subcontinent from the cold northern winds. These cold and chilly winds originate near the Arctic circle and blow across central and eastern Asia. The Himalayas also trap the monsoon winds, forcing them to shed their moisture within the subcontinent.

Mechanism of Weather in the Winter Season

Surface Pressure and Winds :

In winter months, the weather conditions over India are generally influenced by the distribution of pressure in Central and Western Asia. A high pressure centre in the region lying to the north of the Himalayas develops during winter. This centre of high pressure gives rise to the flow of air at the low level from the north towards the Indian subcontinent, south of the mountain range. The surface winds blowing out of the high pressure centre over Central Asia reach India in the form of a dry continental air mass. These continental winds come in contact with trade winds over northwestern India. The position of this contact zone is not, however, stable. Occasionally, it may shift its position as far east as the middle Ganga valley with the result that the whole of the northwestern and northern India up to the middle Ganga valley comes under the influence of dry northwestern winds

Jet Stream and Upper Air Circulation :

The pattern of air circulation discussed above is witnessed only at the lower level of the atmosphere near the surface of the earth. Higherup in the lower troposphere, about three km above the surface of the earth, a different pattern of air circulation is observed. The variations in the atmospheric pressure closer to the surface of the earth have no role to play in the making of upper air circulation. All of Western and Central Asia remains under the influence of westerly winds along the altitude of 9-13 km from west to east. These winds blow across the Asian continent at latitudes north of the Himalayas roughly parallel to the Tibetan highlands. These are known as jet streams. Tibetan highlands act as a barrier in the path of these jet streams. As a result, jet streams get bifurcated. One of its branches blows to the north of the Tibetan highlands, while the southern branch blows in an eastward direction, south of the Himalayas. It has its mean position at 25°N in February at 200-300 mb level. It is believed that this southern branch of the jet stream exercises an important influence on the winter weather in India.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