

Quadrant II – Transcript and Related Materials

Programme: Bachelor of Science (Third Year)

Subject: Botany

Course Code: BOC 105

Course Title: Classical Taxonomy and Phylogeny

Unit: Phylogeny of Angiosperms

Module Name: Terms and Concepts - Primitive and Advanced, Homology and Analogy, Parallelism and Convergence

Module No: 54

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Notes

Terms and Concepts - Primitive and Advanced, Homology and Analogy, Parallelism and Convergence.

Phylogeny - is evolutionary history of a taxon, and attempts to account for its origin and development.

It aims to find origins and relationships of all taxa with both extinct and present day plants.

Most recent common ancestor

The most recent common ancestor (MRCA, also last common ancestor (LCA), or co-ancestor) of any set of organisms is the most recent individual from which all the organisms from such set are directly descended.

Phylogeny is based on changes in set of characters

With advancement of molecular techniques and computer software's, we are now able to devise Phylogeny in more better way.

Phylogenetic tree, a branching diagram referred as "tree" shows the inferred evolutionary relationships among various biological species.

A clade (from Ancient Greek: klados, "branch"), also known as monophyletic group, is a group of organisms that consists of a common ancestor and all its lineal descendants, and represents a single "branch" on the "tree of life".

Clades are nested within one another — they form a nested hierarchy. A clade may include many thousands of species or just a few.

A clade is a grouping that includes a common ancestor and all the descendants (living and extinct) of that ancestor.

Primitive and advanced characters

- A central point to the determination of the phylogenetic position of a particular group is the number of primitive (plesiomorphic) or advanced (apomorphic) characters states.
- Plesiomorphic and apomorphic refer to different character-states of a character, and not different characters.
- Primitive members of that group have retained a relatively high proportion of ancestral (plesiomorphic) characters
- Advanced members have dispensed with a relatively high proportion of these same characters—either by loss or replacement with different (apomorphic) characters

The first step in the determination of relative advancement of characters, is to ascertain which characters are plesiomorphic and which are apomorphic.

Primitive organism is one in that the distribution of **plesiomorphic characters** is displaced towards **primitive members**, which have a **higher** proportion of **plesiomorphic characters**, than the average for the group as a whole.

Primitive versus advanced floral characters	
Primitive floral characters	Advanced floral characters
Flower parts many, more than ten	Flower parts few, ten or less
Flower parts free (not united or fused)	Flower parts united or fused
Superior ovary	Inferior ovary
Flowers with radial symmetry	Flowers with bilateral symmetry

Primitive plants like magnolias tend to have many parts which are separate and not fused together and spiral arrangement of floral parts. Flowers are usually symmetrical.

Advanced flowers like orchids tend to have few parts, parts which are fused together, whorled arrangement of parts and zygomorphic flowers. A complex association with pollinating insects.

Gunderson (1939) used this theory to establish the following evolutionary trends:

Polypetaly to gamopetaly

Polysepaly to gamosepaly

Actinomorphy to zygomorphy

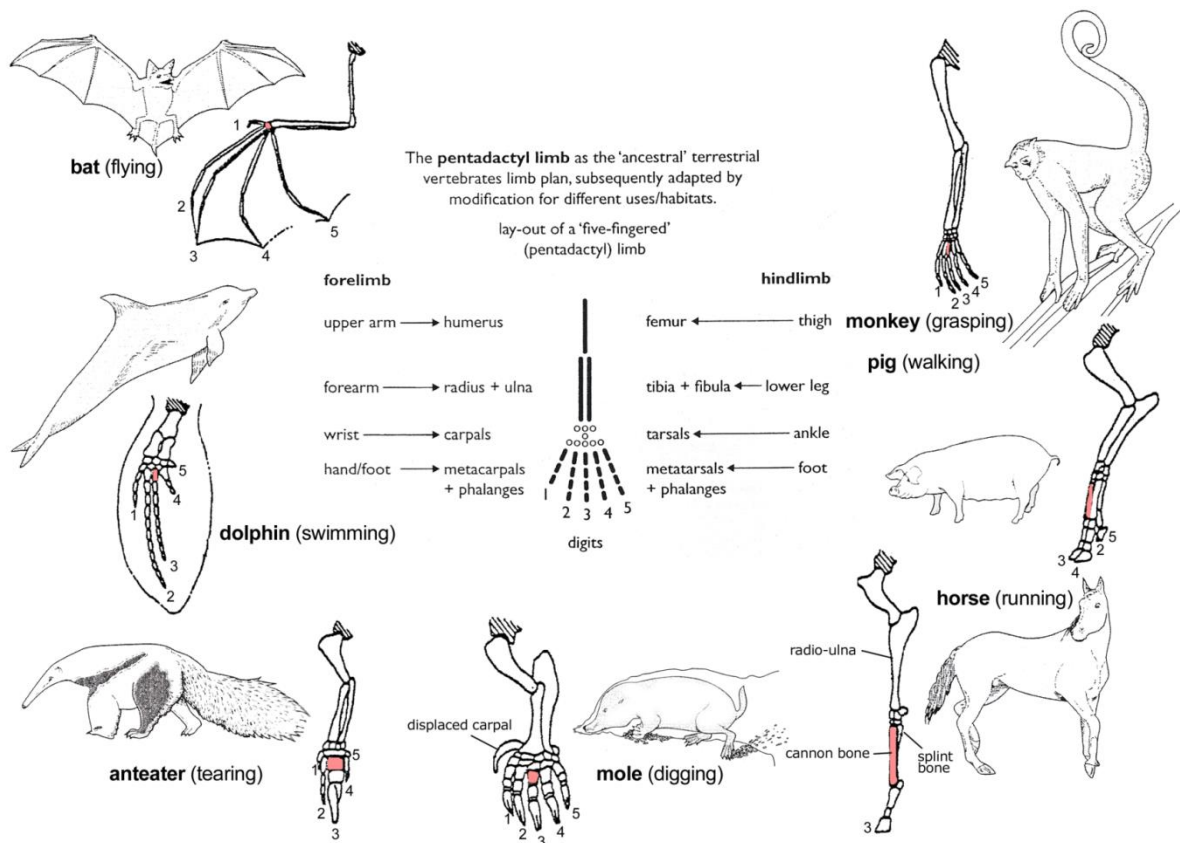
Apocarpous to syncarpous

Homology and Analogy

- Different organisms resemble one another in certain characters.
- Taxonomic groups or taxa are constructed based on overall resemblances.
- The resemblances due to homology are real, whereas those due to analogy are generally superficial.
- A real understanding of these terms is, thus, necessary in order to keep organisms with superficial resemblance in separate groups.
- The two terms as such play a very important role in understanding evolutionary biology
- Darwin (1859) was the first to apply these terms to both animals and plants.
- He defined homology as that relationship between parts which results from their development from corresponding embryonic parts.
- The parts of a flower in different plants are thus homologous and these, in turn are homologous with leaves because their development is identical.

These terms were first used and defined by **Owen (1848)**.

- He defined Homology as the occurrence of the same organ in different animals under every variety of forms and functions.
- He defined Analogy as the occurrence of a part or an organ in one animal which has the same function as another part or organ in a different animal.



Source: Evolution pl.png. https://commons.wikimedia.org/wiki/File:Evolution_pl.png. Created by Jerry Crimson Mann. CC 3.0

- If applied to plants, the rhizome of ginger, the corm of colocasia, tuber of potato, and runner of lawn grass are all homologous, as they all represent a stem.
- The tuber of potato and the tuber of sweet potato, on the other hand, are analogous as the latter represents a root.





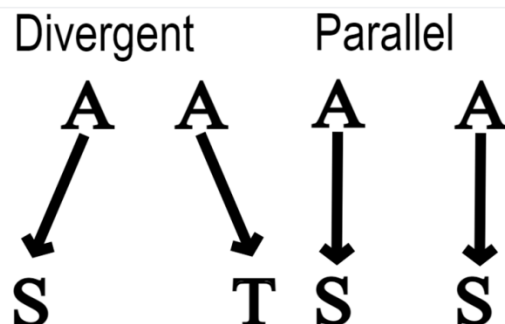
Homologous characters of leaf

Parallelism and convergence

Unlike homology, if the character shared by two organisms is not traced to a common ancestor, the similarity may be the result of **homoplasy** (sometimes considered synonym of analogy).

It can result in three different ways.

- Organisms have a common ancestor but the character-state was not present in their common ancestor- **Parallelism**. eg. Tree plant habit has evolved separately in unrelated classes of plants.
- It could also result from two different characters in different ancestors evolving into identical character-states - **convergence**. eg. flight/wings of insects, birds, pterosaurs, and bats.
- Similarity could also arise from loss of a particular character thus reverting to ancestral condition – **Reversal** eg. loss of perianth in some families.
- Simpson (1961) defined parallelism as the independent occurrence of similar changes in groups with a common ancestry, and because they had a common ancestry
- The development of vessels in Gnetales and dicotyledons also represents a case of parallelism.



- Convergence implies the similar features in convergence arise separately in two or more genetically diverse and not closely related taxa or lineages.

- The similarities have arisen in spite of lack of affinity and have probably been derived from different systems of genes.
- Convergence is generally brought about by similar climates and habitats, similar methods of pollination or dispersal.
- Examples may be found in the occurrence of pollinia in Asclepiadaceae and Orchidaceae.

Convergent

