

A **phylogeny** (or a tree of life) is a theory about how organisms are related to one another through evolutionary time. **Phylogenies** are based on the assumption that more closely related species will be more similar to one another, and they are commonly built using genetic sequences or physical characters.

Primitive Characters of Angiosperms:

- Indefinite number of floral parts.
- Spiral arrangement of floral leaves. i.e. sepals, petals, stamens and carpels.
- Free floral parts. i.e. Polysepalous, Polypetalous, Polyandrous & Apocarpous.
- Fusion of floral parts are present
- Actinomorphic Plants (Divided into 2 equal parts when cut in any plane).
- Solitary flowers.
- Bisexual Flowers.
- Flowers hypogynous with superior ovary.
- Entomophilous flowers are primitive.
- Undifferentiated calyx and corolla.
- Presence of stalk in carpels.
- Primitive carpels lack style and stigma.
- Presence of two integuments of ovule.
- Orthotropous & Anatropous ovules are primitive.
- Long, narrow & sessile stamens with 4 pollen sacs are primitive.
- Large leaf like carpels bearing many ovules are primitive.
- Seeds with small embryo and large endosperm is also a primitive character.
- Absence of vessels in some angiosperms like dromous & degeneria is a primitive character.
- Fruits formed from polycarpellary, apocarpous ovary are primitive.



Advanced Characters of Angiosperms:

- Indefinite number of floral parts to definite or fewer floral parts.
- Actinomorphic flowers to Zygomorphic flowers.
- Free floral parts to fused floral parts. i.e. Gamosepalous, Gamopetalous, Syncarpous and Syngenesious
- Spiral arrangement of floral leafs change into cyclic arrangement.
- Undifferentiated perianth to differentiated perianth.
- Bisexual flowers to unisexual flowers.
- Monoecious plants to dioecious plants.
- Hypogynous flowers to epigynous & perigynous condition.
- Superior ovary to inferior ovary.
- Two integuments of ovule to one integument.
- Leaf like stamens are primitive to typical/normal type.

• Endospermic seeds with small embryos to non-endospermic seeds with large embryos.

Analogy

Analogy, or analogous structures, is actually the one that does not indicate there is a recent common ancestor between two organisms. Even though the anatomical structures being studied look similar and maybe even perform the same functions, they are actually a product of <u>convergent evolution</u>. Just because they look and act alike does not mean they are related closely on the tree of life.

Convergent evolution is when two unrelated species undergo several changes and adaptations to become more similar. Usually, these two <u>species</u> live in similar climates and environments in different parts of the world that favor the same adaptations. The analogous features then help that species survive in the environment.

One example of analogous structures is the wings of bats, flying insects, and birds. All three organisms use their wings to fly, but bats are actually mammals and not related to birds or flying



insects. In fact, birds are more closely related to dinosaurs than they are to bats or flying insects. Birds, flying insects, and bats all adapted to their niches in their environments by developing wings. However, their wings are not indicative of a close evolutionary relationship.

Another example is the fins on a shark and a dolphin. Sharks are classified within the fish family while dolphins are mammals. However, both live in similar environments in the ocean where fins are favorable adaptations for animals that need to swim and move in the water. If they are traced back far enough on the tree of life, eventually there will be a common ancestor for the two, but it would not be considered a recent common ancestor and therefore the fins of a shark and a dolphin are considered to be analogous structures.

Homology

The other classification of similar anatomical structures is called homology. In homology, the homologous structures did, in fact, evolve from a recent common ancestor. Organisms with homologous structures are more closely related to each other on the tree of life than those with analogous structures.

However, they are still closely related to a recent common ancestor and have most likely undergone <u>divergent evolution</u>.

Divergent evolution is where closely related species become less similar in structure and function due to the adaptations they acquire during the natural selection process. Migration to new climates, competition for <u>niches</u> with other species, and even microevolutionary changes like <u>DNA mutations</u> can contribute to divergent evolution.

An example of homology is the tailbone in humans with the tails of cats and dogs. While our coccyx or tailbone has become a <u>vestigial structure</u>, cats and dogs still have their tails intact. We may no longer have a visible tail, but the structure of the coccyx and the supporting bones are very similar to the tailbones of our household pets.

Plants can also have homology. The prickly spines on a cactus and the leaves on an oak tree look very dissimilar, but they are actually homologous structures. They even have very different functions. While cactus spines are primarily for protection and to prevent water loss in its hot



and dry environment, the oak tree does not have those adaptations. Both structures do contribute to photosynthesis of their respective plants, however, so not all of the most recent common ancestor's functions have been lost. Oftentimes, organisms with homologous structures actually look very different from each other when compared to how close some species with analogous structures look to each other.

Analogus Organs in plants : Analogous organs are those organs which have the different basic structural design and origin but have similar functions.

Examples: Plants can demonstrate analogous structures, such as sweet potatoes and potatoes, which have the same function of food storage.

Homologus Organs in plants : Homologous organs are those organs which have the same basic structural design and origin but have different functions.

Examples: The leaves of a pitcher plant, a Venus fly trap, a cactus and a poinsettia are all examples of homology. They are homologous structures because, although they have different shapes and different functions today, they all share a common ancestor.

Examples of Homology and Analogy :

A. Homology of climbing organs which resemble each other in external appearance and function (i.e. analogous to tendrils) :

(1) Tendrils of wild pea (Lathyrus aphaca, Papilionaceae) are modified leaves i.e. homologous to entire leaves.

(2) Tendrils of cultivated pea (Pisum sativum, Papilionaceae) are homologous to terminal leaflets.

(3) Tendrils of Vitis sp. (Vitaceae) are modified stem apices and therefore homologous to them.



(4) Tendrils of Passiflora sp. (Passifloraceae) are homologous to the axillary buds.

(5) Simple tendrils of Cucurbita sp. (Cucurbitaceae) are homologous to either stipules or bracteoles, or first formed foliage leaves (prophylls) of axillary shoots. Branched tendrils are the combination of branches (lower part of tendril) and modified leaves (upper part of tendril).

- (6) Tendrils of Smilax sp. (Liliaceae) are homologous to stipules.
- (7) Tendrils of Clematis gouriana (Ranunculaceae) are modified petioles.

(8) Tendrils of Cardiospermum helicacabum (Sapindaceae) and Antigonon leptopus (Polygonaceae) are modified inflorescence axes.