ANGIOSPERM LIFE CYCLE

Almost all land plants reproduce by means of two distinct, alternating life forms: a **sexual** phase that produces and releases gametes or sex cells and allows fertilisation, and a **dispersal** phase. The sexual phase is known as the GAMETOPHYTE or haploid (n) generation and the dispersal phase is the SPOROPHYTE or diploid (2n) generation. In angiosperms and all vascular plants, the sporophyte phase is the dominant generation.

The gametophyte phase is reduced to a few cells and gametophyes are totally dependent on the sporophyte. Haploid (n) microspores and megaspores (i.e. each spore has a single set of chromosomes) are produced by meoisis.

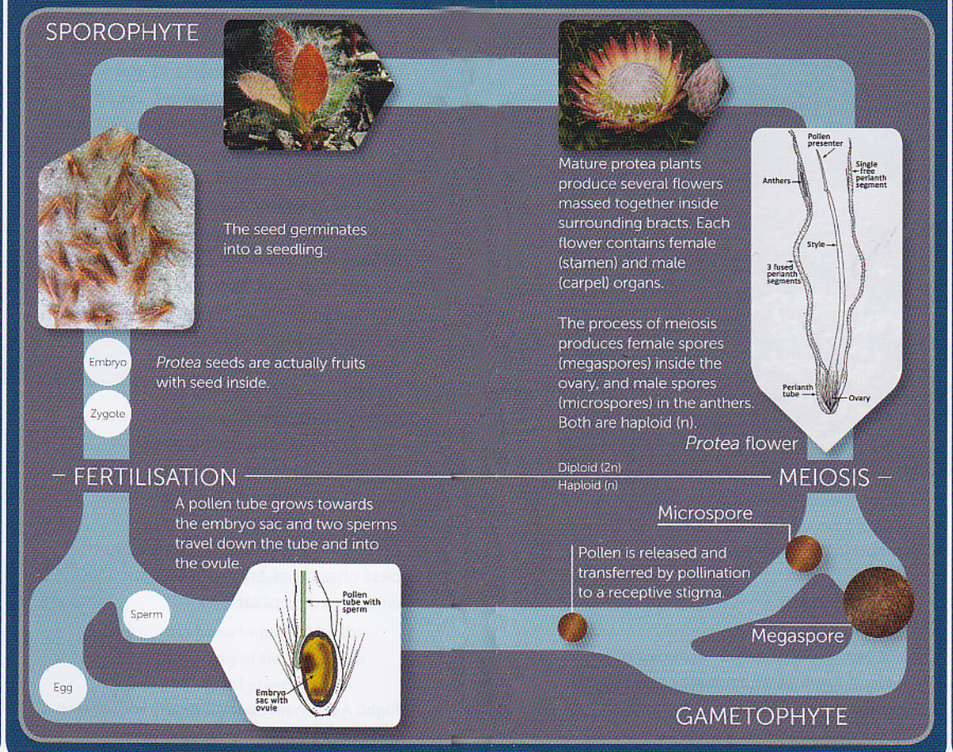
Female megaspores develop into the embryo sac (megasporophyte) that grows inside the ovule, which is retained within the flower on the plant. Male microspores develop into pollen grains (microsporophytes) which are transferred to other flowers – preferably on different plants – during pollination. After a grain of pollen lands on the stigma, a pollen tube grows from the pollen grain down the style to the ovary and enters the ovule. The male gamete or sperm (two in the case of angiosperms) travels along the tube to the embryo sac within the ovule where it fuses with the female gamete (ovum) to form a diploid (2n) zygote (with two sets of chromosomes).

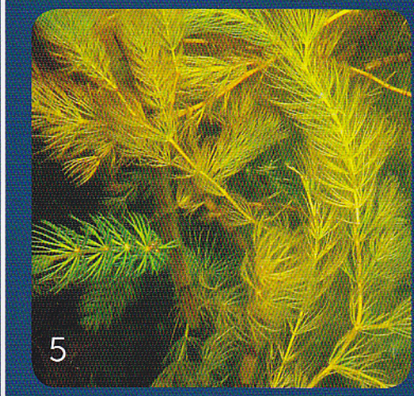
The zygote grows by cell division (mitosis) into an embryo within the seed. In angiosperms the second sperm cell fuses with the large central cell of the female gametophyte, which then develops into the endosperm, a nutrient-rich tissue which nourishes the developing embryo.

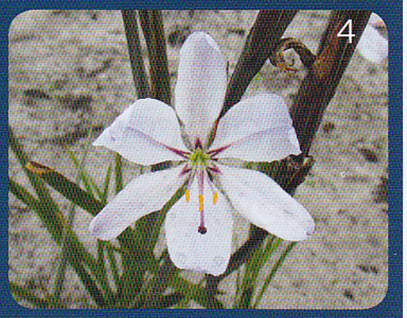
The seed then germinates and grows into the familiar form of the plant (the mature sporophyte). The sporophyte plants produce flowers in which the haploid (n) megaspores and microspores are produced. These have undergone meiosis, a process of cell division that results in four daughter cells each with half the number of chromosomes of the parent cell. The haploid gametophyte generation takes place within the flowers that will eventually release the diploid sporophyte seeds – and so the cycle continues.

Flower Power

Flowers separate the angiosperms from all other plants. Fossil evidence indicates that flowers evolved from modified (usually whorled) leaves and carpels or stamens (the female and male reproductive parts of a plant) so there is some truth in the quote: 'a flower is a leaf, mad with love'. Although some angiosperm species bear female and male flowers on the same plant (monoecious) while others bear female and male flowers on different plants (dioecious), the typical hermaphrodite (male and female parts together) structure of most angiosperm flowers is quite different to the unisexual cones of most gymnosperms. Some angiosperms use wind and water for pollination, but many angiosperm flowers have evolved into different shapes and structures to tempt different animal pollinators. Like gymnosperms, flowering plants also produce seeds but these differ in that they contain an endosperm, and are entirely enclosed in protective ovaries that mature into the fruit.







A diversity of flowers

The ancestors of flowering plants diverged from gymnosperms over 200 million years ago (mya). By 100–60 mya they had replaced conifers as the dominant plants on Earth. Although there is presently a hot debate over the evolutionary history (phylogeny) of the angiosperms, in summary, five of the main recognised living angiosperm groups are: **Basal Angiosperms**, **Magnoliids**, **Monocots**, **Ceratophyllaceae** and **Eudicots**.

Basal Angiosperms: these most primitive flowering plants comprise 0.5% of living angiosperms. Nymphaeales, one of the three orders within this group, is represented in South Africa by the waterlilies.

Magnoliids: eight orders comprising 2.5% of living angiosperms today. They include our well-known Stinkwood Tree (*Ocotea bullata*).

Monocots share traits with Magnoliids. Both arose between 130 and 125 mya from a common ancestor. They comprise about 28% of living angiosperms and are classified into four superorders, one of which is the Lilianae. South Africa is particularly rich in species from this group.

Ceratophyllaceae comprises one genus *Ceratophyllum* with about 30 species – all of which are aquatic, lack roots and their leaves lack stomata. They comprise 0.012% of the world's angiosperms.

Eudicots have a distinctive pollen structure, but otherwise they share many traits with the preceding groups. They contain five superorders and comprise some 69% of living angiosperms. South Africa has countless plants in this group including the daisies, *Ericas* and succulents like the enigmatic Halfmens pictured here in its desert habitat in the Northern Cape.

Bear in mind that classification of plants is in a state of flux due to ever-increasing sophistication in molecular studies, so the phylogenetic tree of Plantae differs in some publications.

FURTHER READING

This factsheet follows on from the *Veld & Flora* Factsheets on Classification in the September 2012, the December 2015, March, June and September 2016 issues of *Veld & Flora*. Discover more about South African angiosperms by visiting iSpot www.ispotnature.org and PlantZAfrica http://pza.sanbi.org/.

Download these and other resources from the *Veld & Flora* LAB pages: http://labpages.blogspot.co.za.

LINKS TO THE CAPS CURRICULUM

GRADE 11 Life Sciences, Strand 1: Diversity, change and continuity. Topic: Biodiversity of plants. Content: Grouping of bryophytes, pteridophytes, gymnosperms and angiosperms.

GRADE 12 Life Sciences Strand 1: Life at molecular, cellular and tissue level. Topic: Meiosis: the process of reduction division purposes of reduction division (gametogenesis and exceptions: mosses, ferns); importance of meiosis: diploid to haploid: production of gametes.

PHOTOGRAPHS/IMAGES

1 Carpets of flowers during spring near Langebaan, Western Cape. Photo by Caroline Voget.

2 Blue Waterlily (*Nymphaea nouchali* var. *caerulea*) growing at Kosi Bay. Photo by Ricky Taylor, iSpot.

3 Stinkwood Tree (*Ocotea bullata*) flowers. Photo by Gigi Laidler, iSpot.

4 *Aristea spiralis*. Photo by Caroline Voget.

5 *Ceratophyllum demersum* var. *demersum* growing on the lake margins in Kosi Bay. Photo by Ricky Taylor, iSpot.

6 Halfmens (*Pachypodium namaquanum*). Photo by Caroline Voget.

Images for the life cycle diagram are reproduced with thanks to Alice Notten, PlantZAfrica (SANBI) and the Protea Atlas Project, SANBI www.proteaatlas.org.za/flowerh.htm.

TEXT adapted by Caroline Voget from the book *The Story of Life and the Environment: An African perspective* by Jo van As, Johann du Preez, Leslie Brown and Nico Smit, published by Struik Nature.