

# Evolution

V Sem B.Sc. Zoology – Core Course VII – Ethology, Evolution  
& Zoogeography

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# EVIDENCES FROM COMPARATIVE PHYSIOLOGY AND BIOCHEMISTRY

# INTRODUCTION

- \* CHEMICAL COMPOSITION OF PROTOPLASM
- \* NUCLEIC ACIDS – DNA
- \* DIGESTIVE ENZYMES
- \* HORMONES
- \* DISTRIBUTION OF PHOSHAGENS
- \* SEROLOGICAL TESTS
- \* BLOOD GROUPS
- \* EXCRETORY PRODUCTS ANALYSIS
- \* VISUAL PIGMENTS
- \* HOST PARASITIC RELATIONS
- \* BIOCHEMICAL PROCESSES

# CHEMICAL COMPOSITION OF PROTOPLASM

- \* Body of all living organism made of common substance – **PROTOPLASM**
- \* The physical basis of life
- \* Each cell – small portion – same qualitative and quantitative composition from virus o man.
- \* C,H,O<sub>2</sub>,N,P,S,etc. incorporated into organic and inorganic compounds of protoplasm – carbohydrates, lipids, proteins, nucleic acids, water and minerals.
- \* Elements and compounds – common to all cells – suggesting common ancestry.

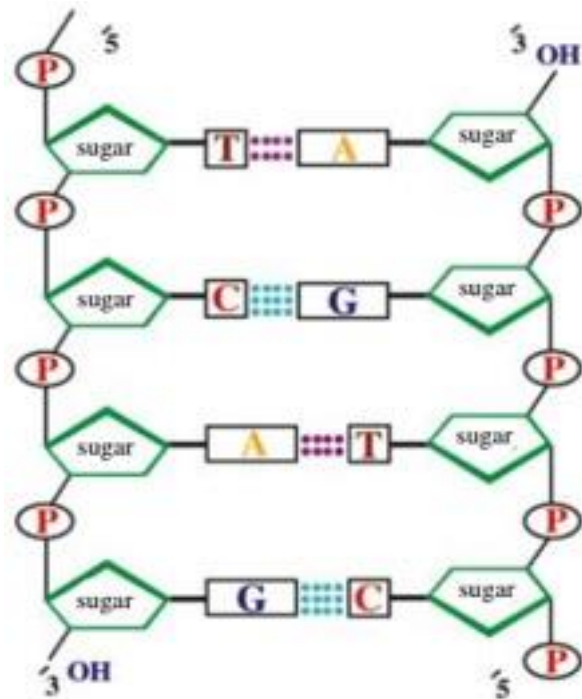
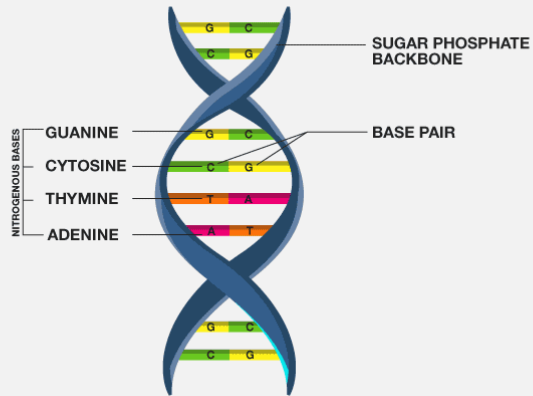
# NUCLEIC ACIDS – DNA

- \* Chromosomes and genes – physical basis of heredity
- \* DNA & RNA made up of proteins and nucleic acids
- \* Structure of nucleic acids same from virus to plants and animals.
- \* Genetic information for all life activities is coded in the arrangements of bases, sugar and phosphate molecules

# NUCLEIC ACIDS – DNA

## DNA STRUCTURE

BYJU'S  
The Learning App



# NUCLEIC ACIDS – DNA

- \* Similarity between DNA of two species was estimated by Hoyer and coworkers in 1964-65
- \* Split DNA into two strands – single stranded DNA was broken into small fragments – brought into contact with DNA of another species
- \* Fragments with complementary base pairs formed double helix
- \* Greater the pairing greater the similarity between species.

# NUCLEIC ACIDS – DNA

it is assumed that the greater the degree of pairing between the DNA bases of species A and B, the closer the similarity between the genetic messages contained in the DNA's of the two species (Fig. 2:10)

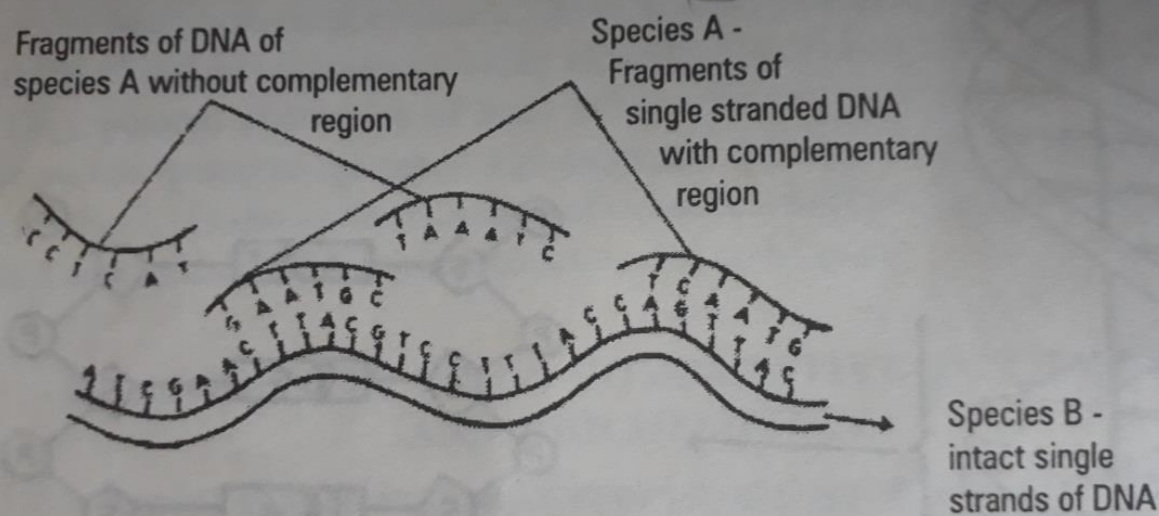
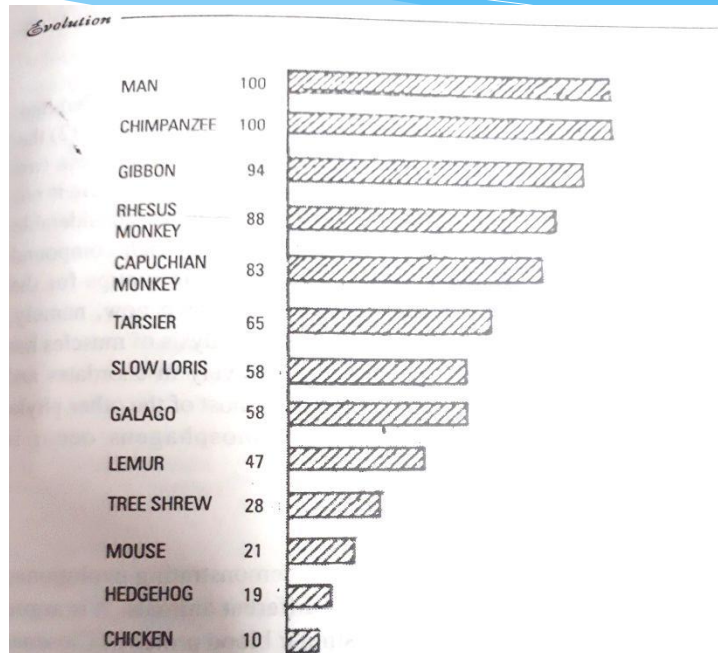


Fig. 2.10. Experiment to test the similarities between DNAs derived from different species.

The DNA similarities can be used to find out phylogenetic relations



# DNA SIMILARITIES TO FIND PHYLOGENETIC RELATIONSHIPS



**Fig. 2.11.** Relative similarity of human DNA to that of other animals.

different animals. For example, hormones extracted from the thyroid gland of cattle can be effectively used in the treatment of human thyroid deficiencies. This hormone is also essential for the metamorphosis of a tadpole. If a tadpole's thyroid gland is surgically removed, it will not metamorphose.

# DIGESTIVE ENZYMES

- \* Certain digestive enzyme has similar structure and function in different animals
- \* Trypsin – protein digesting enzyme from Protists to man.
- \* Amylase – starch – sponges to mammals.
- \* Common ancestry

# HORMONES

- \* Hormones produce similar effect in widely different animals
- \* Thyroid hormones of cattle used for treating human thyroid problems
- \* Essential for metamorphosis of frog tadpoles – surgically removed – given cattle or sheep thyroid hormones – metamorphosis occurs.

# DISTRIBUTION OF PHOSHAGENS

- \* Phosphagens – energy rich compound present in muscles – provide functional phosphate groups for ATP production
- \* Two types – phosphocreatine and phosphoarginine
- \* Phosphocreatine – chordates and Echinoderms
- \* Phosphoarginine – annelids, molluscs, arthropods, ec.

# SEROLOGICAL TESTS

- \* Comparing blood protein of different animals
- \* Phylogenetically similar species have similar blood proteins
- \* Antibodies – Antigens
- \* Human serum injected – rabbit body – antibodies against antigens in human serum. Serum containing such antibodies – **ANTISERUM**
- \* **Precipitin test** – antiserum mixed with human serum in test tube – antigen-antibody reaction occurs – a soft white precipitate
- \* Amount of precipitate – degree of similarity

# SEROLOGICAL TESTS

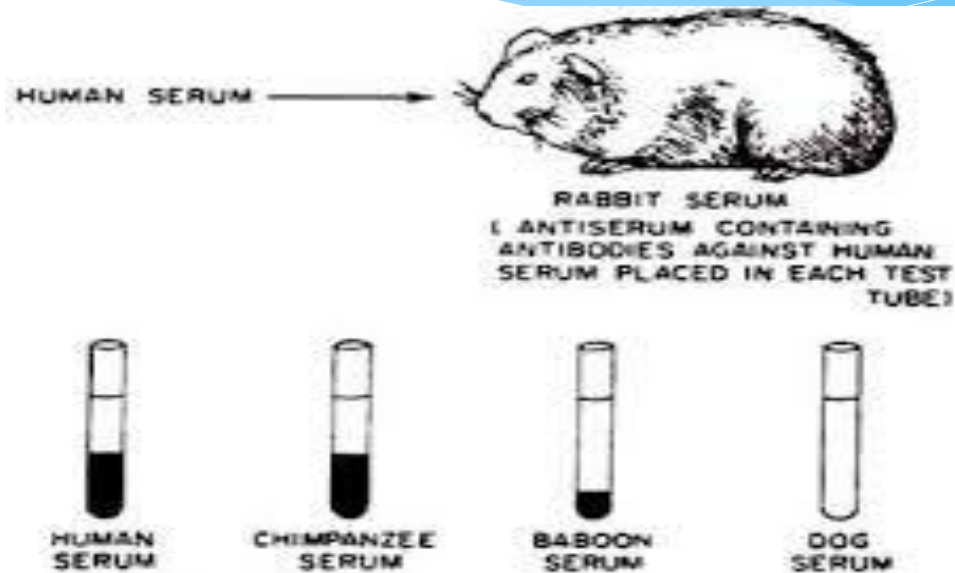


Fig. 1.14. Precipitin test to investigate animal relationship.

# BLOOD GROUPS

- \* Human blood groups – 4 – A, B, AB & O
- \* Based on two Antigens A & B –
- \* A – A, B – B, AB – A&B & O – no antigen
- \* Controlled by genes inherited in Mendelian fashion but a little bit complicated form of Multiple alleles
- \* ABO system present in Man and other primates but absent in non primates.

# EXCRETORY PRODUCTS ANALYSIS

- \* Nitrogenous excretory products – urea, uric acid and ammonia
- \* Aquatic animals – fishes & invertebrates- ammonia
- \* Urea – aquatic and land animals – fishes, amphibians, mammals.
- \* Uric acid – land animals – insects, reptiles and birds
- \* Tadpole – ammonia; Frog – urea – land animals evolved from aquatic animals
- \* Early stages of development chick embryo – ammonia, then urea and later uric acid – aquatic ancestry of land vertebrates



# VISUAL PIGMENTS

- \* Visual pigments – rods of retina
- \* Visual purple – Porphyropsin
- \* Visual Red – Rhodopsin
- \* Fresh water fishes – Porphyropsin
- \* Marine and land vertebrates - Rhodopsin
- \* Aquatic origin of land vertebrates
- \* Amphibians and Salmons – Porphyropsin early life – undergo metamorphosis - Rhodopsin
- \* Salmons later on comes to Freshwater it again changes

# HOST PARASITIC RELATIONS

- \* Host parasite relationship – closely related species often attacked by similar diseases
- \* Virus polio in man – same disease in apes – not in other vertebrates

# BIOCHEMICAL PROCESSES

- \* Physiological and biochemical processes identical in most organisms
- \* Glycolysis and Krebs cycle
- \* Release of ATP energy
- \* Basically similar in all organism
- \* Shows common origin

