Hardy Weinberg Principle-

Allele frequency in a given population.

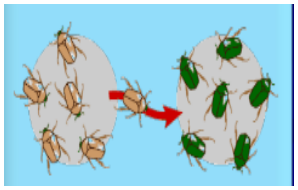
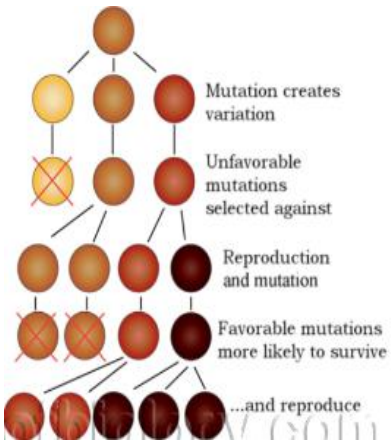
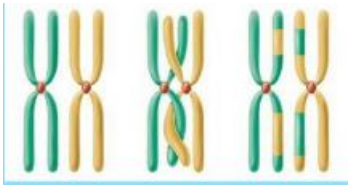
Frequency are stable from generation to generation in absence of any disturbing factors.

The gene pool (total gene and their allele in a population) remains constant. This is called genetic equilibrium and sum total of all the allelic frequencies is 1.

$(p+q)2 = p2+2pq+q2=1$ where p^2=AA, pq=Aa, q^2=aa

Change of frequency in a alleles disturbs Hardy-Weinberg equilibrium in a population resulted due to evolution.

The factors that affect Hardy-Weinberg equilibrium are-

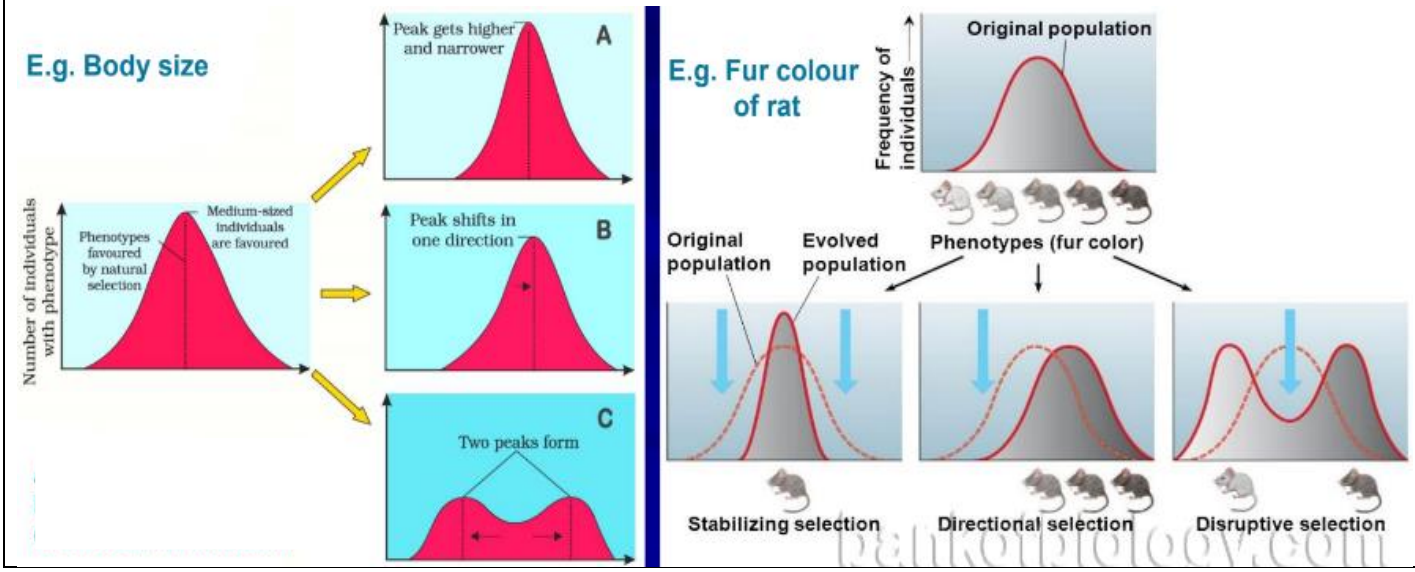
1. **Gene Migration-**	2. **Genetic Drift**	3. **Mutation**	4. **Genetic Recombination**
It is the gene flow from one population to another. Here gene frequency changes in both population Gene flow occurs if migration happens multiple times. 	Gene flow by chance causing change in  frequency. Founders effect- Sometimes, change in frequency is so different in the new sample of population that they become a different population and the original drifted population becomes founder. Founder effect 	It results in formation of new phenotypes. Over few generations, this leads to **speciation** 	It is the reshuffling of gene combinations during crossing over resulting in genetic variation 

5. Natural Selection

A: **Stabilizing**: More individual acquire mean character value & variation is reduced.

B: **Directional**: individual of one extreme (value other than mean character) value are more favoured.

C: **Disruptive**: Individual of both extremes (peripheral character value at both ends) value are favoured.



Brief Account of Evolution

- About 2000 million ago first cellular form of life appeared on earth.
- Some of the cells had ability to release O_2 as the light reaction in photosynthesis.
- Slowly single-celled organisms became multi-cellular forms and by the time 500 mya, invertebrates were formed and active.
- Jawless fish evolved around 350 mya.
- Organisms started to invade from water to land.
- **Amphibians evolved into reptiles** lay thick shelled eggs (do not dry in sun).
- **350mya** fish with stout and strong fins could move on land and go back to water called **lobefins** evolved into the first amphibians (ancestors of frog and salamanders).
- **200mya** -Some land reptiles went back into water to evolve into fish like reptiles (e.g. Ichthyosaurs).
- **Coelacanth** (Ancestor of Amphibian thought to extinct) – 1938 found in South Africa.
- **Continental Drift**-
    1) Animals were overridden by North American fauna (South America joined North America)
    2) Pouched mammals of Australia survived because of lack of competition from any other mammal.
- Mammals is water - Whales, dolphins, seals and sea cows.
- Geological period divided into 4 eras:

1. Proterozoic
2. Palaeozoic
3. Mesozoic
4. Cenozoic

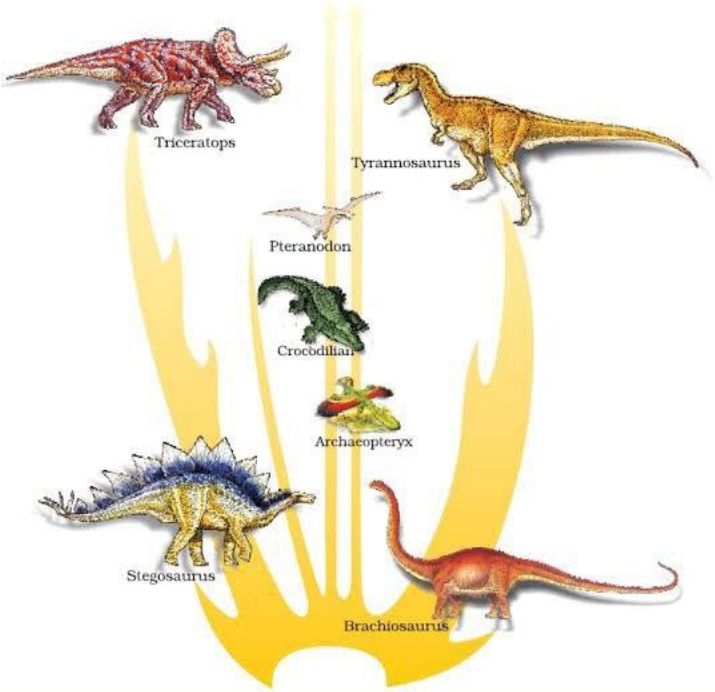


Figure 7.2 A family tree of dinosaurs and their living modern day counterpart organisms like crocodiles and birds

Important Points:

- **Brachiosaurus:** Earliest Dinosaurs, Tall (12-18m), Herbivores
- **Tyrannosaurus rex** -20feet long, Carnivores and had huge dagger like teeth
- **Archeopteryx-** Connecting link between reptiles and Animals.
- Stegosaurus – Herbivores, Small Brain, Kite shape plate at back & Spikes on Tail
- Triceratops- 3 horns, a parrot-like beak , herbivores
- Crocodilian: living fossils bridging the gap between dinosaurs and modern aquatic reptiles.
- Pteranodon- flying reptile

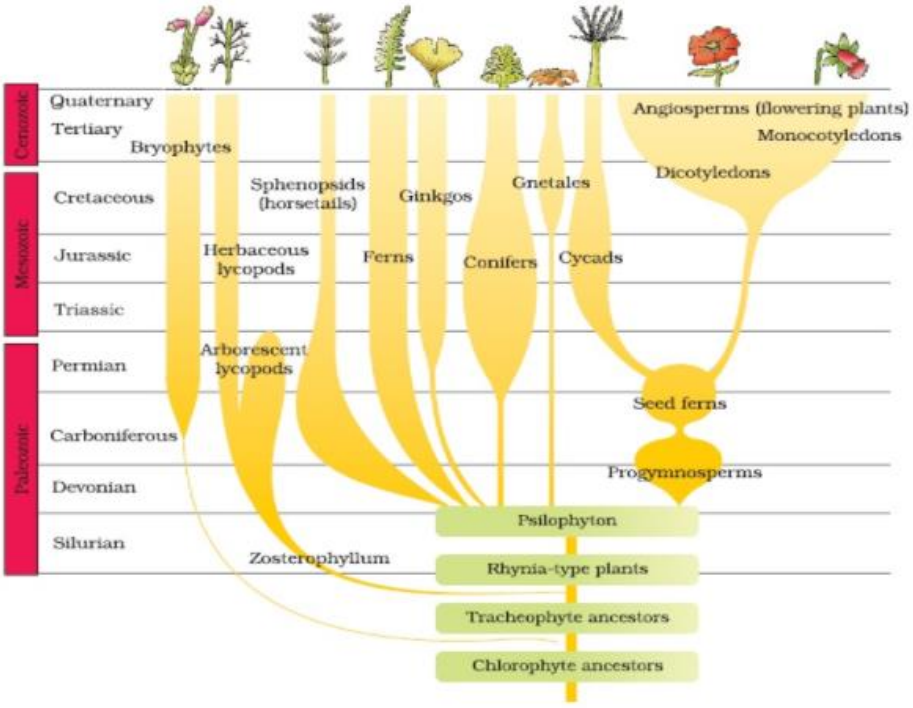


Figure : A sketch of the evolution of plant forms through geological periods

Important Points:

- **Psilophyton**- Ancestors of Pteridophytes, Gymnosperm and Angiosperm.
- Giant ferns (pteridophytes) to form coal deposits.
- Chlorophyte ancestors -aquatic green algae that gave rise to all green plants (i.e. Bryophytes and Tracheophytes).

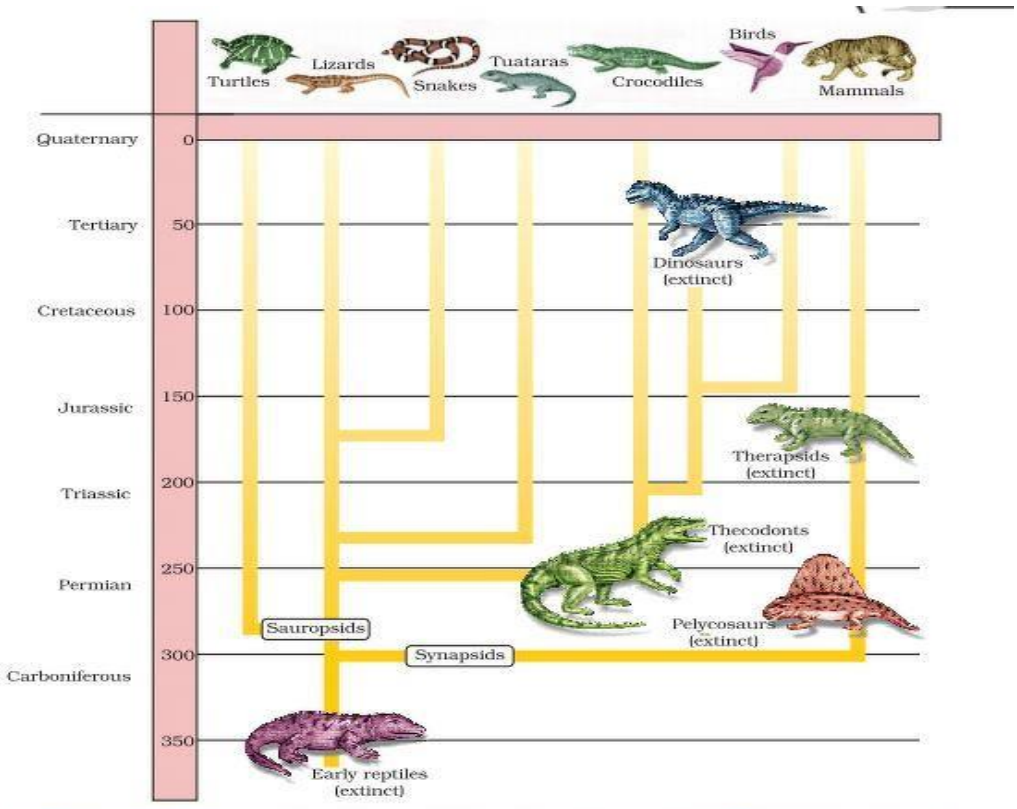


Figure 7.10 Representative evolutionary history of vertebrates through geological period

Important Points:

- There were 5 major mass extinctions on earth :

1. **Ordovician-Silurian Extinction** (around 445 million years ago)
2. **Late Devonian Extinction** (around 375 million years ago)
3. **Permian-Triassic Extinction** (also known as the Great Dying, around 252 million years ago)
4. **Triassic-Jurassic Extinction** (around 201 million years ago)
5. **Cretaceous-Paleogene Extinction** (around 65-66 million years ago)

- 6^{th} Extinction is on going also know as Holocene or Anthropocene Extinction- it is 100-1000 times faster than all other extinctions due to human activities.
- **Sauropsids (**ancestor of reptiles) evolved into modern Reptiles, Birds and Mammals.
- **Synapsids-** ancestors of Mammals
- Thecodont – Teeth fixed in sockets. Ancestor of Crocodile Birds and Dinosaurs
- In Mesozoic era Reptiles-**Dinosaurs-** dominated earth.
- 65 mya **Dinosaurs** disappeared suddenly may be due to climatic changes or evolved into birds
- Small sized reptiles of that era still exist today.
- South America mammals were resembling horse, hippopotamus, bear, rabbit, etc
- The first mammals were like shrews (small sized)
- Mammals were viviparous, intelligent in sensing & avoiding danger.

Origin and Evolution of Man

Man belongs to the family Hominidae of the order Primates. Apes belong to the same order.
The skull of baby chimpanzee is more like adult human skull than adult chimpanzee skull.

Mnemonic: DOCTOR RAM ARRIVE HOME EARLY NANNY SHOUTED

	Period	**Characteristics**
Dryopithecus (**More like Ape**)	15mya	• Earliest known ancestor of Man & Ape. • Hairy and walk like Gorillas & Chimpanzees. • Originated in Africa and migrated to Asia, and Europe. • Inhabited were in densely forest & were herbivores
Ramapithecus/ Sivapithecus (**More like Man**)	15-5.3mya	• Discovered from the Shivalik & later in Africa and Saudi Arabia. • Lived in open grasslands. • Usage of hands for food and defence and extrapolations of upright posture.
Australopithecus	4-2mya	• 4 feet tall and walk erect. • Found in East African Grassland. • They had large jaws and human-like teeth. • Used stones weapons but ate fruits. • Fossils (man-like bones) discovered in African (Ethiopia & Tanzania)
Homo habilis	2mya	• First Human like being-**Hominidae** • Brain size- 650-800cc. • Did not eat meat. • They were five feet tall and could make use of tools. They are believed to have been able to speak.
Homo erectus	1.5 mya	• They were more evolved beings. • Brain size- 900cc. • They had a prominent speech. • Eat Meat. • Fossils discovered in Java in 1891
Neanderthals	1 Lakhs To 40 thousands	• Lived near east &. central Asia • Brain Size – 1400cc • They used hides to protect their body and buried their dead.

	Year Back	
Homo sapiens:	75,000-10,000 Years ago (Ice Age)	• These are modern men. They developed the power of thinking, used tools, were omnivorous, and produced art. • Arose in Africa migrated and developed into distinct races • Brain size was reduced to 1300 cc. • Pre-historic cave art developed about 18,000 years ago. Bhimbetka Rock Shelter – Raisen District Madhya Pradesh) • Agriculture came 10,000 years back and human settlements started.

1. In the Caucasian population of the US, 1 in 2500 babies is affected by a recessive condition – cystic fibrosis. In this population, the frequency of the dominant allele is

(a) 0.02 (b) 0.36 (c) 0.56 (d) 0.98

2. A sampled "a" population has 36% of homozygous recessive genotype (aa). Then the frequency of allele "a" is

(a) 0% (b) 20% (c) 60% (d) 70%

3. 360 out of 1000 individuals in a population have a genotype of AA while 480 have Aa genotype. The rest 160 belong to aa. Frequency of allele A in this population is

(a) 0.7 (b) 0.6 (c) 0.5 (d) 0.4

4. A gene locus has two alleles A and a. If the frequency of dominant allele A is 0.4, then the frequency of homozygous dominant, heterozygous and homozygous recessive individuals in the population is

(a) 0.16(AA); 0.48(Aa); 0.36(aa) (b) 0.16(AA); 0.24(Aa); 0.36(aa)
(c) 0.16(AA); 0.36(Aa); 0.48(aa) (d) 0.36(AA); 0.48(Aa); 0.16(aa)

5. Consider a population of sheep to be in Hardy-Weinberg equilibrium. The allele for black wool(w) has an allele frequency of 0.81 while the allele for white wool(W) has an allele frequency of 0.19. Then the percentage of heterozygous individuals in the population is

(a) 4% (b) 15% (c) 31% (d) 66%

6. 25 individuals in a population are homozygous dominant, then the individuals that are expected to be homozygous recessive are

(a) 100 (b) 75 (c) 50 (d) 25