



# Classification systems: Taxonomy



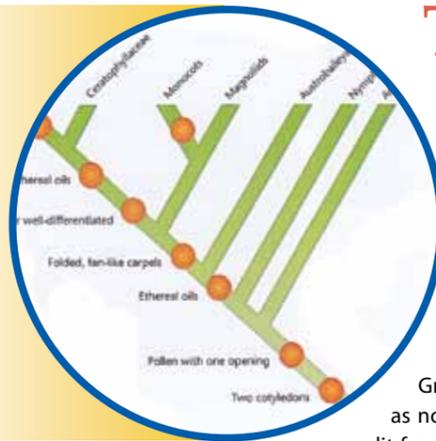
A watercolour by a young !kun boy, !nanni, of a water plant he remembered by the name of 'ntcha'. !nanni stayed with Lucy Lloyd and Jemima Bleek in Cape Town in the early 1880s. He remembers that the root was poisonous, but his family ate the fruit, roasted as well as raw. This precious archive is available online <http://www.cca.uct.ac.za/collections/-the-digital-bleek-and-lloyd.>

The Greek word for group is taxon. Life forms with shared features can be placed in groups or taxa (the plural of taxon). Thus the study of classifying life is known as taxonomy. From the earliest time, humans have been naming, and therefore unconsciously ordering, life forms. Around 2300 years ago the Ancient Greek philosopher, Aristotle, made it formal by applying logic and principles to classification. He divided animals with blood and animals without blood into two large groups (taxa), thereby laying the foundations for taxonomy by recognizing that careful study of the shape and structure (morphology) of life forms could determine what belonged to which group.

The Swedish botanist, Carolus Linnaeus (also known as Carl von Linné when he upgraded himself to the Swedish aristocracy) created the Latin binomial system of naming life forms which is still used today and has greatly aided the science of taxonomy. (See box **Everything is Relative** on the right). Because of this, he is often known as the Father of Taxonomy.

What really revolutionized taxonomy however, was the publication in 1859 of *The Origin of Species by Means of Natural Selection*, by Charles Darwin. Before this pivotal event, the guiding philosophy of classification was driven largely by the need know about useful (to humans) animals and plants. After this momentous event, the focus of taxonomy changed to encompass all aspects of functional and evolutionary knowledge.

Taxonomy is a hugely important scientific discipline. It forms the basis of all knowledge about life on Earth. As our information base increases, and our techniques for studying life become more sophisticated, so the science of taxonomy has expanded. Today **systematics** (which includes taxonomy) involves the study of the range of life forms (diversity), their identification, naming, classification and evolution, and the study of variation in life forms and the causes and consequences of this variation.



## Tree of life

Modern systematics and taxonomy combine functional (outward appearances) and evolutionary (genetic) knowledge. **Phylogeny** is the study of relationships between different groups. An evolutionary tree of life becomes a **phylogenetic** tree which shows the relationships between all ranks mentioned in the box **Everything is Relative** above right. The tree becomes a metaphor for evolutionary lineage and classification, where the twigs at the ends of branches are the species.

Branches of the phylogenetic tree become **cladograms** (from the Greek word clados, a branch). Points where branches split are known as nodes which represent a point in evolution where the different ranks split from each other and form separate lineages or branches. Thus the node represents a common ancestor. The illustration left is a cladogram showing the relationships between the various groups of flowering plants - the Anthophyta. It is reproduced from the book

**The story of Life and the Environment: An African Perspective**. (More details below right).

A **clade** is a representation of a branch containing a common ancestor of all subsequent descendants. See article 'An intriguing Cape orchid' by William Liltved and Greig Russell on p. 108.



**Read more**  
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**How we lost the African acacias**, *Veld & Flora* 98(1), 26, March 2012.

**A preamble to the dassie vygies** by Matt H. Buys & Kush Sing, *Veld & Flora* 95(1), 38-40.

**Mesembs and molecules** by Matt H. Buys, *Veld & Flora* 94(3), 158-160.

**Scentsational freesias: Chemical analysis of fragrance supports the division of the genus *Freesia* into two groups based on DNA and bract texture** by John Manning & Roman Kaiser, *Veld & Flora* 95(3), 132-133, September 2009.  
**iSpot Southern Africa** <http://www.ispot.org.za> has an excellent taxonomy section and several plant keys.



Text and photographs by Caroline Voget, with information directly based on the informative new book *The story of Life and the Environment: An African Perspective* by Jo van As, Johan du Preez, Leslie Brown and Nico Smit, published by Struik Nature. No school in South Africa should be without this remarkable book. It is the best teaching textbook in the life sciences for southern

Africa that I have come across: presenting and explaining the biodiversity of our African continent in an accessible, accurate, up to date and exciting way. Download this poster and other related articles from <http://LABpages.blogspot.com> or directly from the BotSoc webpage <http://botanicalsociety.org.za>.



# Keeping Order

**Life on Earth** is complex and diverse, yet amongst all life forms shared features lead to a similarity of appearance that has allowed us to group them together to try to compartmentalize and impose order on the natural world. Have you ever wondered why we all look like other humans, but slightly different from chimps? Or why all pine trees look similar, but slightly different from acacia trees? Plants and animals, bacteria and algae – all need to recognize friend from foe, or predator from mate in order to survive – and this unconscious, ever-evolving process enables us to classify all of life into groups. We need to know what exists on our Earth and how we are related in order to understand how it all works.

Sickle-leaved Aloe (*Aloe falcata*).



**Prokaryotes**  
Microscopic single-celled life forms that have neither a distinct nucleus nor other organelles in their cells. All the life forms in the domains Bacteria and Archaea are prokaryotes.  
**Eukaryote** A life form with a cell or cells that contain a nucleus in which the genetic material is contained. All life forms in the domain Eukarya are eukaryotes.

# Everything is Relative

**Linnaeus devised an** ingenious system for naming and classifying all species, which he described in his book *Systema Naturae* first published in 1735, that is still in use today. His system places all life forms into a hierarchy of groups (taxa). At the most basic (or specific) is the **species**, then the more general **genus**. A group of genera comprise a **family**. Related families are grouped together into **orders**, which are in turn grouped into **classes**, then into **phyla** and then into what used to be the top of the hierarchy, the **kingdoms**. Taxonomists call these different levels, ranks – and today, because of new discoveries being made in the exciting world of molecular science, another higher rank has been added – the **domain**.

Classification is in a state of flux, especially the classification of plants, because of the great strides being made in molecular science. This new evolutionary knowledge (genetic structure) doesn't always agree with functional (observable shape and function) classification which has necessitated some re-arranging of family trees. (See box **Tree of life** below left.)

In the 1960s Robert Whittaker proposed that all life be divided into five kingdoms. Since then there have been many variations, and now a three-domain and five-kingdom classification is most widely used. The three domains are: **Archaea** (Single celled micro-organisms with no nucleus in their cells that include the 'extremophiles' that live in salt lakes or boiling hot deep sea hydrothermal vents. They are similar to bacteria, which are also prokaryotes, but differ in that they have genes and some metabolic pathways that are closer to the eukaryotes.), **Bacteria** (the vast number of prokaryotes) and **Eukarya** (all life forms, both unicellular and multi-cellular, containing cells with nuclei).

The kingdom **Plantae** falls under the domain Eukarya. The other kingdoms in this domain are **Protozoa**, **Chromista**, **Fungi** and **Animalia**.



The Laurel-leaf Sugarbush has been classified as belonging to the species *laurifolia*, the genus *Protea*, family Proteaceae, order Proteales, superorder Rosiidae, class Magnoliopsida (the dicots – which are now undergoing major revision because of new findings by molecular scientists that will place our flower into the eudicots subdivision), phylum Anthophyta (flowering plants), kingdom Plantae and the domain Eukarya.

## In the Kingdom of Plants

**Plants evolved from** alga-like ancestors about 700-450 million years ago. They moved from an aquatic to a terrestrial lifestyle, becoming multicellular in the process; and radiating out into the rich diversity of habitats that they occupy today. Plants can be classified into two broad groups – **Non-vascular plants** (mosses and other Bryophytes) and **Vascular plants**. The latter group is further divided into **Seedless vascular plants** (ferns and other Pteridophytes) and **Seed-bearing vascular plants**. The latter group, in turn can be broadly divided into **Cone-bearing vascular plants** (conifers and other Gymnosperms) and **Flower-bearing vascular plants** (the Angiosperms).

