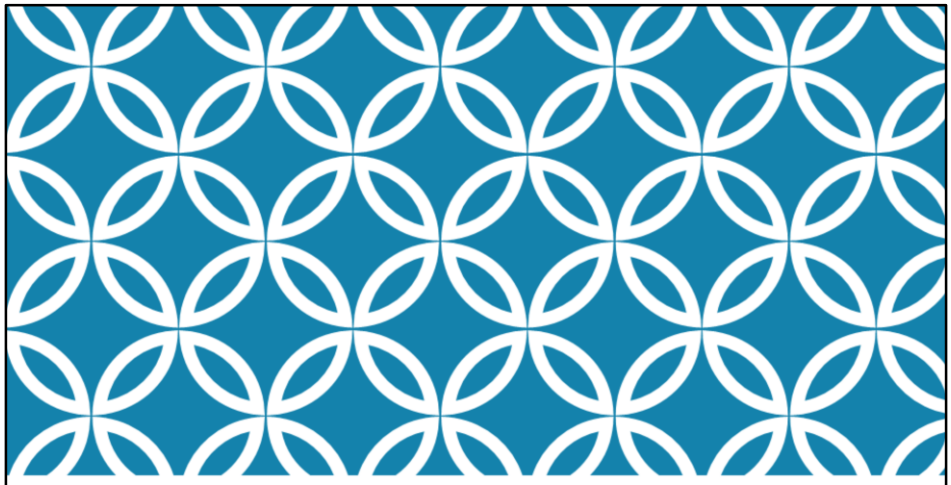
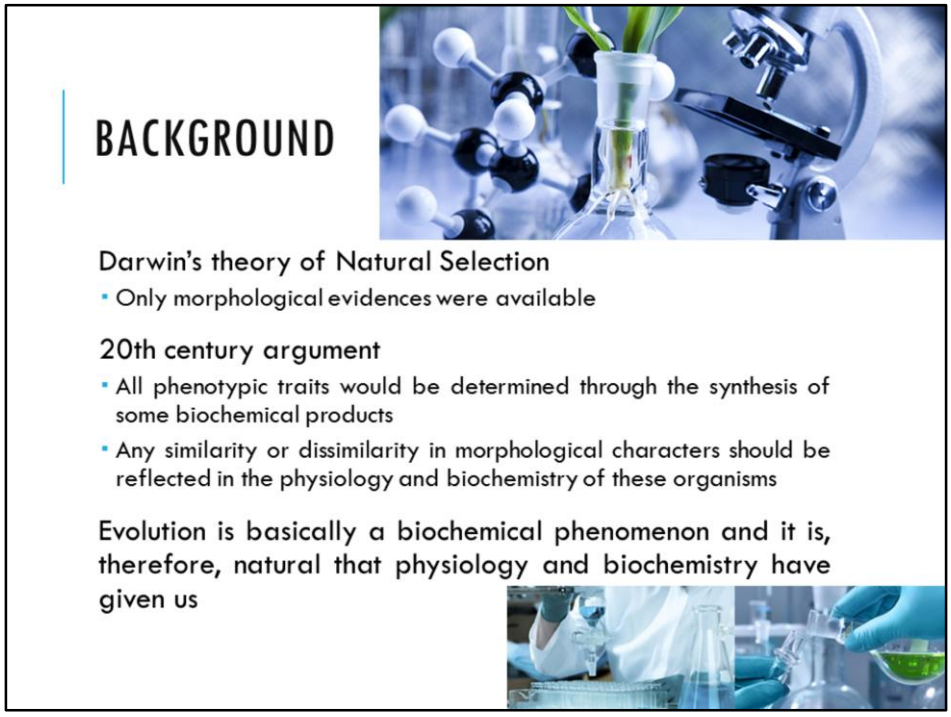


EVIDENCE OF EVOLUTION

From Biochemistry and Physiology



At the time when Darwin proposed his theory of Natural Selection for evolution, only morphological evidences were available to explain organic evolution.

SIMILARITY IN CHEMICAL COMPOSITION

Biochemical study of the living matter in the protoplasm

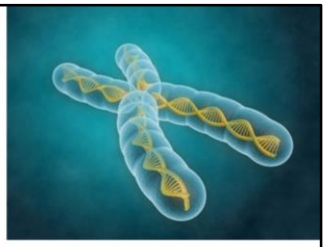
- From variety of sources (including organisms as diverse as plants and animals) has the same biochemical constitution
- Four major elements like C, H, O, N form organic compounds
- C, H, O combine to form carbohydrates and fats and with N to form proteins

The most fundamental property (Cells) of living things has remained intact, while variations in essential respects produced the variability

SIMILARITY IN VITAL LIFE PROCESSES

- Cell Division
  - Uniformity is seen in the universality of mitosis in all cellular organisms
  - The similarity of meiosis in all sexually reproducing organisms
- Metabolism, is the set of life-sustaining chemical transformations within the cells of living organisms. The metabolism of very different organisms is based on the same biochemistry
  - The protein cytochrome c is needed for aerobic respiration, is universally shared in aerobic organisms
  - The more similar molecules found in organisms that appear more related (monkeys and cattle) than between those that seem less related (monkeys and fish)
- The use of ATP by all organisms for energy transfer
- The fact that almost all plants use the same chlorophyll molecule for photosynthesis.

CHROMOSOME CHEMISTRY



The chromosomes of all living organisms basically consist of nucleoproteins.

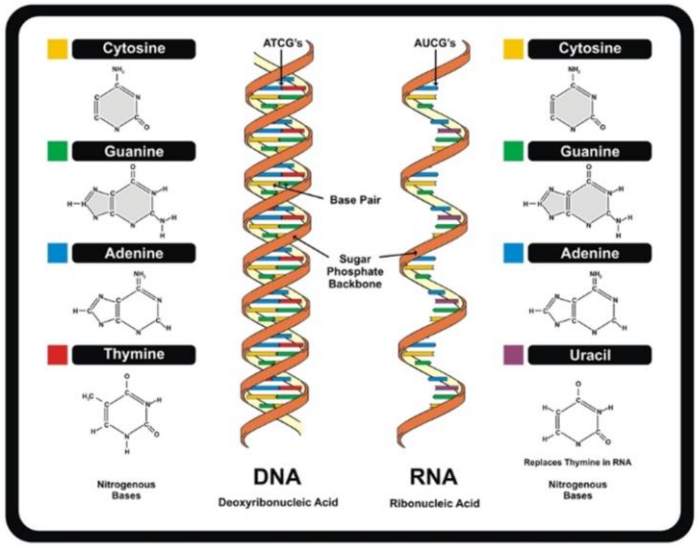
- The nucleic acid is essentially deoxyribonucleic acid (DNA) and proteins are essentially histones and protamines.
- Other kinds of proteins like globulins and some amount of RNA are also found.

Different groups of living organisms thus vary mainly in the sequences of nucelotides in the DNA of the chromosomes

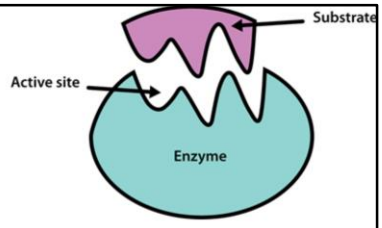
- the synthesis of a variety of proteins, controls the phenotypic characters

Such a high degree of uniformity in the composition of chromosomes again suggests a common origin. Different groups of living organisms thus vary mainly in the sequences of nucelotides in the DNA of the chromosomes. This then, through the synthesis of a variety of proteins, controls the phenotypic characters.

CHROMOSOME CHEMISTRY



ENZYMES AND HORMONES



Large groups of animals and plants→ Identical enzymes and hormones available

Several enzymes found in the digestive tract are common in a variety of animals.

- Trypsin and amylase are found in a wide variety of animals.
- Trypsin is found in animals ranging from protozoa to Mammalia, while amylase is found from sponges to Mammalia.

A number of enzymes used in photosynthesis are common in a variety of plants.

- Such common enzymes and consequently common mechanism of the process of **photosynthesis** suggest a common, ancestry of green plants

ENZYMES AND HORMONES

A number of hormones which throw light on the organic evolution

- Thyroid hormone is common in all vertebrates
- This hormone from one class of organisms can be substituted for that in another class of organisms

Another interesting example is that of **melanophore,** expanding hormon of amphibians.

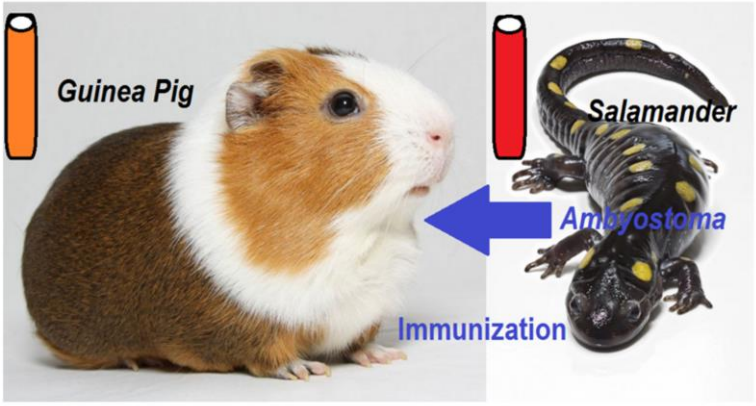
- Found in mammals also, but has no known effect there
- Melanophore, extracted from mammalian pituitary glands, supplied to amphibians, is as effective as the amphibian melanphore
- The enzyme in mammals does not have any known function and is only found as a vestigial of the amphibian ancestry

For the treatment of human thyroid deficiency, beef thyroid has been successfully used. Also, in case thyroid gland of frog, if surgically removed at a young stage, frog will not metamorphose, but if it is again fed with thyroid tissue from mammals, the metamorphosis can be easily brought about.

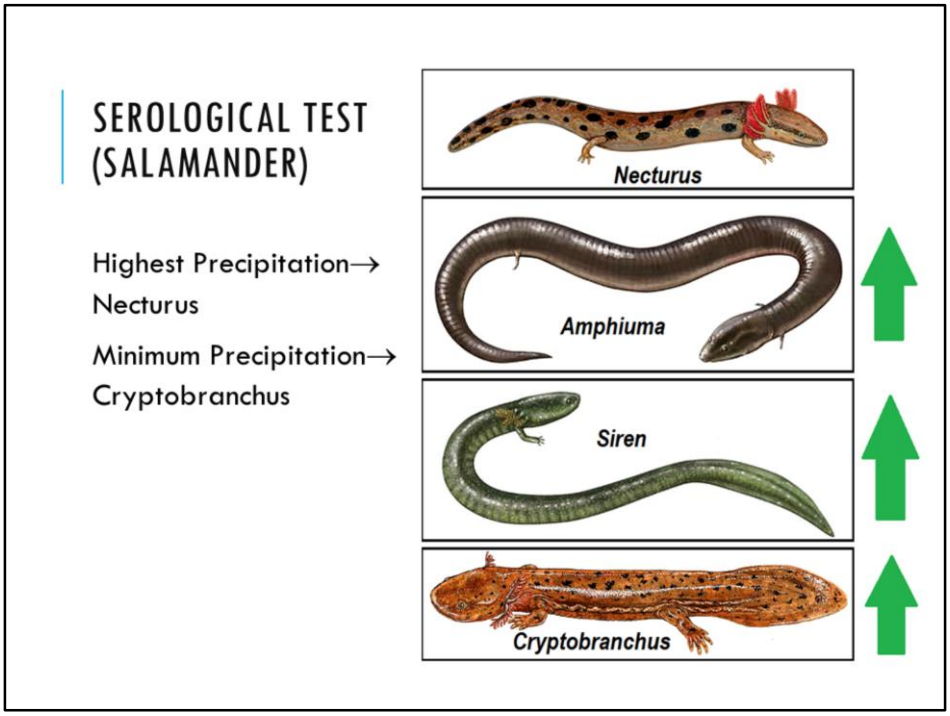
SEROLOGICAL TESTS

- A small amount of blood serum from an animal is injected into the blood of guinea pig or any other animal
- Antibodies against the antigens of injected blood will be produced
- These antigens will be destroyed now by antibodies thus produced in the blood stream as well as in a test tube
- The relative degrees of precipitation of antigens of the serum from a group of animals will give an idea about the degree of relatedness between them

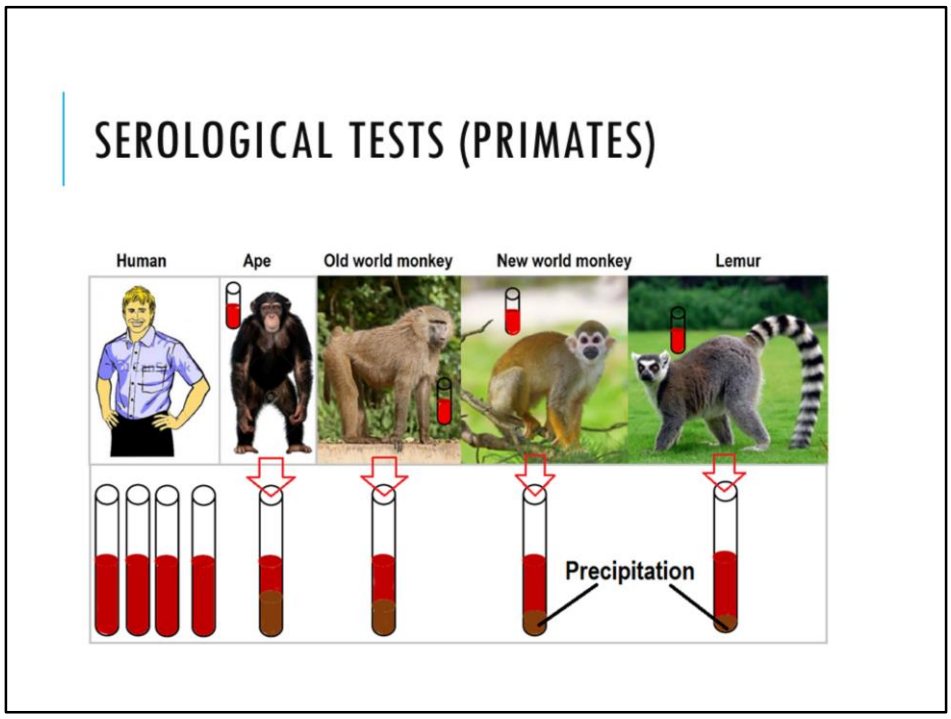
SEROLOGICAL TEST (SALAMANDER)



Suppose a guinea pig is immunized against the blood of *a* salamander *(Ambiostoma).* The serum of this blood is taken in four test tubes, and antigen serum is added from four different groups namely *Necturus, Amphiuma, Siren* and *Cryptobranchus.*

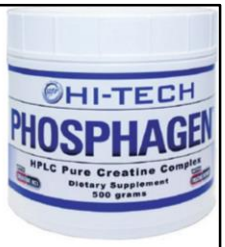


The highest precipitation occurs in test tube, where *Necturus* serum is added and the minimum precipitation occurs in the one where *Cryptobranchus* serum is added. *Amphiuma* and *Siren* are closely related to each other but distantly related to much more primitive salamander *Cryptobranchus.*



In another test, blood serum immunized against human blood is divided in five parts and antigen serum from man, an ape, an old world monkey, a new world monkey and a lemur is added. The degree of precipitation decreased in the order in which these five names are given above. Such results are in complete conformity with the conclusions reached through comparative morphology.

PHOSPHAGENS



Phosphagens
- Play a key role in muscle contraction and are
- The source of energy for the resynthesis of ATP, once it is broken down.

Categories
- Phosphogene of most vertebrates- **Creatine phosphate**
- In most invertebrates- **Arginine phosphate**

Hemichordates, the most primitive chordates,
- Have both the phosphagens, the creatine phosphate and arginine phosphate.

Echinoderms
- Such a situtation is also present and on morphological grounds echinoderms were considered close to the ancestry of chordates

The **phosphagens** are energy storage compounds, also known as high-energy phosphate compounds, are chiefly found in muscular tissue in animals. However, arginine and creatine are very closely related compounds and the former is used for the synthesis of the latter by the vertebrates. In certain cases, arginine is abundant at the embryonic stage but not in adults. Thus, it is a case of recapitulation at the biochemical level.


Thank you!