Lecture- Week-2

Phylogeny of Angiosperms -2

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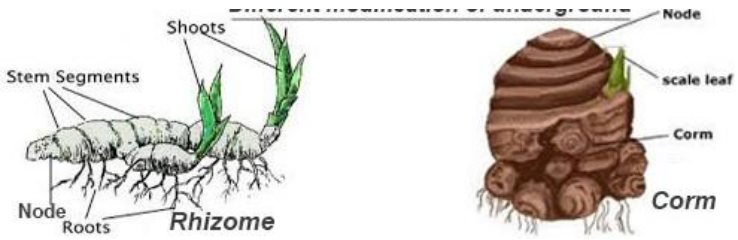
HOMOLOGY

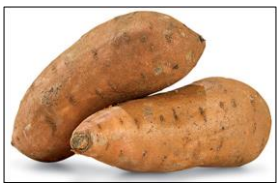
- **Homology** is ***the resemblance between two organisms due to inheritance from a common ancestry.***
- Characters with same origin, but, different in appearance or function
- The resemblances due to homology are real.
- Homology between two organisms can result only from their having evolved from a common ancestor, and the ancestor must also contain the same feature or features for which the two organisms are homologous.
- 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**.



- Through divergent evolution, organisms may develop *homologous* structures.

ANALOGY

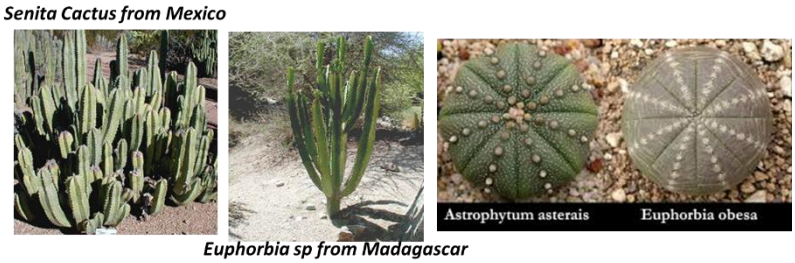
- Analogy is ***the resemblance between two organisms due to functional similarity and not due to inheritance from a common ancestry.***
- Characters with different origin, but, similar in appearance.
- The resemblances due to analogy are generally superficial.
- Analogy between two organisms can be due to superficial resemblance, i.e., ***occurrence of a part or an organ in one organism which has the same function as another part or organ in a different organism***
- The **tuber of potato** and the **tuber of sweet potato**, appears similar. But are analogous as the potato tuber is a **stem** and sweet potato tuber represents **a root.**

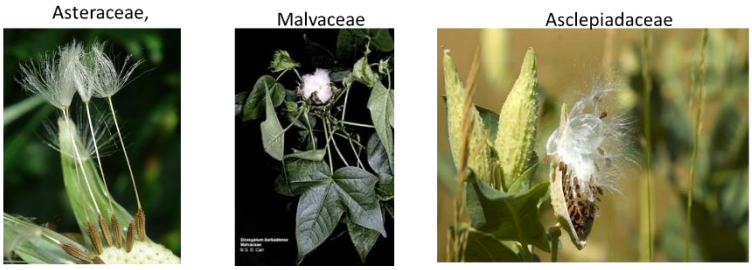


- Through convergent evolution, organisms may develop analogous structures.

HOMOPLASY

- Homoplasy and Analogy are synonymously used terms.
- The term homoplasy was coined by Lankester in 1870.
- It refers to analogous structures, i.e. structures that show similarity and may perform the same function, but that are not derived from a structure found in a common ancestor.
- The wings of bats and insects are analogous (homoplastic) because they both function for flight, but evolved from different primitive structures.
- These organs arise via convergent evolution and are thus **analogous**, (not homologous to each other). Similar characters but not because of inheritance from a common ancestor.

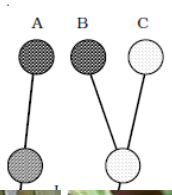




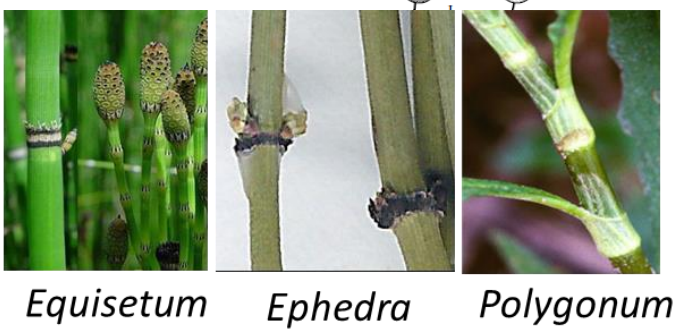
Homoplasy may arise due to any of the 3 following ways: Convergent evolution, Parallel evolution or Character reversal.

1. or
2. **Character reversal** (**atavism** or an evolutionary throwback- re-evolution of sexual reproduction in ***Hieracium pilosella***).

Convergent evolution



Convergence - If two different characters in different ancestors evolve into identical character-states shared by two organisms. In convergent evolution, the organisms do not share a common ancestor. Convergence implies increasing similarity between two distinct phyletic lines, eitherwith regard to individual organ or to the whole organism. The similar features in convergence arise separately in two or more genetically diverse and not closely related taxa or lineages. Examples may be found in the occurrence of pollinia in

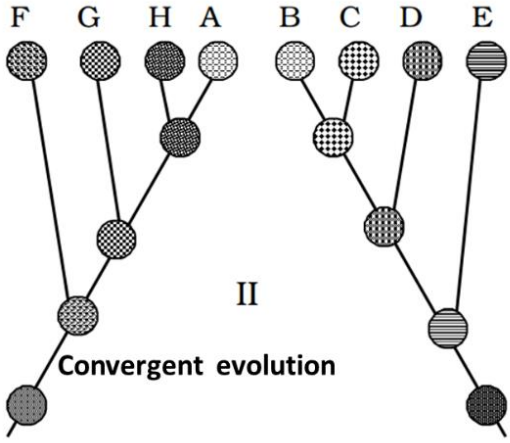


Asclepiadaceae and Orchidaceae, and the '**switch habit**' (circular sheath at nodes) in *Equisetum, Ephedra* and *Polygonum.*

Convergence is generally brought about by similar climates and habitats, similar methods of pollination or dispersal. Once the convergence has been identified between two taxa, which have been grouped together, they are separated to make the groups natural and monophyletic.

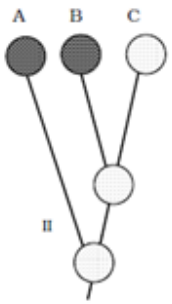
Convergence commonly results from

1. **Adaptation to similar habitats.** The gross similarity between certain succulent species of Euphorbiaceae and Cactaceae is very striking example of convergence.
2. **Simila**r **modes of pollination-** pollinia in Asclepiadaceae and Orchidaceae.; wind pollination in such unrelated families as Poaceae, Salicaceae and Urticaceae,.
3. **Similar modes of dispersal-** hairy seeds of Asteraceae, Asclepiadaceae and some Malvaceae..
4. Convergence commonly occurs between **relatively advanced members of respective groups**.- The two species *Arenaria leptocladus* (A) and *Minuartia hybrida* (B) of Caryophyllaceae, show more similarity than between any two species of these two genera due to convergent evolution as these are the most specialized or advanced species within their respective genera. *Arenaria leptocladus*



Parallel evolution

Parallelism is the *independent occurrence of similar changes in groups with a common ancestry and because they had a common ancestry* (Simpson, 1961).



The two species *Ranunculus tripartitus and R. hederacea* have a similar aquatic habit and dissected leaves and have acquired these characters by parallel evolution.The development of vessels in Gnetales and dicotyledons also represents a case of parallel evolution.

Reversal is a common evolutionary process or change back to an ancestral condition (wherein loss of a particular character may lead to apparent similarity with ancestral condition). The occurrence of reduced unisexual flowers without perianth or with reduced perianth in Amentiferae was once considered to be primitive situation, but the evidence from wood anatomy, floral anatomy and palynology have shown that apparent simplicity of these flowers is due to evolutionary reduction (reversal), and as such the assumed similarity to angiosperm ancestral condition is representation of homoplasy, a false similarity between an evolutionary advancement (secondary reduction) and ancestral simple condition.

Reference:

1. Singh, G. (2012). Plant Systematics: Theory and Practice, 3rd edition. Oxford and IBH Pvt. Ltd. New Delhi.
2. Walter S. Judd, et.al. 2015 Plant Systematics : A Phylogenetic Approach 4th Edition Sinauer Associates , Oxford University Press USA .