GUIDING LEVEL II

A TRAINING MANUAL DESIGNED TO ASSIST WITH PREPARATION FOR THE FGASA LEVEL II AND TRAILS GUIDE EXAMS

All rights reserved. No part of the material may be reproduced or utilized in any form or by any means, electronic or mechanical including photocopying, recording or by an information storage retrieval system, without the written permission of Lee Gutteridge.

(INCLUDING MORE THAN FOUR HUNDRED PHOTOS AND DIAGRAMS)

COMPILED BY LEE GUTTERIDGE

THIS STUDY MATERIAL CONFORMS TO THE SYLLABUS SET BY FGASA FOR THE LEVEL II EXAMS AND IS APPROVED BY PROFESSOR W.VAN HOVEN OF THE CENTRE FOR WILDLIFE MANAGEMENT AT THE UNIVERSITY OF PRETORIA

P.O. Box 441, Mookgopong, 0560, Limpopo, South Africa. Cell 083 667 7586

LEVEL TWO TRAINING MANUAL

This manual has been compiled from the perspective of a guide in the field. In writing it I asked myself what can I use on a game drive, or game walk as regards information. These aspects covered in this manual will give the guide good, interesting and factual information for direct discussion with the guest. No one book will cover every aspect so here I have included sections on the following topics.

1. Ecology
2. Mammals
3. Birds
4. Reptiles and Amphibians
5. Astronomy
6. Botany
7. Insects, Arachnids and their relatives
8. Geology and Climatology
9. Fish
10. Survival
11. AWH and VPDA

The problem for guides is not always finding the answers, but also what is the question to be researched in the first place? It is difficult for a guide to pre-empt what guests will ask them over their guiding careers, but many of the questions and answers which will come into play have been covered here. There are some peculiar questions and glossaries of terms pertinent to the subjects at hand, which in particular are important to understand the many field guides and books available on the particular subjects.

This manual was designed to assist with F.G.A.S.A. level 2 and F.G.A.S.A. Trails Guide candidates exam preparation and has been endorsed as such. Some of the information is obscure (albeit interesting) and only available from specific reference materials, not all of which are easily obtained, so I have decided to produce this as an informative manual to assist guides. Anyone with an enquiring mind should use all resources available to improve upon and add to the existing information and definitions, as there is always more to be learned. I have purposefully kept it simple however as this is not a level three manual. In FGASA level two there is also a need to cover Trail procedures, Bush craft and First aid in order to fully prepare for the said exams. There are many excellent works covering these topics, but they are not discussed in this manual. Wherever possible diagrammatical representations have been inserted for clarification on certain topics, and in order to make the subjects at hand more understandable.

Lee Gutteridge
Entabeni Nature Guide Training School
083 667 7586

Cover photograph- Young Lions by Lee Gutteridge

© Lee Gutteridge – 2 December 2005

University of Pretoria

Centre for Wildlife Management
5 Feb 2006

Mr Lee Gutteridge

Training manual for FGASA level 2 course and the trails guide exams

The manual that has been prepared to serve as handbook for the above mentioned course has been studied by myself. This manual and course is certified to be correct in terms of the factual content thereof and further certified to be at the correct standard for the purpose of this training course.

Sincerely

Prof. W van Hoven

© Lee Gutteridge – 2 December 2005

Contents of manual

INTRODUCTION.....2
LETTER OF CERTIFICATION……3
CONTENTS ……..4
ECOLOGY.....5
MAMMALS.....27
BIRDS.....58
REPTILES.....98
ASTRONOMY.....121
BOTANY……138
INSECTS AND ARACHNIDS……..….168
GEOLOGY…….…....204
FISH…….219
SURVIVAL…….226
BIBLIOGRAPHY…….…...251
AWH and VPDA…….252

© Lee Gutteridge – 2 December 2005

ECOLOGY

GLOSSARY

1. Abiotic factors - non-living components of an ecosystem.
2. Arboreal – tree dwelling.
3. Biomass – the physical mass of a population or community in nature i.e. the biomass of prey animals consumed in a year by Lions.
4. Biome – a specific area type based on vegetation groups i.e. fynbos.
5. Biosphere – the total area in which life occurs.
6. Carnivore – meat eating.
7. Carrying capacity – the amount of animals which can successfully survive in an area naturally.
8. Commensualism – a form of symbiosis where one party benefits and the other is unaffected.
9. Community – a group of organisms within an area.
10. Coprophage – to eat dung. It is done by many mammals and the young of some herbivore species.
11. Crepuscular – active at dusk and dawn.
12. Diurnal – active by day
13. Ecological niche – where an animal fits into the ecosystem as compared to potential competitors.
14. Ecology – "oikos" and "logos", Greek words meaning home and study. The study of the biotic and abiotic components of our world.
15. Ecosystem – a functioning interconnected part of the environment.
16. Edaphic factors – factors pertaining to soil.
17. Endemic – a species occurring in only a specific restricted geographical region.
18. Environment – specific surroundings of any organism including medium, substrate, climatic conditions, other organisms, light and PH.
19. Ethology – the study of mammal behaviour in their natural habitat.
20. Folivore – leaf eating.
21. Fossorial – living predominantly underground.
22. Frugivore – fruit eating.
23. Gene pool – sum total of relevant genetic source material of a population represented by gametes.
24. Geophage – eating of soil for mineral acquisition purposes.
25. Herbivore – an animal which eats vegetation.
26. Home range – an area lived in but not defended actively.
27. Insectivore – an insect eating animal (not necessarily from order Insectivora).
28. Interspecific – an interaction between different animals of different species.
29. Intraspecific – an interaction between different animals of the same species.
30. Mutualism – a symbiotic relationship between two organisms in which both benefit.
31. Natural selection – mechanism by which gradual evolutionary changes take place. Organisms which are better adapted to their environment will produce more viable offspring and increase in population, and therefore be selected.
32. Nocturnal – animals which are active at night.
33. Oestrus (estrus) – the time when a female animal is ready to mate, ovulates and conceives.
34. Omnivore – an animal which eats both meat and plant material.
35. Osteophage – an animal that eats or chews bones to facilitate mineral acquisition.
36. Parasitism – a form of symbiosis where one organism benefits to the detriment of another.

© Lee Gutteridge – 2 December 2005

37. Piloerection – the raising of hairs along the spine, by muscular action.
38. Population – the number of individuals of a specific group within a community.
39. Sexual dimorphism – the presence in a population of two sexes, each with a different phenotype. (Male and female look different).
40. Succession – the progression from initial colonization of an area by organisms to the climax population or community.
41. Symbiant – the two organisms composing a symbiotic relationship.
42. Symbiosis – the relationship between two different organisms, which ends in mutual benefit, or to the benefit of one species of the two.
43. Terrestrial – living on land, ground dwelling.
44. Territory – an area actively defended by an animal against members of its own species to protect its food and mating sources.

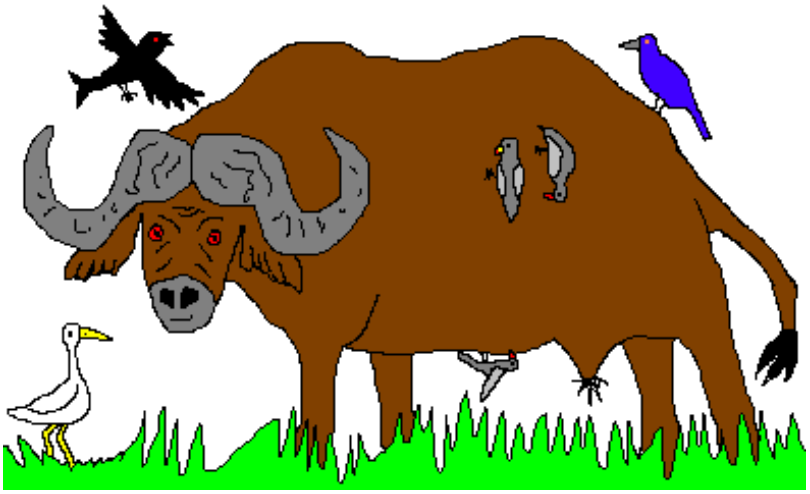
© Lee Gutteridge – 2 December 2005

SYMBIOSIS

Types of symbiosis found in nature, and some examples of these interactions. Symbiosis refers to an interaction in nature, and for this assignment there are examples of mutualism, commensualism, hemi-parasitism (epiphytes (epi means on top, phyton means plant)) and parasitism. There are no examples here of neutralism (neither affected), or amensualism (1 species inhibited with no effect on the other). (Prof. J.Du P.Bothma 2001)

The symbiotic relationship between the Buffalo and bird species.

The Red and the Yellow Billed Ox-peckers are birds commonly associated with this large bovid. These two birds provide a degree of benefit to the Buffalo in that large numbers of ectoparasites are removed. This zygodactylous species easily gathers the parasites from all parts of the body including eyes, ears, under the tail and groin area. There is an aspect to the detriment of the Buffalo in that wounds in the fur are worried and caused to bleed as they will utilize the blood as a food source, this can slow the healing process considerably but would keep maggots from the wounds. This would mainly be a mutual symbiosis where both animals benefit. The Buffalo in areas where the Ox-peckers do not occur are sometimes attended by Red Winged Starlings which actively seek out ectoparasites in the fur. These birds however are not as efficient, as many ticks are found on the underside of the belly and in the groin area, which due to their large size and passerine foot structure, they are not able to reach. Red Winged Starlings will also capture insects disturbed in the path of the Buffalo.



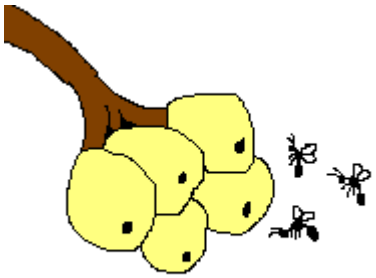
A Cape Buffalo and some of its bird Symbiants.

Cattle and Little Egrets also attend Buffalo, often perching on the Buffalo's back, catching disturbed insects as they fly up out of the grass. They have no impact on the life of the Buffalo however, a commensual relationship being the symbiosis in place. Fork Tailed Drongos are another species which takes advantage of herd animals moving through their grassland and savannah homes, snapping up any grasshopper that may flee the path of the moving ungulates from suitable perches. The Cape and Burchells Glossy Starlings run the gauntlet between the feet of the animals for the same reason.

© Lee Gutteridge – 2 December 2005

The symbiosis between Fig trees and their conspecific wasp species.

Fig trees in South Africa belong to the genus *Ficus*. These trees hide their flower inside their fruit. This fruit is attended for pollination by a small wasp of the family *Agaonidae*. These are small black wasps with a longitudinal groove on the head. The male is flightless and never leaves the Fig where he is hatched, but the female has wings and will fly from fruit to fruit to search for males and thereby pollinate the Figs flower (Picker and Weaving 2002). A well known species of Fig wasp is *Blastophaga psenes*. Two other common genuses are *Elizabethiella* and *Ceratosolen*. The family *Torymidae* also has some Fig associated wasps in it but the females of this family lack the mandibular appendages of the previous family. Males of the two species are indistinguishable from one another. The wasps of the *sycophaginae* sub family are generally accepted as being parasitic on the wasps of the *Agaonidae* (Boucek 1978). They too will serve the function of pollinating the Fig while looking for wasps to parasitize.



Female wasps at Fig fruits.

The symbiosis between the components of lichen.

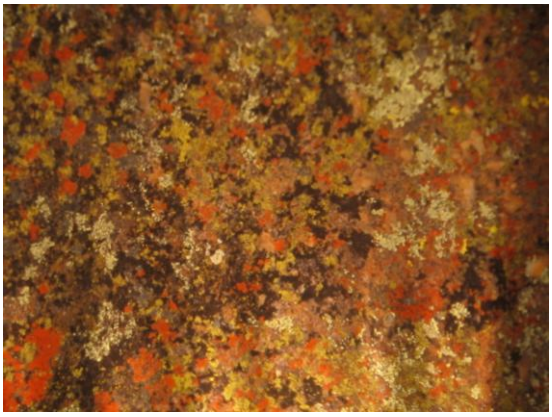
Lichen is a mutualistic relationship between fungi and algae.

Fungi do not photosynthesize, being part of the kingdom *Fungi*, and will obtain their food through either symbiosis (lichen), parasitism (obligate fungi) or by drawing nutrition from dead or rotting animals and plants (saprobic fungi). Some fungi cause diseases and are referred to as pathogenic. One such pathogenic fungi is *Phytophthora infestans* which causes a disease called late blight which decimated Irish potato crops in the 1843-1847 famine in Ireland. More than 24 000 species of fungus are identified in the class *Fungi Imperfecta*. (Weier, Stocking, Barbour 1974)

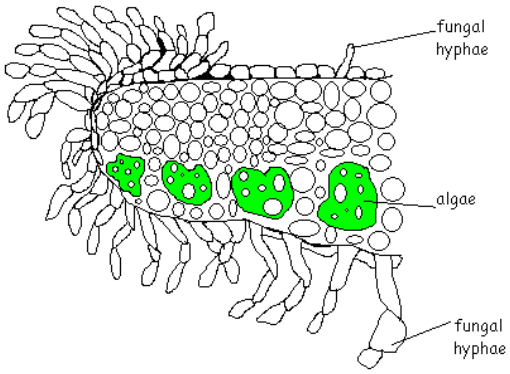
Algae photosynthesize, being part of the kingdom *Plantae.* They are known as Thallophyte plants. These plants are thallus, meaning they lack roots, stems etc. They occur in the form of seaweed, algae in fish ponds and dams, on the top of soil and in microscopic form in the top 75 metres of the ocean. Algae are responsible for 70% of the oxygen released into the atmosphere. Not all algae are green, with brown (which contains algin, a long-chain polymer of mannuronic acid in the cell walls), blue-green and red being common. The oldest known evidence of life on earth is in a layer of chert found near Barberton. The chert is about 3.2 billion years old (called the Fig tree formation) and was a sea bed rich in silica, and it contains microfossils of a bacterium like creature called *Eobacterium isolatum* and a blue green algae called *Archaeosphaeroides barbertonensis*. These algae lived in a sea with no oxygen. Organic residues found in the chert showed evidence of breakdown products of chlorophyll. The ratio of carbon-13 to carbon-12 (two natural carbon isotopes) is lower than in today's atmosphere, which implies photosynthesis, as plants have a marked preference for carbon-12 when photosynthesizing, lowering the ratio.

© Lee Gutteridge – 2 December 2005

Lichens are composite plants composed of algae and fungi. Algal components are generally single celled forms belonging to either the chlorophyta or the cyanophyta. When free from the fungus the algae may exist normally. The fungal component is generally an ascomycete or basidiomycetes. The fungal component cannot live without the algae, unless special nutritive material is provided. The algae provide the food and the fungi provide moisture and shelter from high light. There are four distinct layers in lichen, the top and bottom being intertwined fungal filaments. Algal cells form a green layer beneath the top mass and a layer of loose hyphae (fungal threads or filaments) lay below the algal cells. They are slow but efficient soil formers and are pioneer plants (they will form on lava before any other plant). To classify lichens into groups a simple method was established based purely on appearance. Fruticose lichens are made up of small tubules or branches. Foliose lichens are leaf shaped. The most common type we encounter is crustose lichen, which is common on rocks and vegetation. Indeed any natural bright colouration on rock or bare wood is likely to be crustose lichen. Lichen can reproduce asexually, simply by the distribution of small pieces of the thallus. Many lichens produce a special powdery body to help spread themselves vegetatively. These are called soredia (singular, soredium). Both the algal and fungal components will develop these spores, with the fungal dying soon if not in contact with an algal spore. The algal spore will survive if there is no fungus however. Sexual reproduction can also occur, and is characteristic of the types of fungi evident. Two types which occur in South Africa are the orange *Caloplacca cinnabarina* and the creamy yellow *Dermatiscum thunbergii*.



The orange lichen is *Caloplacca cinnabarina*.

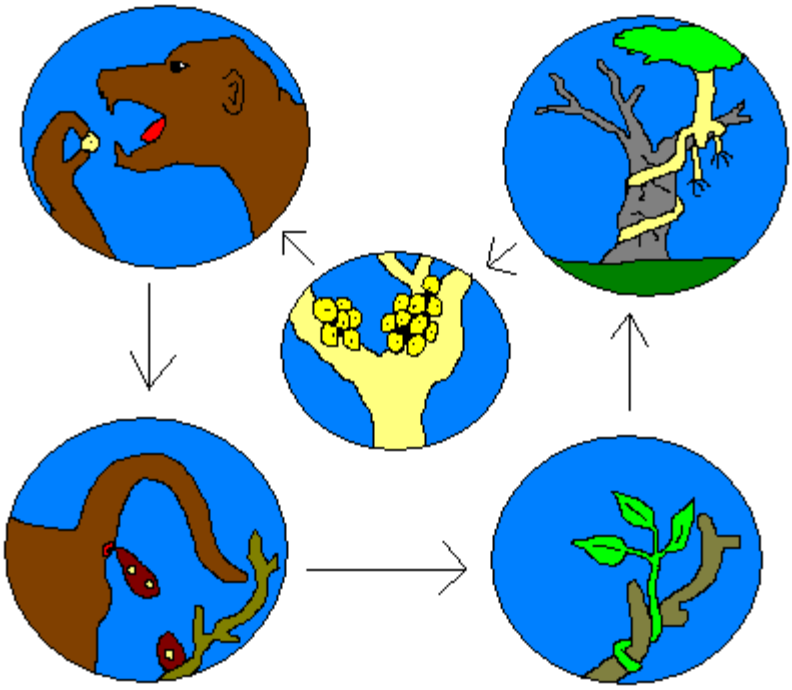


A cross section of a lichen plant.

© Lee Gutteridge – 2 December 2005

The symbiosis between Strangler Fig trees and their hosts

The principal species of Strangler Fig in northern and eastern South Africa is the *Ficus thoningii* or Common Wild Fig. They parasitize many species of tree including Marula, Knobthorn Acacia and African Mangosteen. The seed bearing fruit is eaten and carried by birds, Baboons, Monkeys and Fruit Bats from a Fig tree to various other species of tree where they may roost or forage. Seeds which survive the digestive processes of their transporters are often deposited in dung on a suitable substrate such as the fork of a tree branch. The seed sends out a root system to tap into the host trees bark and anchor it in place and then begins to send its own roots down to the ground. The young Fig tree produces very large leaves in order to produce a lot of food as quickly as possible. With time the roots which have reached the ground thicken and will wrap around the trunk of the host, restricting lateral growth. The trunk of the Fig which is growing from a point several metres above ground level on top of an extant tree, soon reaches higher than its host and spreads a leafy canopy, cutting off most of the available sunlight, thereby impairing the photosynthesis processes' of the host. After a time the host tree will die and begin to rot away, leaving a root system, which is now hollow and tubular in the absence of the woody host trunk. Many giant specimens of Fig have a hollow trunk for this reason. With time the branches of the Fig will drop aerial roots which when they reach the ground level will appear as smaller stems, supporting the huge spreading branches of the tree. This tree in turn will provide a micro habitat for many species.



The cycle of a baboon eating the ripe fruit, defecating in a suitable site, propagation, strangling of a host and bearing of fruit as a mature tree.

© Lee Gutteridge – 2 December 2005

The symbiosis between birds and ants

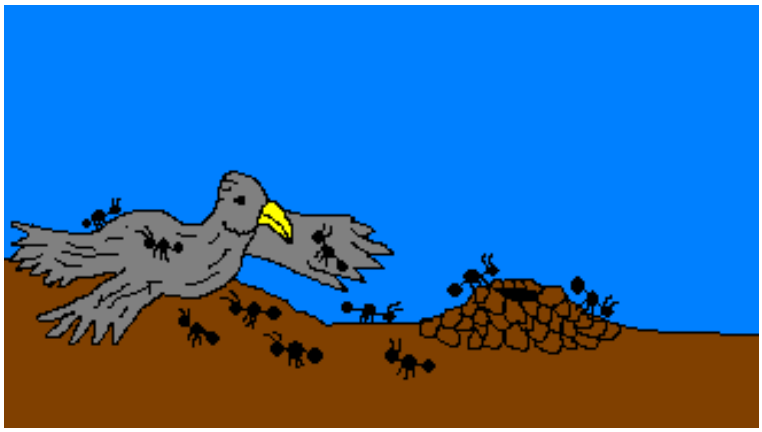
Birds of many species perform a cleaning function called anting. This takes place in two ways, passive and active. During active anting, an ant is picked up and rubbed on the feathers. During passive anting, the bird will lie or crouch on the ground and spread the wing and tail feathers, allowing the ants to crawl all over the bird. This takes place next to or on an ants nest, and vigorous ruffling of feathers seems to attract the ants. The ant species most commonly involved in this behaviour is the pugnacious ant, *Anoplolepis custodiens*, which squirts formic acid from its abdomen. It is believed generally that the acid has a detrimental effect on the ectoparasites such as louse flies of the family *Hippoboscidae*, bird ticks of family *Ixodidae*, body lice of family *Mallophagidae* and feather mites of family *Analgesidae*. There is however a dispute as to the validity of this function as during active anting the ants are rubbed against the tips and outer edges of the primary remiges and retrices and the majority of the mites and lice are actually in the down, or at the base of the feathers and on the innermost feathers, so how much of the acid actually reaches the parasites? (Solomon Dec 2001 FGASA newsletter).

A Russian researcher found that a Pippit had reduced mite loads after anting but this is the only time that this has been scientifically demonstrated.

According to Solomon there are 17 species of bird in South Africa which participate in anting. Passive – Rock Kestrel, African Finfoot, African Hoopoe.

Active – White-backed Mouse Bird, Fork Tailed Drongo, Cape Robin, Black-eyed Bul bul, Red-eyed Bul bul, White Crowned Shrike, Fiscal Fly-catcher, Paradise Fly-catcher, Cape White-eye, Wattled Starling, Greater Blue-eared Starling, Red-winged Starling, Cape Weaver, Spotted Backed Weaver and Red Bishop.

An article by Peter Ryan in Africa birds and birding discusses possible anti-bacterial properties of the excretions of certain glands in ants, which may assist in the reduction of feather eating bacterial loads. Moulting at certain times of the year may also help with this process, along with sunning and dust bathing.

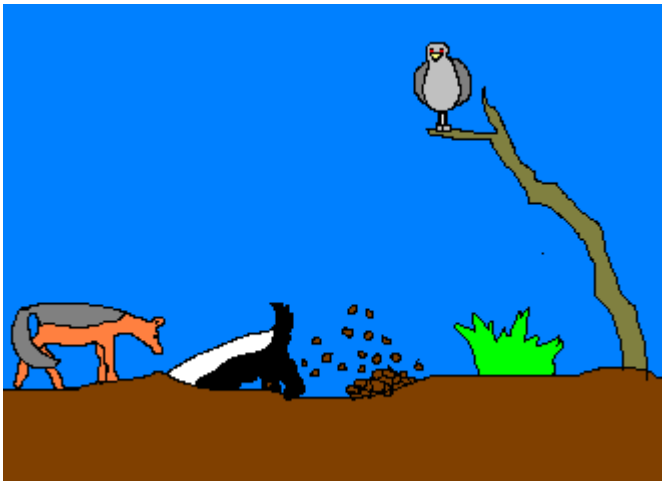


A bird passively anting at an ant nest.

© Lee Gutteridge – 2 December 2005

The symbiosis between the Honey Badger, Black-Backed Jackal and the Pale Chanting Goshawk.

The Honey Badger is a powerful digger and often excavates the burrows of rodents to catch the occupants. In fact in a study of the stomach contents of seven Honey Badgers in Zimbabwe 51% of the diet was family *Muridae* (rats and mice)(Smithers). The rodents often have several access and exit burrows which means a large percentage of the rodents will escape. This escape percentage is dramatically reduced however when Jackal and Goshawk are in the area, taking advantage of any prey item that may escape the Badger. The Jackal is much faster than the Badger and the Goshawk perched a few metres from the ground will see any potential escapees. This is a commensual relationship in that the Honey Badger is not being harmed as the rodents would have escaped anyway and the Jackal and Goshawk are the only ones to benefit.



A simplified picture of the Honey Badger at work digging for rodents, accompanied by a Goshawk and a Black Backed Jackal.

The symbiosis between Orchids of the *Ansellia* genus and their hosts.

The African Leopard orchid is Hemi-parasitic (*epiphytes*), in that it does not kill or seriously injure its host, but cannot survive without assistance, particularly as a young plant. There are 15000 species of orchid world wide. All forms are perennial. The *Ansellia* Orchids have a basket forming root system which anchors itself into the bark of a host tree and slowly grows into a basket shape which will eventually catch falling leaves and dust to form an arboreal compost heap of sorts. This is to become the food source for the plant. It has green leaves and photosynthesises its own starches. It basically uses the host tree for support, and may live for more than a hundred years and reach a width of a couple of metres.

The symbiosis between the Brown Hyaena and Lion.

The Lion is a large carnivore which is adept at hunting its own medium to large prey. The Brown Hyaena is primarily a scavenger, and will commensally benefit from occurring in a sympatric range with a Lion, by being able to eat any carrion that is left over. The hyaena will have no direct effect however, on the Lions. Brown Hyaena will not move within 200m of Lions on a kill, and will wait for half an hour before moving in on a kill which the Lions have utilised. With Leopard and Cheetah however a Brown Hyaena will steal the carcass.

© Lee Gutteridge – 2 December 2005

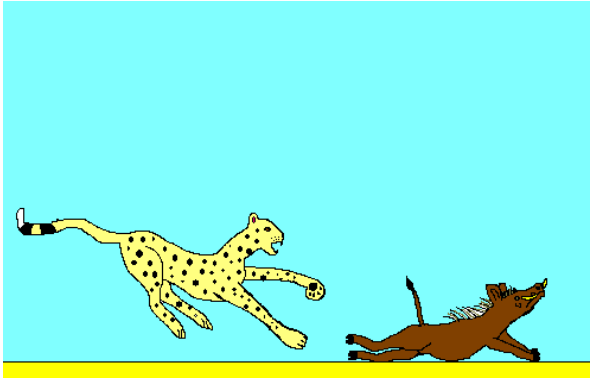
THE ARMS RACE IN NATURE

The arms race in nature refers to the constant competition and development of the prey and predator interrelationships of the producers and primary consumers, and the primary and secondary consumers.

The arms race between the Cheetah and the animals upon which it preys.

The Cheetah first started to develop into a high speed hunter when its prey, medium to small antelope and suids started to learn to run fast to escape predation. The Cheetah has existed in its present form, for close on one million years (fossil remains from late Pleistocene beds in Bulawayo).

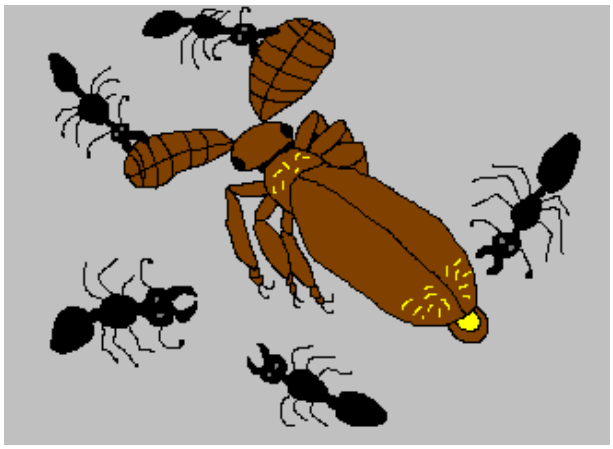
The Cheetah fills a diurnal open habitat niche to exclude competition with most other large predators. The Cheetah has a highly adapted body, built for speed, with a flexible spine, long tail (almost rudder like), detached clavicles (to allow unrestricted movement of the shoulders), cartilaginous scapula (flexibility of the shoulders again), large nostrils for fast air flow, large lungs, long legs, semi-retractable claws which show in the tracks (running spikes), slightly elongated 2 outside rear lobes on the plantar pads (visible in the spoor and increasing traction when turning) and a rapid suffusion of lactic acid into the muscle tissue causing a stiffening of the animal's muscles and prevention of oxygen starvation of the tissues when chasing game by being forced to stop because of this system. A biological shutdown to prevent damage to the Cheetahs system. The Cheetah also has smaller canines than other big cats, leaving more space for nostrils (space which would be occupied by canine roots), as well as less muscle on the head, therefore reducing the power of the bite and leaving the slender Cheetah to finish off its prey by suffocation instead of a spinal bite. In this regard it benefits the Cheetah if the prey is exhausted and already oxygen starved, as it will succumb to suffocation more quickly and prevent harm to the lightly built Cheetah. The antelope have developed high speeds i.e. Springbok which can run at approximately 80 km per hour, and the ability to twist and turn at high speeds i.e. Steenbok. The Cheetah however, is seldom able to defend a kill from other predators due to its light build, the price it pays for specializing itself so much. Even Jackals have been recorded as pushing a Cheetah from its kill.



© Lee Gutteridge – 2 December 2005

The Ants Guest Beetle and its hosts.

The Ants Guest Beetle, family *Paussidae*, is Myrrmecophilous. This means, literally, ant loving. The beetle lives in ants nests, where it preys in its larval stage upon the larvae of the ant colony or as an adult depends on trophyllaxis (mouth to mouth feeding by the ants) and have spoon shaped mouth parts which are used to beg food from the ants. The ants can be very aggressive and dangerous, some of which have stings or spray formic acid, so the beetle had to adapt itself to pacify the ants. The beetle secretes a substance from the sub-cutaneous glands, indicated by the presence of yellow hairs, which the ants lap up greedily, and this fluid some how calms the ants. These yellow hairs or trichomes are found on the protothorax, antennae and the tip of the abdomen. Larvae have a cup shaped bowl (anal cup) at the end of the abdomen which is full of trichomes, and is used to appease the ants. More primitive species of ant's guest beetles use their tough integument and flattened limbs as well as bombarding the ants with a gas containing quinones from special pygidial glands. Pupas also have trichomes. The ants also make use of the specially adapted antennae of the beetle to drag the beetle around from chamber to chamber, and put it where they want it. The more specialized groups of Pausids only leave the hosts nest to mate. This is a case of true social parasitism, as the association is obligatory for the beetle. In South Africa there are about 85 species. (Scholtz and Holm 1985)

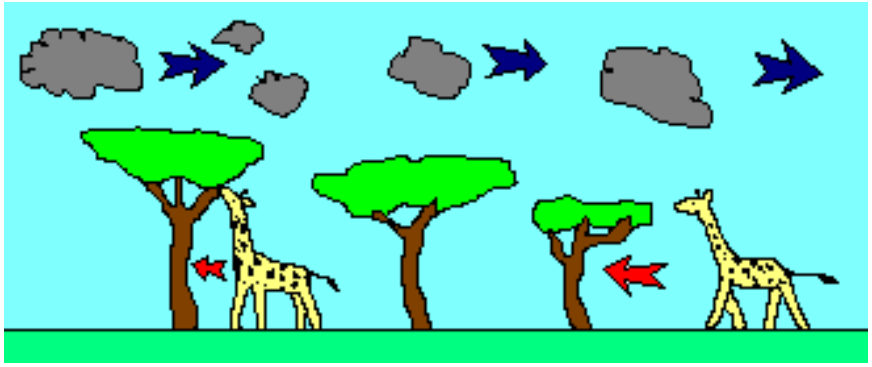


The Ants Guest Beetle being dragged by ants using the specially designed antennae in an ant nest. Note the hairs, or trichomes on the abdomen and thorax.

© Lee Gutteridge – 2 December 2005

The Giraffe and the Acacia species which it eats.

The Giraffe is thought to have begun evolving from a Chevrotain like animal about 20 million years ago (Kingdon 1997). It increased in height to exclude competition from other folivores, along with the increased height of trees. Trees of the Acacia group produce tannins as a defensive mechanism, affording the leaves an astringent, bitter taste, which will poison an animal which eats too many tannin saturated leaves. The Giraffe can therefore not feed on any one tree for too long. The Giraffe moves every few minutes to feed on a different tree. The trees counter this move by causing a plant hormone to be produced which, when carried on the wind will trigger production of tannins in all down wind trees. The Giraffe's response is to feed into the wind, thereby 'creeping up' on unsuspecting trees. The production of thorns is another chapter in this arms race, where certain leaves developed into thorns to protect foliage. The Giraffe's response to this is a 45 cm long, leathery tongue which is impervious to the thorns, as well as bristly tough, prehensile lips. The trees such as the umbrella thorn Acacia grow in a flat topped fashion to prevent Giraffes from feeding on the leaves in the central region of the crown, and do not produce as many large thorns in this area, leaving energy for food production, not defence.

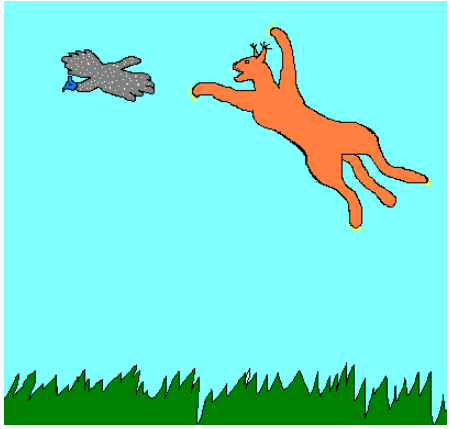


The top arrows indicate wind direction, and the bottom arrows indicate the Giraffes feeding direction.

© Lee Gutteridge – 2 December 2005

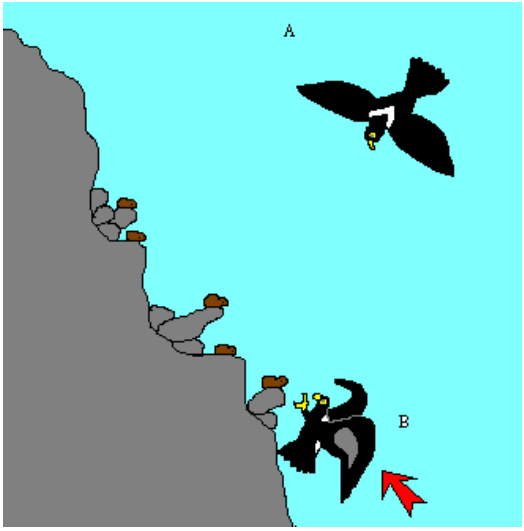
Caracal and the birds upon which it preys.

The Caracal is a specialized hunter of birds renowned for its jumping capabilities. (one record of a tame Caracal which was startled claimed that from a sleeping position the Caracal leaped up and hit the wall, leaving footprints 8 and a half feet up the wall). This leaping ability is one of the things which have helped the Caracal to be an effective hunter of birds. The hind legs are disproportionately long and muscular to facilitate this.



The Black (Verreaux's) Eagle and the Dassie or Rock Hyrax.

The Verreaux's Eagle is an avid hunter of Dassie's, and has developed certain hunting techniques to facilitate this. These Eagles are usually seen in pairs, and will soar at great heights observing Hyrax colonies on the cliff faces, but flying so high that the Hyraxes are not disturbed by them. After observing their intended victims precise location the Eagles begin their attack. The Hyraxes live and forage in areas where there is plenty of rock cover and tunnels etc. for escape purposes. One of the eagles will usually attack from below, under cover of the rocks, with the other flying high as the decoy.



Eagle **A** is the decoy, and **B** is the hunter. The arrow indicates the hunter's direction of attack.

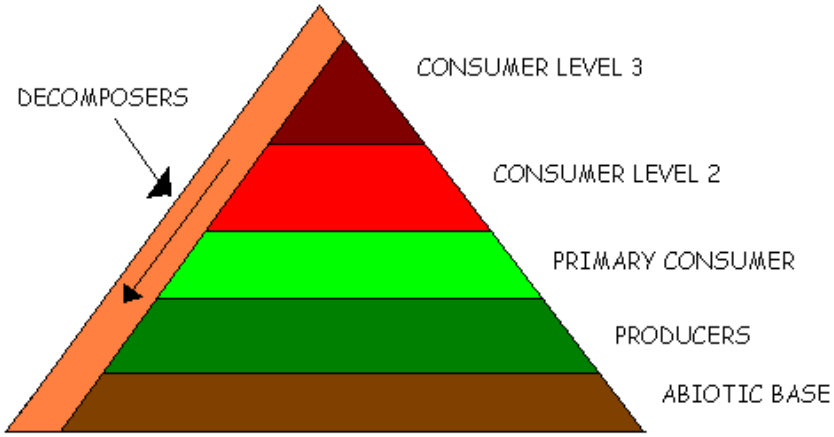
© Lee Gutteridge – 2 December 2005

ECOLOGICAL PRINCIPLES

Some of the principles of ecology. These are diagrams and general principles which govern biology and ecological structure in nature.

The trophic triangle or pyramid

This diagrammatic representation of how food is cycled in the environment provides an abiotic base, which is the largest surface area, being soil and other inorganic material. This allows for the growth of producers, being plants, which by definition produce their own food by means of photosynthesis. Consumer level one feeds directly on the producers (plants) and are therefore herbivores. Consumer level two, are carnivores feeding upon consumer level one. Consumer level three is not always included in a trophic triangle but deserves mention as there are predators that feed upon predators, as well as scavengers. An example of a predator that feeds exclusively upon predators is the Cape File snake. This reptile feeds exclusively upon other snakes, and has in fact developed a certain amount of immunity to the venom of dangerous snake species. Another commonly seen example is the Brown Snake Eagle. I have also watched White Backed Vultures feed upon the carcass of a Spotted Hyaena, killed by a Lions. This is all then broken down and recycled by bacteria etc., also known as decomposers.



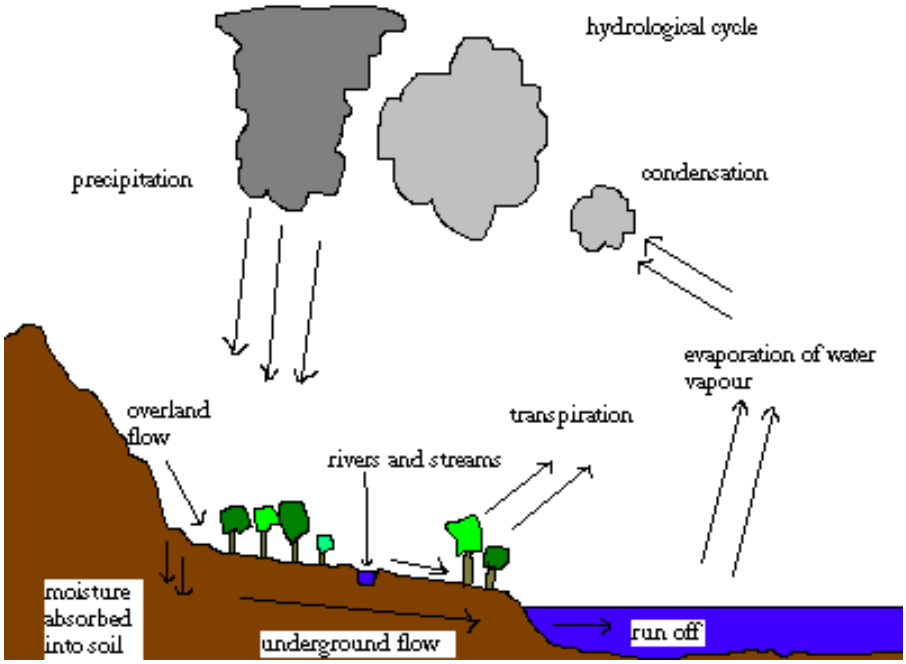
Natural selection

Each species of animal is a product of evolution, adaptation and modification to fit a specific niche. For example, if an animal is born with a slightly better horn structure, during the rut it may be able to defeat its rivals, and not break its horns when its rivals do. It would then have the opportunity to mate with some of the available females and would pass on the genetic material of strong horns to its offspring, affording them the same advantage for mating in the future. This would eventually become the standard for this animal in its area. Other such evolutionary successes are height (Giraffe), speed (Cheetah) and the great leaping capabilities of some animals (Kudu). Some animals however developed specializations such as manes, trunks, digging claws and large teeth or long tongues. These were probably not present in ancient or ancestral species, but by means of natural selection the modern descendants have these adaptations as the norm.

© Lee Gutteridge – 2 December 2005

The Hydrological Cycle

This is the process whereby water is recycled through the natural system. The following diagram represents the stages a water droplet passes through.



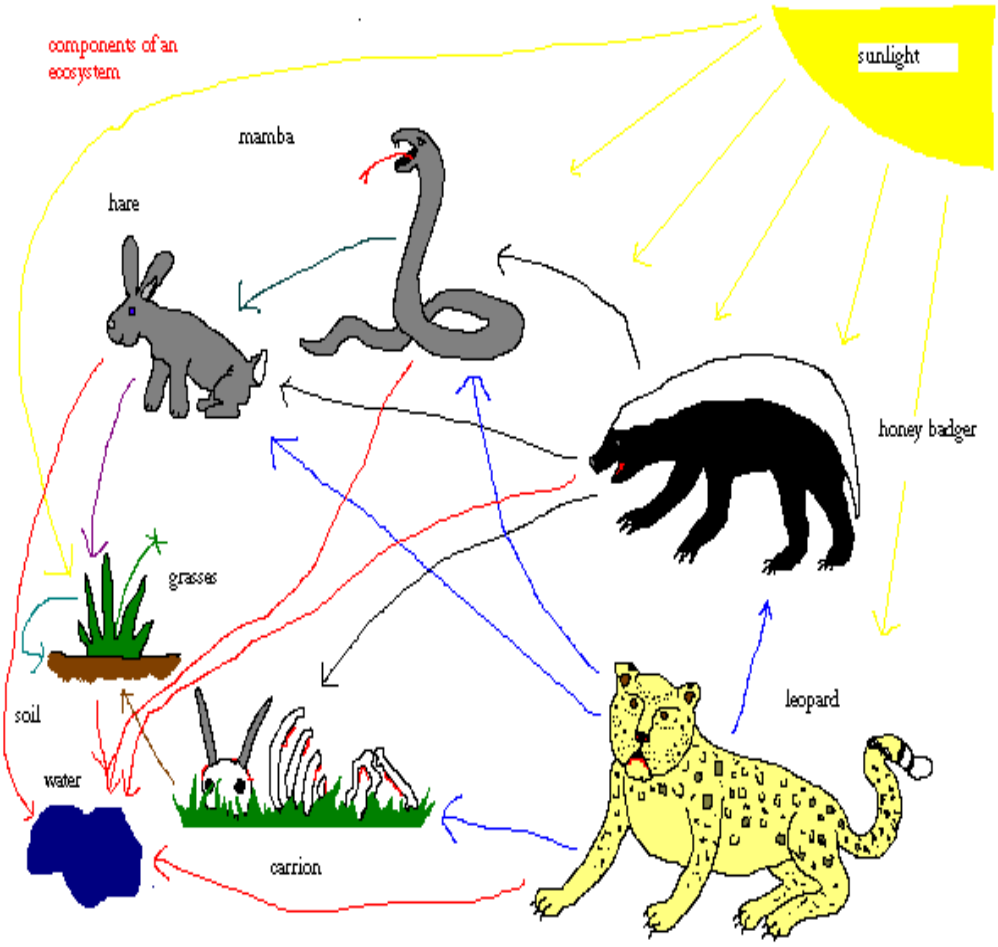
The meaning of the word ecology

The word ecology is derived from the Greek words oikos, meaning home and logos, meaning study. Therefore ecology literally means the study of our home.

© Lee Gutteridge – 2 December 2005

The Components of an Ecosystem.

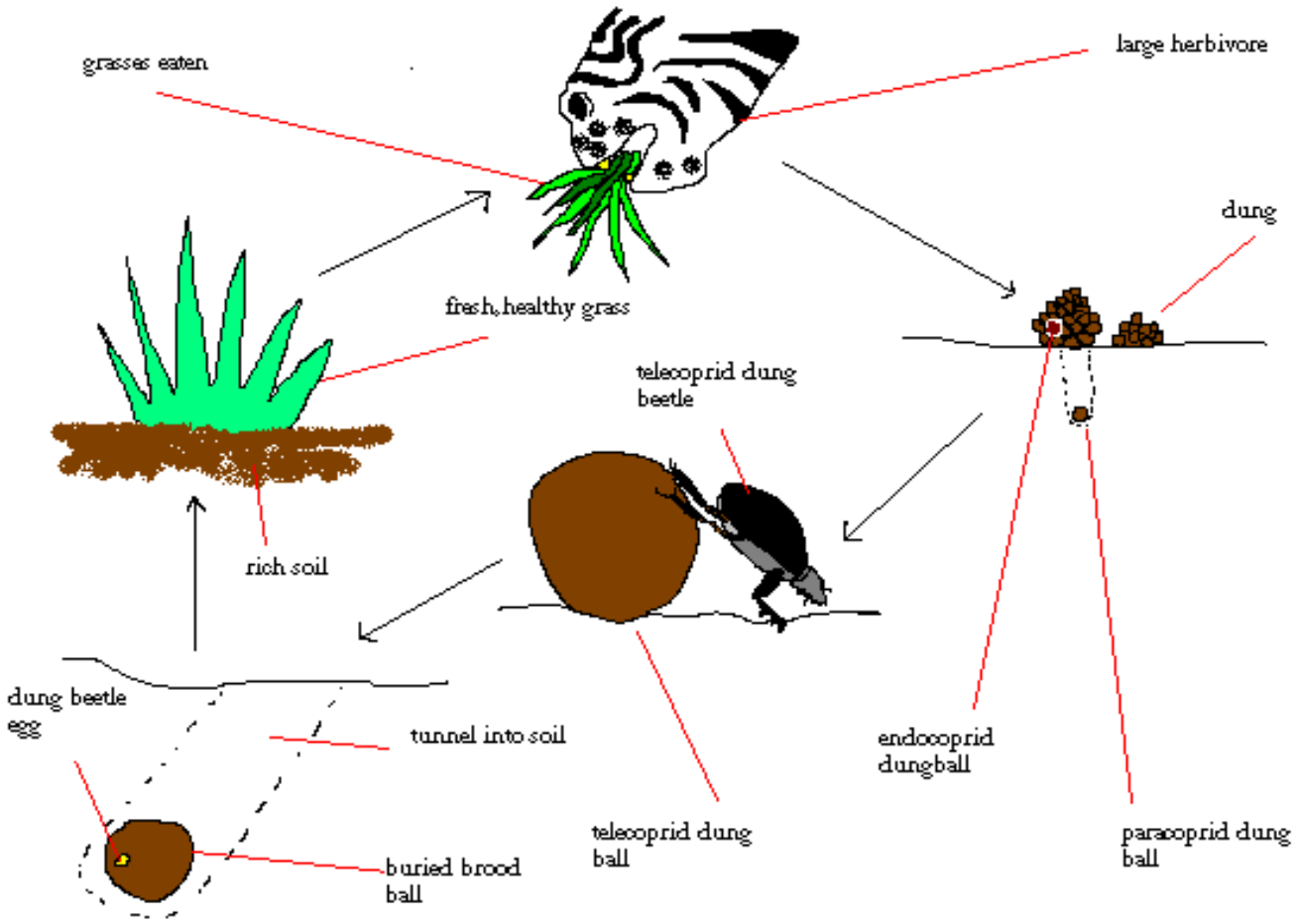
These are all aspects of nature which live together and have bearing upon one another's lives, from abiotic base matter to consumers at level three.



In this diagram there are a few different organisms which all interrelate in an ecosystem, and have some effect on one another. Examples of these interrelationships are as follows. The hare eats the grass, the grass grows in the soil which is enriched by the carcass rotting, which was killed by the Leopard that also eats Honey Badgers and snakes and hares. Without sunlight and water however none of the production of plant food would take place, thereby eliminating a food source for the consumer level one etc. All of these aspects are linked to one another and the arrows show directly linked components. Effectively there is a link between all the organisms shown here.

© Lee Gutteridge – 2 December 2005

The Nutrient Cycle



Vegetation utilized by herbivores passes into their digestive systems and is broken down by means of bacteria secreting cellulaze to break down cell walls made of cellulose (in plants). This is then deposited in the form of dung after the mammal has utilized all it can, and falls to the ground. Here it is broken up mechanically by dung beetles and an array of other insects into smaller portions which are translocated in some cases (except endocoprids) and buried, where the larvae of the beetles can break down the dung, accompanied by bacteria and fungi which will even more efficiently decompose all remaining dung matter into minerals and nutrients etc which can be utilized by plants in their development of photosynthesized starches. Further links can be added by incorporating predators which further digest the herbivores which have ingested the plants, and already broken down into useable proteins the nutrients from the plants.

© Lee Gutteridge – 2 December 2005

The Greenhouse Effect

This describes the process whereby layers of carbon dioxide accumulate around the earth within the atmosphere and create a gas 'blanket'. Under natural circumstances this is favourable, allowing for habitable temperatures on earth. Without this 'blanket' the earth would be about minus 16 ºC, and an icy wasteland.
However, with the added gas emissions of carbon dioxide caused by man and his industries, other problems are occurring, upsetting the balance which has sustained life on earth for million of years. Heat radiation from the sun has a short wavelength compared to reflected radiation off the earth's surface, which has a longer wavelength. This then means that the short wavelengths access the blanket easily, but the long wavelengths bounce back and are reradiated, as they cannot pass through, causing a gradual heating up of the earth's atmosphere. We are now finding that the temperature of the earth's atmosphere is heating up as carbon dioxide builds into a thicker blanket, allowing less of the heat radiation to escape.
Power stations create about 30% of the gas, industry 25%, homes 11% and cars 30%. The USA, Russia, Japan, Germany, Britain and S.A. create most of these carbon dioxide deposits.
Possible effects of the Greenhouse effect are -

- Melting of polar ice caps, raising water levels.
- Spread of disease bearing organisms into new ranges.
- Extinction of species

Nitrogen constitutes 80% of the earth's atmospheric gasses, oxygen 19%, and carbon dioxide 0.03% (with methane, chlorofluorocarbons, nitrous oxide and water vapour comprising the rest.)
With the current rate of gas emission the average global temperature has increased by 0.5 degrees Celsius in the last hundred years. Not too much of an increase is required in order to melt the ice caps, which would cause most existing coastlines to submerge.

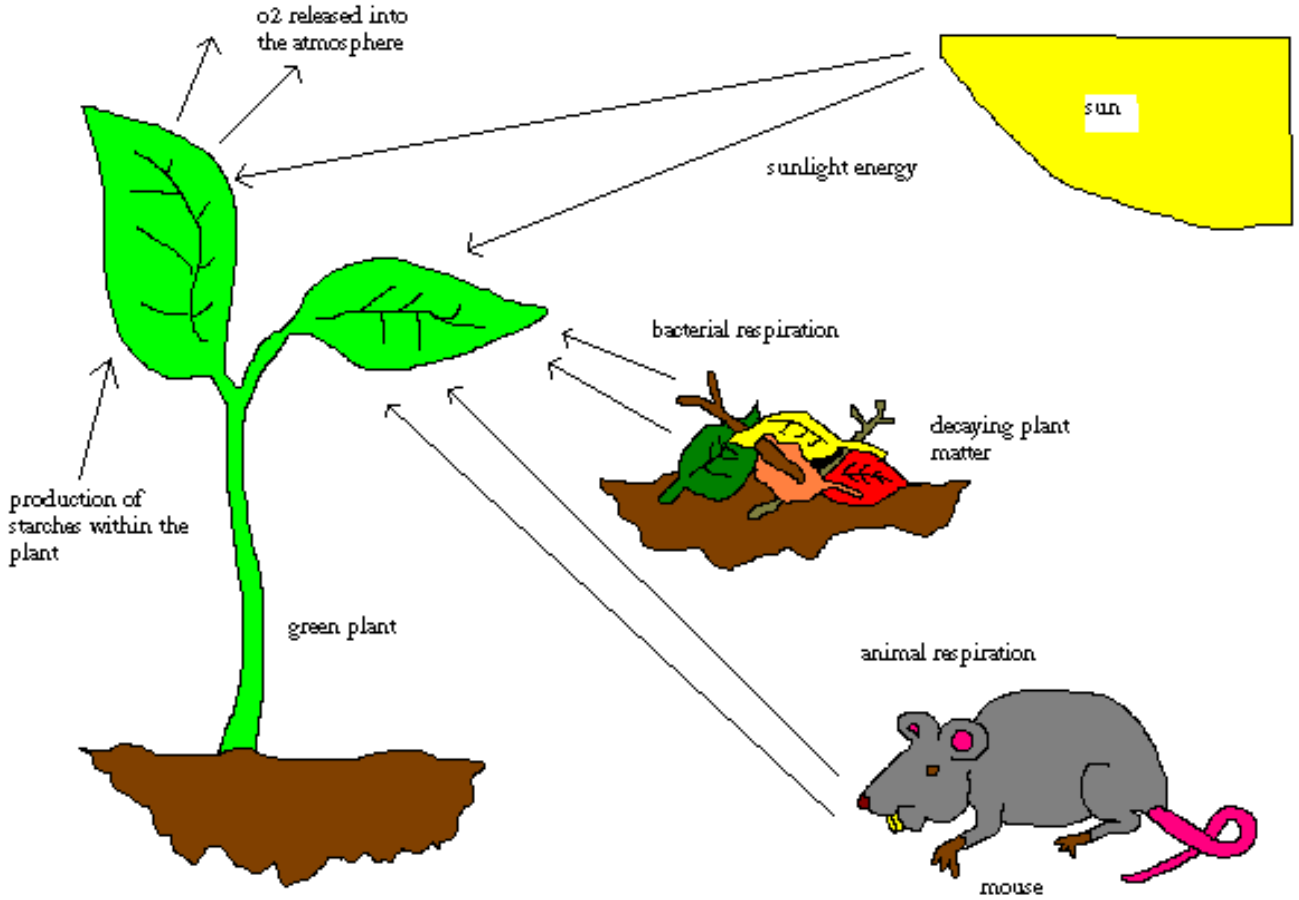
The Ozone Layer

Ozone is a bluish gas which is an allotrope of oxygen (different molecular form) with 3 atoms (O3) instead of 2 (O2). Ozone shields life on the earth's surface from harmful ultra-violet (UV) radiation. UV has a shorter wavelength than visible light, but does not pass through thick layers of Ozone. The layer of ozone around the earth is between 10 and 50 km thick.
A British research group in Antarctica found in 1982 that the Ozone layer had a hole in it, and the next year it had increased in size. This was attributed to chlorofluorocarbons (CFC's). Ozone was first identified by an English professor called Dobson in the late 50's, and the unit of measurement for Ozone is now the Dobson unit. A second type of UV called UV-C has been discovered which in laboratory experiments has destroyed RNA, DNA and protein, the building blocks of life.
CFC's are chlorine based, and chlorine reacts with the three molecule allotrope, causing it to become a two molecule allotrope. It has been estimated that a single chlorine molecule can destroy thousands of Ozone molecules. Each chlorine molecule will act repeatedly, to destroy more and more Ozone.

© Lee Gutteridge – 2 December 2005

Photosynthesis

This is the process whereby plants utilise sunlight (heat energy), water (H2O), carbon dioxide (CO2) and chlorophyll to make plant sugars (C6 H12 O6) and breathable oxygen (O2).

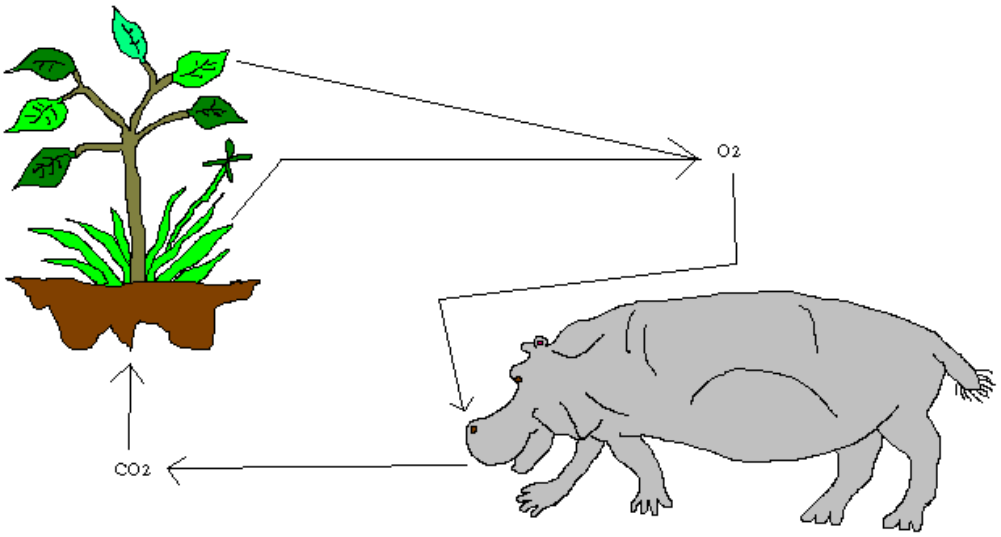


The process:

Plants contain a pigment called Chlorophyll 'A' which is contained in the chloroplasts and drives the process of photosynthesis. Plants absorb water through the roots and carbon dioxide through the leaves and these 6 CO2 and 6 H2O, in combination with energy from the sun and the catylistic influence of the chlorophyll, produce a plant starch (C6 H12 O6) and a by-product of 6 O2's (part of breathable air). Air is utilised by mammals, and other animals, and CO2 is produced by animals and bacteria.

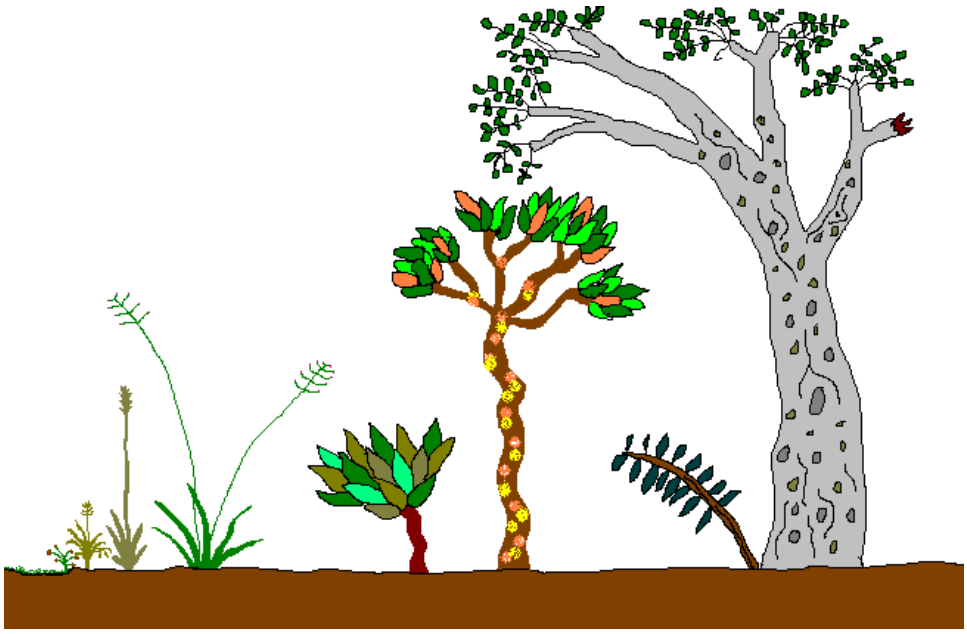
© Lee Gutteridge – 2 December 2005

The Oxygen Cycle



Green plants produce oxygen which is in turn consumed by animals in respiration, and then exhaled as carbon dioxide this is then recycled in the process of photosynthesis, producing the by-product of breathable oxygen, along with plant starches, to be reused by animals**.**

Plant Succession



Plant succession is basically the reclamation of barren ground by plant life. First mosses and algae, then weeds and pioneer grasses will take root. These plants are usually non-perennials which will die off in the winter months. Sub-climax grasses, tougher weeds and forbs begin to grow next, providing ground cover, followed by climax grasses and small bushes, & lastly by small trees and large climax woodland community trees. Retrogression is the same in reverse, from climax to pioneer.

© Lee Gutteridge – 2 December 2005

The Niche Theory

A niche is an area or aspect of nature which describes where an organism fits into the surroundings, of habitat, activity times and food preference. It describes generally the role of an animal in its environment. Animals develop and adapt through evolutionary processes to fill a specific role in the environment, i.e. a solitary living, nocturnal large predator, which inhabits riparian and hillside habitats and which feeds on small to medium sized mammals would be accurate for a niche description of a Leopard. The Lion by comparison would be a large nocturnal predator, which associates in groups or prides, and hunts large game in grassland or woodland habitats. Animals will adapt to fit into specific vacant niches, and through many generations they will eventually become specifically adapted to their niche. As animals slowly fit into new environmental spaces they will develop new skills and physical adaptations which will facilitate their functioning in the new habitat.

Carrying Capacities

Any given area of veld can only produce a specific amount of vegetation. Animals grazing or browsing in an area can only eat as much vegetation as is produced, so it makes sense that there is a limit to the amount of game that can be carried on any one area of veld. Of course if we allow all the vegetation to be eaten there will be no reproductive stock to produce the next year's vegetation to prevent the animals from going hungry, so we need to look at the quantity of animals on any given area. We also need to look at the fact that dependent upon rainfall, height above sea level, soil type, temperatures and many other variables, the quality of the vegetation as regards food yields and seasonal quality vary. Carrying capacity is in effect the amount of game which can be sustained on a multi-seasonal basis in any given area of veld.

Fire in the Ecosystem

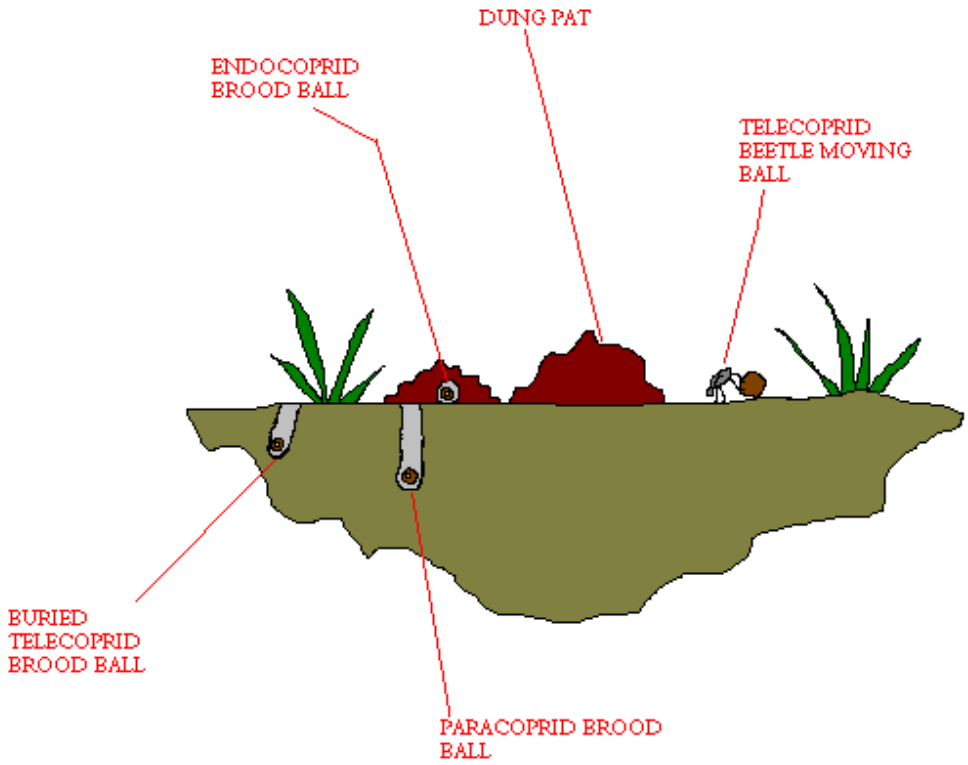
Fire plays a limiting role for certain plants and vegetation groups in the ecosystem. Fire can stop the spread of some thicket forming plants such as sickle bush, which is a notorious encroacher, and assist with the spread of others such as certain protea species. Fire is an important natural agent in the savannah and fynbos biomes, which has helped over the ages by means of lightning strikes, to control the delicate balance of the vegetation groups.

Sectional Burning Programmes

Sectional burning takes place in game reserves, where boundary fences prevent the migration of game. In these artificially maintained environments if all vegetation is burned simultaneously the animals can not leave to find new food supplies. In these instances the managers of the reserve can only burn small areas at any one time, to ensure continued food resources. This is known as block or sectional burning.

© Lee Gutteridge – 2 December 2005

Nutrient Reabsorption in the Ecosystem



Dung contains a huge amount of nutrients which are recycled into the soils by bacteria and fungi. In order to make this efficient however several other creatures are involved in the breaking down of these dung pats into more manageable units such as dung beetles. These combined activities facilitate a speedy reabsorption of vital nutrients into the soil.

The Function of Parasites and Diseases in the Ecosystem

The general impression of diseases and parasites is a negative one, and in many instances this is correct. However in circumstances of extreme weather, such as droughts, or other times where strength is a requirement for survival such as predation, disease and weakening by parasites can assist with natural selection of the strongest genetic material. The surviving individuals of a population usually have stronger genes or better immunity to a disease or resilience to parasites and are therefore more likely to survive. The weaker animals will often die off, or be eaten, leaving more food, and other valuable resources for the genetically strong.

Acid Rain

Acid rain is the term applied to precipitation which has collected particles of pollution from the atmosphere and become acidic, i.e. a PH less than 7. The main producer of acid rain is sulphur dioxide, which is a by product of industry.

© Lee Gutteridge – 2 December 2005

Deforestation

The clearing away of trees and natural forests is a great problem in South Africa and it has been estimated that 40% of our natural forests are gone. These forests are cleared for fire wood collection, clearing ground for crop planting, planting of non-indigenous forests and to make space for buildings. The major problems are depletion of diversity, soil degradation and loss due to exposure and erosion and a shortage of forest products.

Desertification

Desertification is a result of over or mis-utilization of cultivated areas, denuding ground cover by cutting for fire wood and / or of poor irrigation techniques. Poor weather such as droughts can increase the effects of desertification. Approximately 30 000 000 hectares are rendered agriculturally worthless every year due to this process.

© Lee Gutteridge – 2 December 2005

MAMMALS

GLOSSARY OF TERMS

1. Albino – An animal with little or no pigmentation.
2. Aloe-grooming – Reciprocal grooming between two members of the same species i.e. Impala.
3. Anal pouch – A pouch which houses scent glands, and is situated in the anus of the mammal, and protrudes for use i.e. Brown Hyaena.
4. Androgen – Male hormone which causes aggression.
5. Artiodactyl – Even toed hoofed animal.
6. Auditory bullae – A bony protrusion on each side of the lateral base of a mammal skull.
7. Auditory meatus – The ear canal.
8. Carnassial shear – The cutting edge on the pre-molar of a carnivore.
9. Carnivora – The order to which meat eating mammals belong.
10. Cartilaginous – Soft, flexible bone like material.
11. Civetry – The midden of an African Civet.
12. Colostrum – Anti-body rich milk produced by a mammal just after giving birth.
13. Conspecific – Pertaining to a particular species.
14. Deciduous teeth – Baby teeth, or other teeth that are shed or lost by natural design.
15. Dental formula – a formula depicting how many teeth a species has per half of top and bottom jaws.
16. Dew claw – The claw of a carnivore in the position of a thumb, which seldom touches ground, and is therefore not depicted in the track.
17. Dew lap – the loose fold of skin which some mammals have on the throat, i.e. Eland.
18. Digitigrade – Walking on the toes.
19. Endoparasite – internal parasite.
20. Ectoparasite – External parasite.
21. Endothermic – Produce ones own heat.
22. Estrogen – Female hormone.
23. Fetlock – Ankle of a herbivore.
24. Flehmen grimace – A mammal grimace which opens the organs of Jacobsen, to receive chemical messages.
25. Gestation – The time of pregnancy in mammals.
26. Glands – Chemical signals are produced by glands, as well as secretions such as sweat and milk. Glandular tissue is tissue designed to produce these liquids.
27. Hierarchy – Order of dominance in a population of animals.
28. Hind gut fermenter – An animal which breaks down plant material in the hind gut, with bacteria housed in a cecum.
29. Hoof – An animal's toe, housed in Keratin.
30. Hybrid – Cross breed.
31. Hyoidean processes – A group of bones in the throat of a carnivore.
32. Interdigital – Between the toes.
33. Keratin – The material of which hair and nails are formed.
34. Lactate – To produce milk.
35. Larynx – Voice box.
36. Mammary gland – Where milk is produced in mammals.
37. Marsupial – A group of mammals from Australia and the USA where very little foetal development takes place inside the mother, but most of the growing happens in a pouch on the stomach, i.e. Kangaroo.

© Lee Gutteridge – 2 December 2005

38. Marsupium – This is a pouch.
39. Matriarchal – A society dominated by the female of the species.
40. Melanistic – A recessive gene causes too much melanin, and the animal is darker than it should be, or completely black.
41. Midden – Dung heap which is revisited for territorial purposes.
42. Monotremes – A mammal group in Australia which lay eggs, i.e. Duck Billed Platypus
43. Musth – The breeding cycle of an Elephant bull, taken from the Hindu word for crazy.
44. Oestral cycle – Female mammal's receptive time for successful breeding.
45. Oestrus – As above.
46. Olfactory – Pertaining to smell.
47. Organs of Jacobsen – Chemical signals i.e. hormonal messages, are interpreted by this organ.
48. Ossification – Hardening of bone or cartilage, or a deposit of extra bone material on a break.
49. Ovulation – The time when a female mammals egg is ready for fertilisation.
50. Pachyderm – Thick skinned animal.
51. Paenungulate – A super-order of mammals including Hyrax, Elephant, Dugong and Aardvark. It means literally near ungulates.
52. Patriarchal – A society of animals where the male is dominant.
53. Perrisodactyl – Odd toed hoofed animals.
54. Pheromones – air borne chemical messages between mammals.
55. Piloerection – Raising of the hair on the back to look bigger.
56. Pinna – The visible part of the mammal ear.
57. Post orbital – Behind the eye.
58. Post partum oestrus – sexual readiness after having a recent litter of cubs.
59. Preorbital – In front of the eye.
60. Pro-lactin – A female hormone which causes the female mammal to lactate.
61. Rods and Cones – Sensory cells of the mammalian eye.
62. Ruminant – A mammal with a four chambered stomach, which chews the cud.
63. Sinus – A part of the mammal nasal cavity.
64. Suspensorium – The collective name for the Hyoidean processes.
65. Tapetum – A reflective membrane, full of reflective crystals in the back of a mammal's eye.
66. Testicond – This refers to mammal's with internal testicles i.e. Hippo.
67. Testosterone – A male hormone.
68. Thermoregulation – Literally the control of temperature.
69. Tri-turbinate region – A part of the mammal nose, three small bones surrounded by capillaries which assist in temperature regulation of air and in some cases, blood.
70. Ungulate – Hoofed mammal.
71. Vertebrate – Animals with a spinal chord surrounded by bone.
72. Vibrissae – Whiskers or sensory hairs.
73. Weaving – A form of territorial behaviour performed by Blesbok, involving the secretion from the pre-orbital gland and the thrashing of the horns through this secretion on the grass.
74. Zygomatic arch – Cheek bone in a mammal skull.

© Lee Gutteridge – 2 December 2005

MAMMAL SELF STUDY

This section of training involves self study using mammal reference books to familiarise one's self with the larger mammals of the area. Here is a template which can be copied and used to do this study.

Detailed study guideline for mammals

Common name …….…….

Other names …….

Scientific name (genus and species)…….…….

Family …….. Order ….……

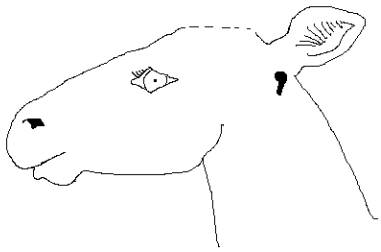
Basic description and colour
……
……
……
……

Weight of adult male …… female ……

Sexual dimorphism (difference between male and female) ……
…….…….

Shoulder height of male …… female ……..

Horn length (where applicable) ……
Draw shape of horn on the diagram below (in antelope only)



Habitat utilized (i.e. river beds, rocky areas etc.) …….

© Lee Gutteridge – 2 December 2005

Special features ……
……..

Social organization (i.e. solitary, bachelor herds, breeding herds, pairs etc.)
……
……

Activity period ……..

Postures and locomotion (how does the animal stand and how does it move)
……
……

Feeding behaviour and food types ……..
……
……
……
……

Interesting feeding behaviours ….....…….

Communication - Vocal (sound)
……..
- Tactile (touch)
……..
- Olfactory (smell)
……..
- Visual (sight)
……..

Dominance behaviour
……
……
……

Territorial behaviour (where applicable)
……
……
……
……

Reproduction
Number of young ……..

Gestation period ……

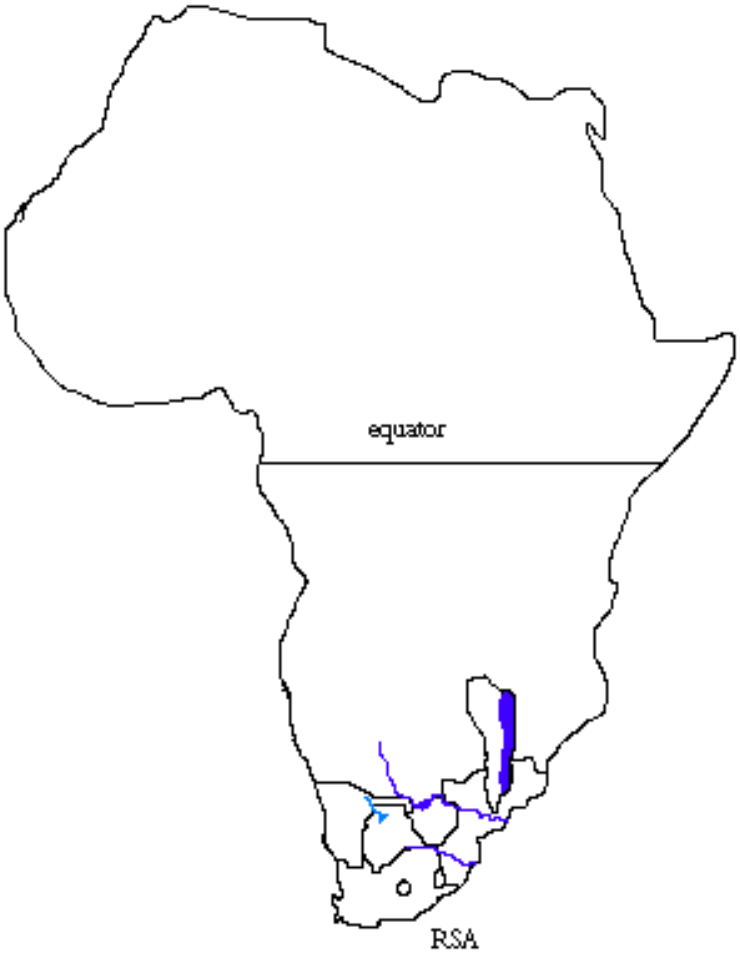
Breeding season ……
Birth season ……...

© Lee Gutteridge – 2 December 2005

Anti-predator behaviour ……..
……
……

Interesting features and additional facts
……
……
……
……
……
……
……
……

Draw in the African distribution of the species.

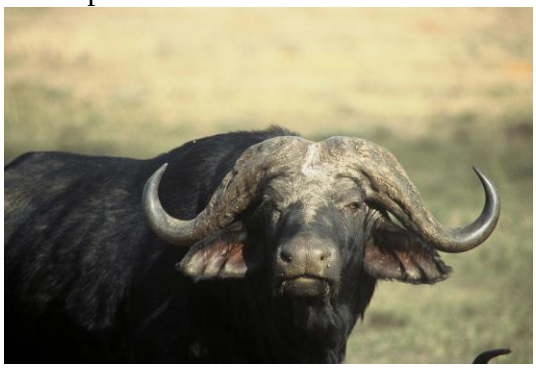


© Lee Gutteridge – 2 December 2005

List of Common Mammals in the Waterberg Region

These are some of the mammals from the Waterberg area, but there are a few such as bats and certain rodents which are not mentioned.

1. Aardvark
2. African Civet
3. African Wildcat
4. Baboons
5. Banded Mongoose
6. Bat Eared Fox
7. Black Backed Jackal
8. Blesbok
9. Blue Wildebeest
10. Brown Hyaena
11. Burchells Zebra
12. Bushbuck
13. Bushpig
14. Cape Buffalo



15. Caracal
16. Cheetah
17. Common Reedbuck
18. Dwarf Mongoose
19. Eland
20. Elephant
21. Gemsbok
22. Giraffe

23. Greater Cane Rat

© Lee Gutteridge – 2 December 2005

24. Grey Duiker
25. Hedgehog
26. Hippo

27. Honey Badger
28. Impala

29. Jameson's Red Rock Rabbit
30. Klipspringer
31. Kudu
32. Large Spotted Genet
33. Leopard
34. Lesser Bushbaby
35. Lions

36. Mountain Reedbuck
37. Pangolin

© Lee Gutteridge – 2 December 2005

38. Porcupine
39. Red Hartebeest
40. Rock Hyrax
41. Scrub Hare
42. Serval
43. Slender Mongoose
44. Small Spotted Genet
45. Springbok
46. Spring Hare
47. Steenbok
48. Tree Squirrel
49. Vervet Monkey
50. Warthog
51. Waterbuck
52. White Rhino

53. Wild Dog

© Lee Gutteridge – 2 December 2005

COMPARED SIMILAR SPECIES

Comparisons between similar species often assist with quick identification in the field, as well as helping to prepare to interpret these differences in the field for guests on a safari.

Cheetah	**Leopard**
Long legs.	Short legs.
Light build. Up to 65 kg.	Powerful build. Up to 85 kg
Small head, little musculature.	Heavy muscular head.
Short canines, 2.5 cm.	Medium length canines 3.5 cm.
Semi-retractable claws.	Fully retractable claws.
Spots on coat and Black tear mark on the face.	Rosettes and spots on coat and no tear marks.
Open habitats.	Closed habitats.
Sprints over open ground to hunt.	Ambushes prey at close quarters.
Can not Growl or roar.	Growls and roars.
Dark coloured eyes.	Light coloured eyes.
Diurnal and terrestrial.	Nocturnal, with arboreal tendencies.
Poor tree climbers.	Good tree climbers.
Outside of plantar pad elongated in spoor.	Outside of plantar pad not elongated in spoor.
Feet not flexible.	Feet highly flexible.
Nomadic, territories held for short time.	Highly territorial.
Eats prey *in situ*, as quickly as possible.	Stores prey up trees.
Small to medium prey animals.	Small to large prey animals.
White Rhino	**Black Rhino**
Head down posture.	Head level or up.
Large, up to 2,3 tons.	Medium to large, up to 1,6 tons.
Square lip.	Hooked lip.
Grazer.	Browser.
Large neuchal hump.	Small neuchal hump.
Raised spinal bump in back.	Saddle like shape to the back.
Open grassland habitat.	Dense bush or river habitat.
Tail curls when running.	Tail erect when running.
Larger spoor.	Smaller spoor.
Young have deciduous canines.	No deciduous canines.
Young tend to run in front of adults.	Young tend to run behind adults.
Tend to be fairly placid.	Tendency towards aggression.
Brown Hyaena	**Spotted Hyaena**
Long coat.	Short coat.
Light build, up to 45kg.	Heavy build, up to 80kg.
Brown colour.	Spotted Black on Yellowish brown.
Scavenger. Seldom hunts.	Scavenger, but often hunts.
Clan living, foraging solitarily.	Clan living, foraging in family group.
Will not compete with Lions.	Will compete with Lions if good enough numbers. Average 6.7 (mills) individuals per

© Lee Gutteridge – 2 December 2005

	aggressive group.
Will carry food to den.	Seldom carries food to den. Will hide food in mud or water.
Not vocal.	Highly vocal.
Huge territories.	Smaller territories.
Red Hartebeest	**Blesbok**
Reddish brown colour with a light rump.	Dark brown colour with white markings and a white blaze.
Handle-bar shaped horns.	Lightly curved horns.
Large antelope.	Medium sized antelope.
Does not weave, rubs face on ground.	Weaves pre-orbital secretions.
Does not do static territorial advertising.	Does static territorial advertising.
Usually does not associate in huge herds.	Often associates in herds of hundreds.
Springbok	**Impala**
Black stripe on side of body.	No Black stripe on side of body.
Two dark stripes on rump.	3 dark rump stripes.
Marsupium containing erectile White hair on rear end.	No Marsupium, white hair on tail.
Often pronks, including high jumps.	Does not pronk, but has a stotting gait for same purpose.
No metatarsal gland, but glandular skin in Marsupium.	Has a pair of metatarsal glands.
Sort slightly curved horns.	Longish, backswept horns.
Occupies dry habitat.	Occupies moist habitat (except subspecies *Petersii*)
Grazer.	Browser and grazer.
Common Reedbuck	**Mountain Reedbuck**
Grey colour.	Reddish grey, with White underbelly.
Lives in moist grassland, and reed beds.	Lives on rocky hills and mountains.
Large, up to 80 kg.	Small, up to 40 kg.
Medium length slightly curved horns.	Short forward curved horns.
Blue Wildebeest	**Black Wildebeest**
Large greyish Blue with Black brindling on shoulder. Black mane and tail.	Black, with White mane and tail.
Lives in wetter climates.	Enjoys arid climates.
Lives in savannah biome.	Lives in grassland biome.
Horns curve outward and up.	Horns curve forward and up.
Very large, up to 290 kg.	Large, up to 180 kg.

© Lee Gutteridge – 2 December 2005

Bushpig	**Warthog**
Long hair. With White mane.	Short sparse hair with Reddish brown mane.
Tail not erected when running.	Tail erected when running.
Tusks barely protrude beyond lip.	Tusks protrude well beyond the lips.
Enjoys dense bush.	Enjoys open grassland and woodland.
17 sub-species.	4 sub-species.
Omnivorous.	Mainly grazer.
Both sexes presumed to be territorial.	Not territorial.
Grey Duiker	**Steenbok**
Greyish brown colour.	Red coloured with a white underside.
Dung dropped in above ground midden.	Dung buried in a midden.
Female is larger than male	Male larger than female.
Live for 12 yrs	Live for 7 yrs.
Male is territorial.	Both sexes are territorial.
Microchiroptera	**Megachiroptera**
Insectivores.	Frugivores.
Use echolocation to find food.	Use only sight to find food (except Egyptian fruit Bat).
Clicks generated in throat.	Clicks generated by tongue in Egyptian fruit Bats echolocation.
Insectivore ancestor, that was able to glide.	Primate ancestor.
Small size. Usually less that 20 cm wingspan.	Large size. Wing span up to 75 cm.
Mostly flat faces and large ears.	Mostly long faces and medium sized ears.
Not often heard vocalising as it is out of human hearing range in many instances.	Often heard vocalising.
Chacma Baboons	**Vervet Monkey**
Large primate.	Small primate.
Long face (more pronounced in males).	Flattish face.
Generally a greyish brown colour.	Light grey in colour.
Less arboreal, except when running or feeding.	Mostly arboreal.
Will eat meat on occasion.	Herbivorous except for insects.
Female's rumps swell when ready to mate.	Sexually active males have Blue testicles and a Red penis.
Aardvark	**Pangolin**
Hair covers the body.	Scales cover the body.
Up to 65kg.	Up to 18kg.
Moves on four legs.	Moves on two legs.
Runs and hides in a burrow when disturbed.	Curls into a defensive ball when bothered.
Digs burrows readily.	Prefers to use an existing burrow, but can dig.
Cannot climb.	It is a slow but capable climber.
Young move alongside mother.	Young ride on mothers back or base of tail.

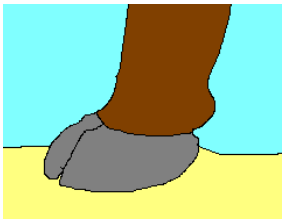
© Lee Gutteridge – 2 December 2005

MAMMAL ORDERS

The following section is a brief discussion on some mammal orders and prominent members and characteristics. Ancestry is also covered where possible.

Artiodactyla

Members include Giraffe, Buffalo, Impala, Kudu, Warthog and the many other cloven hoofed animals from our region. Also the Hippopotamus, which has four toes. Artio means even, and Dactyla means toes. Many of these animals such as the Giraffe and antelope are ruminants. They have a four chambered stomach, with a rumen, omasum and abomasum, reticulum and duodenum. These animals re-chew food regurgitated from the rumen back to the mouth to ensure that it is as fine as possible for the bacteria and protozoans to break it down in later stomachs. The Warthog breaks food down in the hindgut, by means of fermentation caused by bacteria in the cecum. The Hippo however is the only foregut fermenter in the order, which has the fermentation processes before the stomach where absorption takes place. All these animals are herbivores predominantly, with some such as Warthog, Duiker, Bushpig and Giraffe occasionally eating meat and bone. These animals have sideward facing eyes for peripheral vision and predator detection. The ancestry of the various Artiodactyl groups is as following. Hippo evolved from a pig like ancestor, diverging from this line about 40 million years ago. Up until 1 million years ago there were at least 8 species of Hippo in Africa. Now there are two. The pig family evolved from its ancestors, believed to be a Eurasian Wild Pig, about 10 million years ago according to Kingdon and 30 million years ago according to Smithers. The exact origin of the Warthog is unknown but there were Wild Pigs twice as big as the modern Warthog dug up in Pleistoscene deposits from the Vaal river area. Giraffes are believed to have evolved from a Chevrotain like creature about 20 million years ago. Bovids are believed to have developed from Eurasian ancestors, and due to continental separation they developed along separate lines. This split was about 20 million years ago

1  2  3 

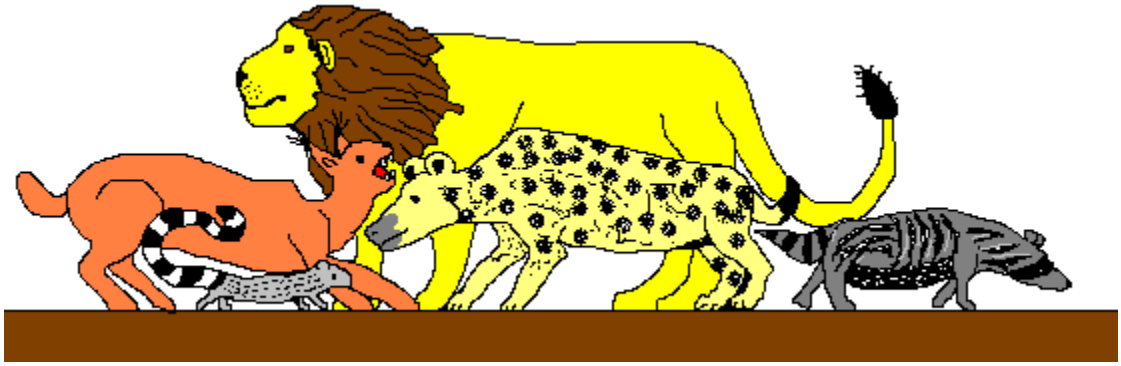
The Chevrotain (1) is similar to an animal believed to be the ancestor of the Giraffe. The distinctive cloven hoofed spoor (2) and cloven hoof (3) of the even toed ungulates.

© Lee Gutteridge – 2 December 2005

Carnivora

This order includes most of the meat eating animals, although some of these species eat insects. Carnivores have specially designed teeth for tearing, cutting (carnassials) and chewing meat. They also have well developed canines. Carnivores have forward facing eyes to help with distance judgement. The carnivore group evolved from a well known fossil group called '*Miacids*'. Mongoose and hyaena evolved in Africa, dogs in North America, and cats' origin is not certain, but it is not likely to be Africa (Kingdon). The carnivores can be divided into two super families *Canoidea* and *Feloidea* (Simpson 1931). *Canoidea* includes Mongoose, Jackal, Wild Dog, Honey Badger, Foxes and Otters. *Feloidea* includes Hyaena, Cats, Genets and Civets.

The dog group of carnivores. (Mongoose, Jackal, Wild Dog, Honey Badger, Fox and Otter).



The cat group of carnivores. (Cats, Genets, Hyenas and Civets).

Chiroptera

The only order of mammals capable of true flight, mostly quite small in size although the Fruit Bats achieve wingspans in South Africa of up to 75cm. The smaller insect eating bats have developed methods of echo location, sending out a high pitched sound which will strike objects and echo back to the bat, helping the bat to create a picture from the sound to identify prey or obstructions in its path. These small bats are believed to be descended from a small insectivorous gliding animal.

The larger fruit eaters locate food by sight and smell. These bats vocalisations are often within the hearing range of humans. These bats play a role in the pollination of many of their food plants, such as the Baobab, which has large white flowers that are easily seen at night. One unusual species of bat in the fruit eating group is the Egyptian Fruit Bat, which, on totally dark nights will use a form of echo location to assist it in flight to avoid objects. This echo location click is formed by the tongue, not the throat as in insectivorous bats.

© Lee Gutteridge – 2 December 2005

Hyracoidea

About 30 million years ago there were 11 genera of Hyrax in Africa, now there are three.
These animals used to be the dominant grazing animals during their era, but have been replaced largely by ruminants. This is not because of poor digestive abilities however. It is probably more to do with poor stamina, poor temperature regulating abilities, slow reproductive rates, short legs and a primitive brain. The brain is very similar in some respects to the 50 million year old ancestor of the Hyrax, a type of near ungulate. The Hyrax has a type of hoof and can be classed as an ungulate (Kingdon). It in fact shows similarities in early fossils with the lineage of the Elephant with which it is classed in the super order Paen-ungulata. Recent research also shows similarities with the odd toed ungulates as regards anti-bodies, mammary glands, placentas and genetalia. The tusk-like incisors have been adapted for defence and grooming, leaving the molars for both gathering and processing of plant food.

Insectivora

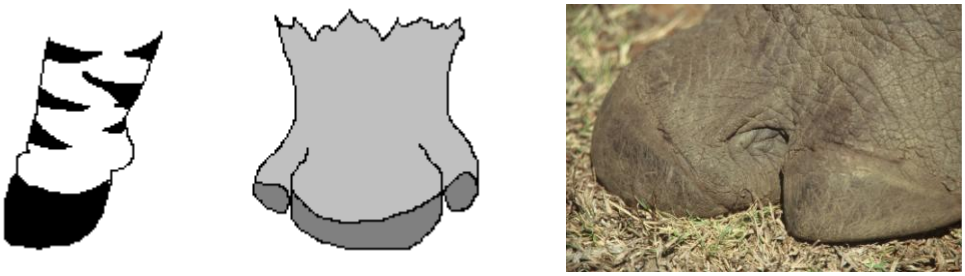
A strange group of primitive mammals which includes Shrews, Golden Moles and Hedgehogs. Golden Moles are fossorial, and betray their presence with a selection of mole hill types. They feed on invertebrates which they usually obtain underground. They have been seen above the surface acquiring food though. Hedgehogs are nocturnal insect eaters, which are very widespread. They are the remnant of an ancient group of animals, whose survival can be largely attributed to the development of spiny armour. Shrews have recognisable ancestors dating back 40 million years. Their incisors are said to function as pincers and their molars as shredders of chitin from their insect prey (Kingdon).

Lagomorpha

Hares and rabbits fall into this order, and differ from rodents in several ways. One of the most evident differences is that the incisors are completely covered in enamel, and have a pair of peg like teeth behind the upper pair. Hares generally have few young, born precocial above ground in a form. Rabbits have many altricial young below ground in a warren. The oldest hare ancestor known is *Eurymylus* which lived 60 million years ago in Asia.

Perisodactyla

These mammals are very evident in Africa and are the subjects of many safaris. Rhino and Zebra are the two we see in Africa, and in South America the Tapir is another member of the group. This is the remnant of what was the dominant herbivore group, and most abundant between 55 and 25 million years ago. This was however a development which began about 65 million years ago, and wholly outside the African continent. {Hyraxes would have been dominant in Africa for part of this time (Kingdon)}. Ancestral forms had five toes on the front and back feet.

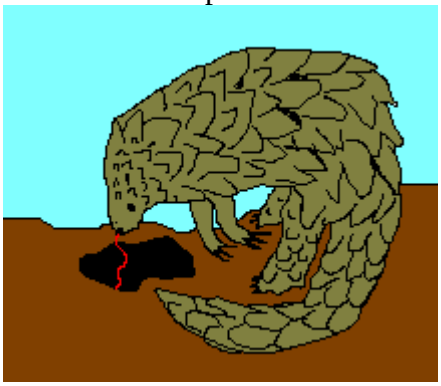


Perrisodactyl feet, showing one and three toed types.

© Lee Gutteridge – 2 December 2005

Pholidata

Scaly Anteaters are believed to have evolved from an ancient proto-insectivore, which may have been arboreal, about 75 million years ago. The skull is thick and well protected when the animal curls up (to protect itself with its large horny scales which cover the outer surfaces). The vestiges of ear cartilage under the skin around the ear openings imply that its ancestors had external ear pinna. Our southern African representative is a specialist termite feeder.



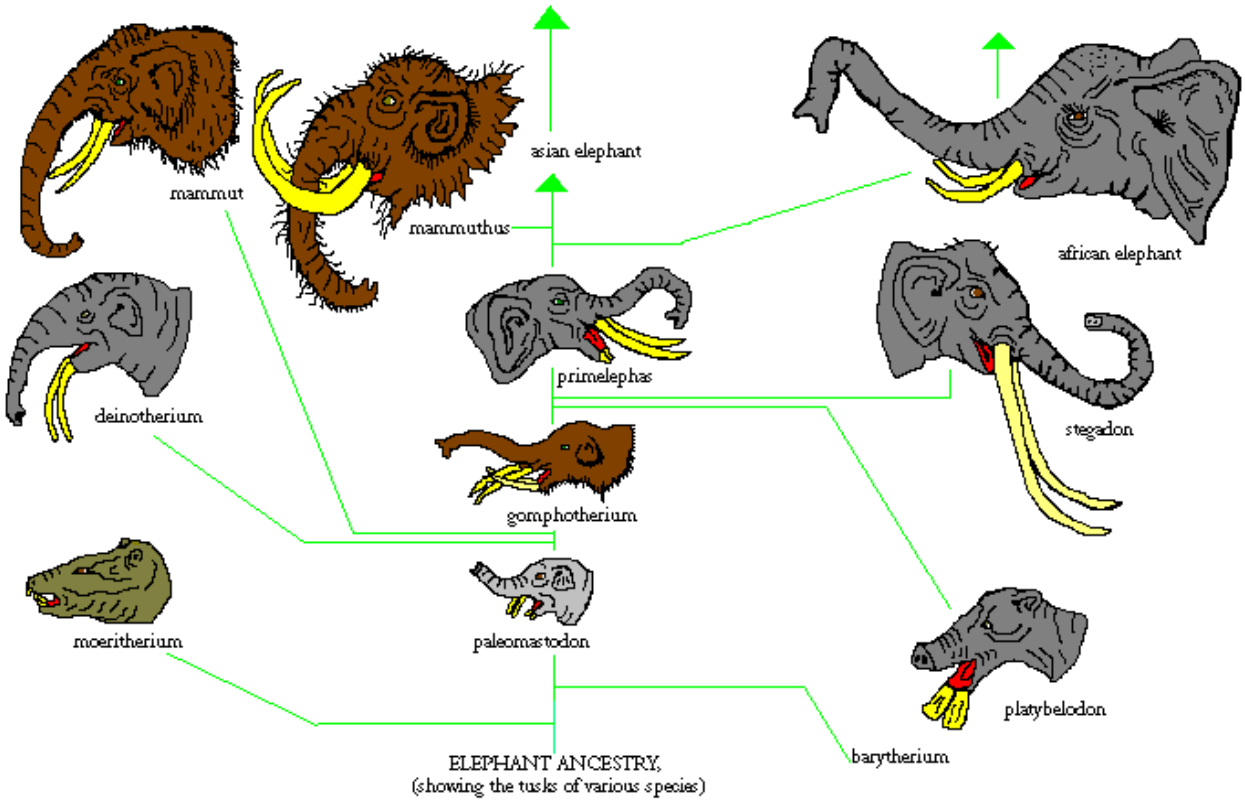
Primates

According to fossil evidence primates may have evolved from an ancient arboreal insectivore. 60 million year old fossil evidence shows the development of powerful big toes and forward facing eyes (Kingdon). The thumb of most primates is well developed, although some lack this appendage altogether such as Colobus Monkeys. The development of primates followed changes in diet from insects to nuts and fruits, through to leaves. The development of large muzzles in some species is believed to be due to the need to house more powerful teeth. The primary senses of primates are sight and touch, more than smell.

© Lee Gutteridge – 2 December 2005

Proboscidia

Elephants are the only modern representatives of this group. Direct ancestors include Paleomastodon, Gomphotherium and Primelephas. Before the branch off the family tree which leads to the moeritherium (this ancestor lived around the Tethys Sea, modern Sahara Desert and Mediterranean Sea area, about 50 million years ago. It lived in water and was less than a metre tall) there was a common ancestor with the Hyrax and the Dugong (according to popular scientific belief). Some authors also include the Aardvark in this group. The Paleomastodon lived around 40 million years ago, the Gomphotherium about 28 million years ago and the Primelephas about 8 million years ago.

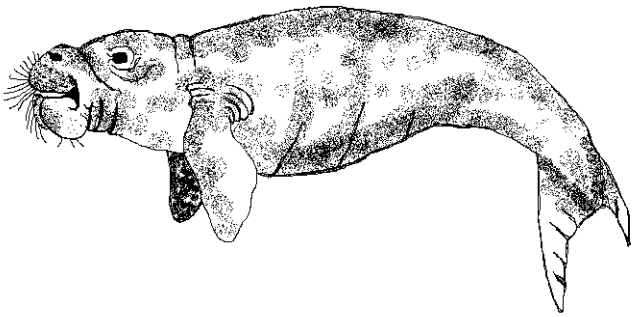


Rodentia

This mammal order contains the most species, all characterised by two large incisors for gnawing (these teeth keep growing as there is no enamel on the rubbing or cutting edge) with a large gap or diastema before the premolars. Squirrels are a late comer to Africa, coming from the Middle East about 10 million years ago. The exact origin of Spring Hares is not known, and their pre-Miocene history is unknown (Smithers). It is possible that they share a common ancestry with Anomolures, or Flying Squirrels (Kingdon). Dormice have been identified in 40 million year old fossil beds but are unspecialised, and have no cecum for digesting cellulose. Blesmols and Sand Puppies are also obscure, and their relationships with other rodents are unknown. Porcupines may have come from South-East Asia where the most primitive of the modern forms occur. The many rat and mice species in Africa have diverse origins, some having developed in Africa.

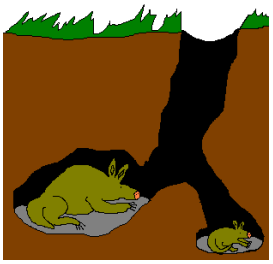
© Lee Gutteridge – 2 December 2005

Sirenia
Simpson (1945) placed the dugong in the same super order as Elephants, Paen-ungulata. Fossil records are extensive and they once occurred over a much wider range than they do today.



A Dugong.

Tubilidentata
The Aardvark is the only living member of the order in Africa, but fossil records indicate that there were four different genera of this order, dating from as early as the Miocene, 25 million years ago. Modern Aardvarks eat Termites, but there are some ancestors with well developed canines such as *Leptorycteropus.*



Aardvark adult and baby in their burrow. Young often occupy a smaller self excavated burrow adjacent to the adults. The burrow is usually collapsed between the animal and the entrance for extra protection.

WHALES AND DOLPHINS
Order Cetacea includes Toothed Whales and Baleen Whales. These sub-orders include Beaked Whales, Sperm Whales, Dolphins, Pilot Whales, Killer Whales and False Killer Whales, Right Whales, Pygmy Right Whales and Rorquals.

Beaked Whales
Most Beaked Whales have 1 or 2 pairs of teeth in each half of the lower jaw. In some species only the males teeth erupt. These whales eat deep sea fish, Squid and some surface fish.

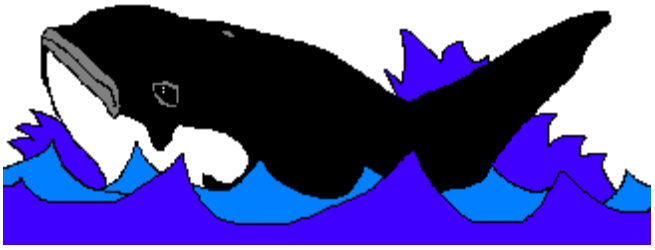
Sperm Whales
The Sperm Whale is the largest of the toothed whales reaching 19 metres in length. The Pygmy and Dwarf Sperm Whales reach a maximum of 3.5 metres. These smaller whales eat sea going fish from beyond the continental shelf as well as crabs, squid and prawns when near the coast. The Sperm Whale eats mid or deep water squid.

© Lee Gutteridge – 2 December 2005

Dolphins
Some species feed entirely on Squid and others on fish. These well known mammals are well represented in our coastal waters.

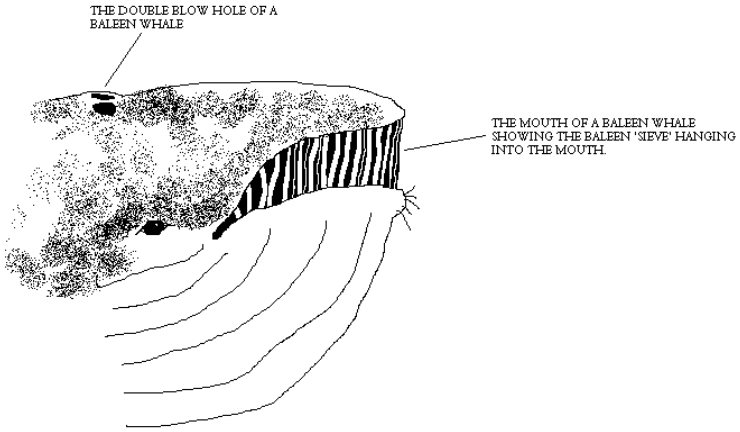
Pilot Whales
There are two Pilot Whales in our region, the Long and Short Finned Pilot Whales. The Short Fin has shorter fins as the name implies and less teeth than the Long Fin. It is also known as a Black Fish.

Killer whale
Orcas, as they are also known, are formidable hunters of all marine animals from fish, to Turtles, to squid and marine mammals such as whales. They have been known in certain areas to take seals from beaches and will also catch birds near the water surface.



An Orca.

Right Whales
These animals belong to the sub-order *Mysticeti*, and have no teeth (although the foetus' do, which are reabsorbed into the jaw before birth), with 140 to 400 baleen plates which hang from the palantine ridge from the roof of the mouth. These plates are used to sieve krill and other plankton out of the water. They have two blow holes.



Rorquals
These baleen whales include Mink, Sei, Brydes, Fin and the Giant Blue Whale. The Blue is the largest whale in the world, up to 33.58 metres. This is the largest animal that has ever lived on the earth. They all feed on plankton.

© Lee Gutteridge – 2 December 2005

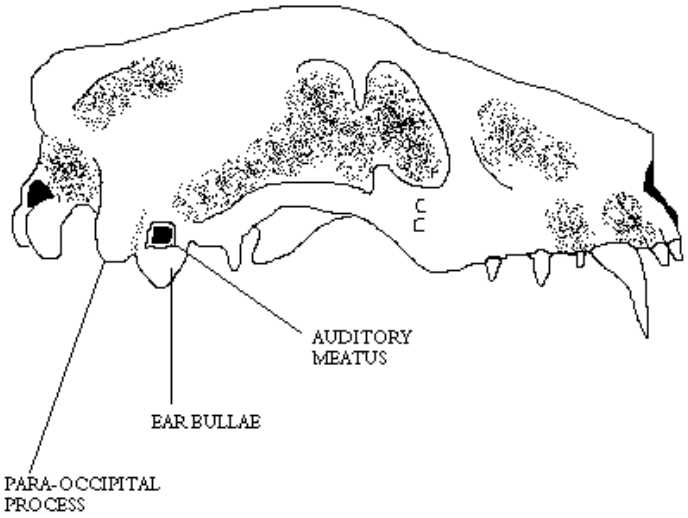
DIFFERENTIATION BETWEEN DOG AND CAT GROUPS OF CARNIVORES

The dog and cat groups of carnivores are very similar in most respects; the differences are not obvious to the layperson however. In 1931 a man called Simpson sub divided the carnivores into Feloidea and Canoidea. Canoidea includes Canidae (Jackals and Wild Dogs etc.), Mustelidae (Otters, Weasels, Polecats and Honey Badgers), Otaridae (Fur Seals) and Phocidae (seals). Feloidea includes Felidae (cats), Viverridae (Mongoose, Genets and Civets), Protelidae (Aardwolf) and Hyenidae (Hyaena).

The differences between the groups are not the non-retractable claws, and roaring as compared to barking which many believe. The differences are as follows:

1. A septum, or membrane, dividing the ear bullae into anterior and posterior chambers is present in Feloidea, but not in Canoidea.
2. Most of the members of Canoidea have a lengthened and bony ear meatus. In Feloidea it is little more than a bony ring.
3. In Canoidea the Para-occipital process is independent of the ear bullae (except Honey Badger and Pole Cat)

IN THIS DIAGRAM (A REPRESENTATION OF AN AARDWOLF SKULL) THE CAT GROUP CHARACTERISTICS ARE EVIDENT IN THE FUSED (JOINED) BULLAE AND PARA-OCCIPITAL PROCESS, AND THE MEATUS IS A SMALL RING, NOT PROJECTING OUT OF THE SKULL TOO MUCH. THE SEPTUM IN THE EAR BULLAE IS NOT VISIBLE FROM OUTSIDE.

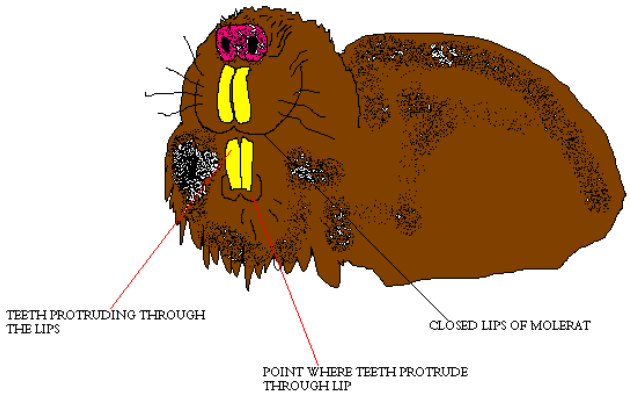


© Lee Gutteridge – 2 December 2005

GENERAL MAMMAL FACTS

1. **A Common Fossorial Rodent**

The Common Molerat occurs in the majority of Southern Africa. These mole like animals have large incisors which grow through the lips. The teeth are used for tunnelling, and the lips behind the teeth can remain closed to prevent the swallowing of soil. The Molerat aerates the soil when tunnelling, and leaves dung in the tunnels which will enrich the soil. It eats tubers and grass roots.

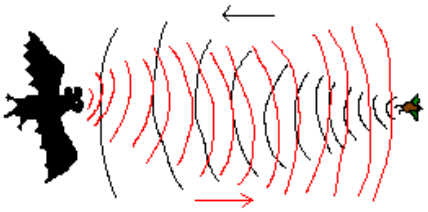


2. **Give examples of the following**

Coprophagious feeder	Scrub Hare
Diurnal herbivore	Giraffe
Nocturnal herbivore	Spring Hare
Diurnal predator	Cape Hunting Dog
Nocturnal predator	Leopard
Nocturnal insectivore	Hedgehog
Nocturnal scavenger	Brown Hyaena

3. **Order Chiroptera as regard food location in the two groups in South Africa**

The only order of mammals capable of true flight. Mostly quite small in size although the Fruit Bats achieve wingspans in South Africa of up to 75cm. The smaller insect eating bats have developed methods of echo location, sending out a high pitched sound which will strike objects and echo back to the bat, helping the bat to create a picture from the sound to identify prey or obstructions in its path. These small bats are believed to be descended from a small insectivorous gliding animal.



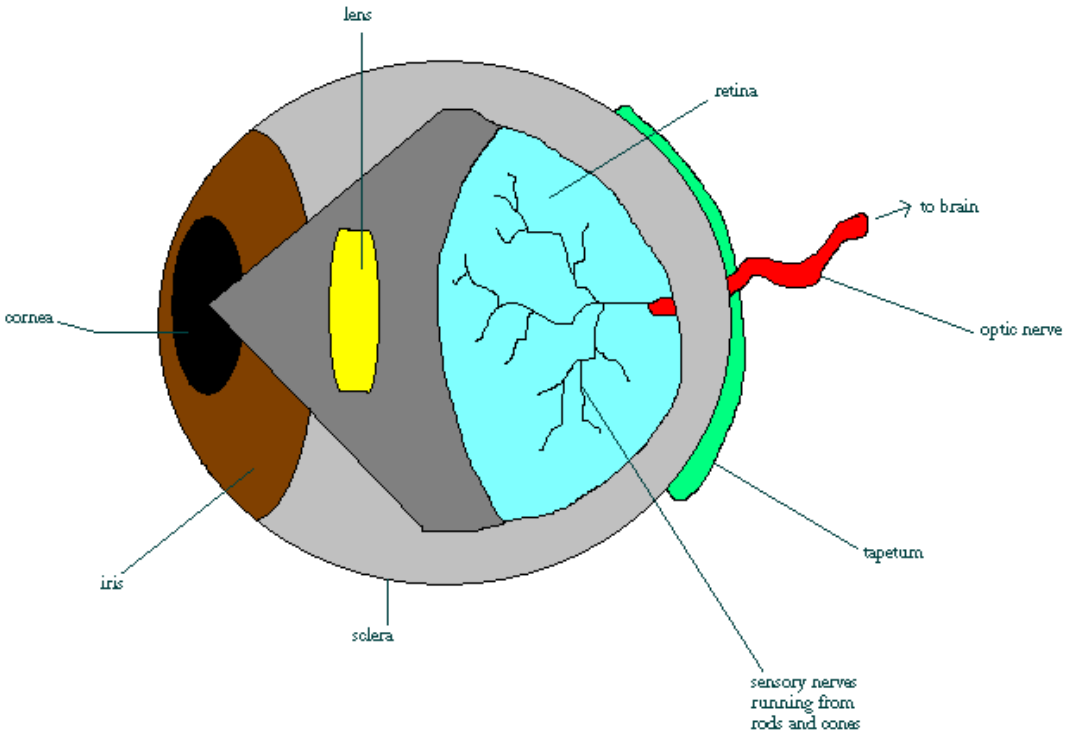
Microchiropteran locating prey by sound waves being emitted (red) and then bouncing back (black).

© Lee Gutteridge – 2 December 2005

The larger fruit eaters locate food by sight and smell. These bats vocalisations are often within the hearing range of humans. These bats play a role in the pollination of many of their food plants, such as the Baobab, which has large white flowers that are easily seen at night. One unusual species of bat in the fruit eating group is the Egyptian Fruit Bat, which, on totally dark nights will use a form of echolocation to assist it in flight to avoid objects. This echo location click is formed by the tongue, not the throat as in insectivorous bats.

4. **The Biology of a Mammalian Eye**

This is the organ of sight. There are many different designs, but the basics remain the same. The eye is a lens which focus' light onto sensitive cells. The eyes of mammals have two main types of sensory receptor cells, the rods and the cones. Cones determine detail and colour and the rods determine light and dark, and movement. The wall of the eye is called the sclera. The front of the sclera is transparent and called the cornea. It is surrounded by a muscular ring called an iris. This is the coloured part of the eye. Light passes through the cornea and into the lens where it is focused on the retina. Nocturnal animals have a *Tapetum Lucidium* which re-reflects light onto sensory rods of the eyes of the animal preventing the wasting of necessary light.



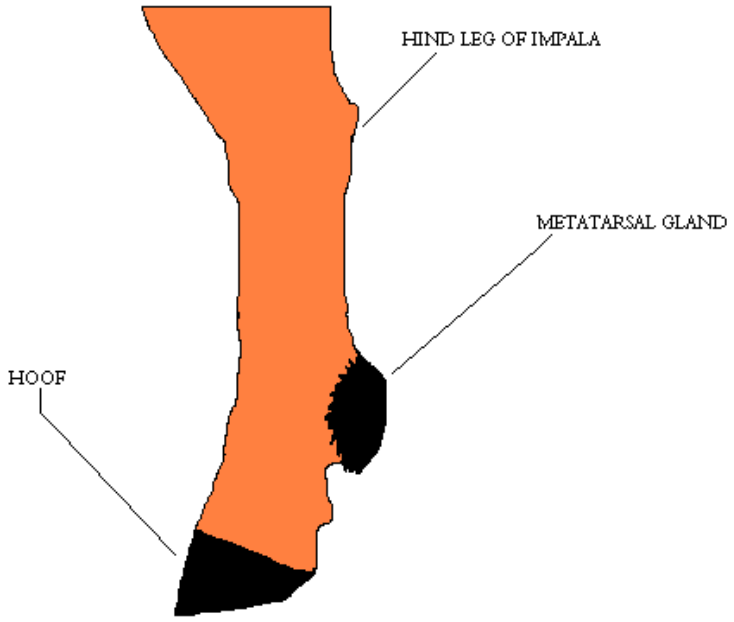
5. **Allogrooming**

Allogrooming in the Impala is done as a social interaction, for reaffirming bonds, and displaying social status. This is where one will groom the other, and the time doing the grooming is usually about the same as the time spent being groomed. The bottom teeth will splay open when pushed, acting almost as a comb.

© Lee Gutteridge – 2 December 2005

6. **Metatarsal Glands**

Impalas are the only mammal with a metatarsal or fetlock gland. This gland is covered by a tuft of black hair. The uses are not known but it is speculated that the gland may be used for territorial marking, or possibly as a jumping signal. When defecating an Impala usually flexes its legs, causing an issue of secretion in the midden area. Impala are not strictly territorial however, and the midden may just be there to mark out open areas for escape routes when attacked by nocturnal carnivores. (During certain times of the year males develop a certain degree of territoriality.) As the animal leaps a small spray of glandular secretion also issues forth, and it may be that the sudden smell of this secretion will warn an animal, running in the herd with a poor forward view, of impending obstacles. The mystery is as yet not clearly resolved.



7. **The Zebra and its stripes**

Why exactly do Zebras have stripes? **No one really knows**. There are many theories and discussions, and here are a few which I have heard. All of the following are easy to argue down, and discount, but they are food for thought. Please be aware that I am not stating any of the following as fact, but more for interest's sake.

Camouflage: it has been said that the Zebra's stripes assist with camouflage when standing in shady woodland, and long grass. The vertical stripes resembling trees and vegetation, and the related shadows.

Confusion: the running herd of Zebra's is believed to present a more difficult target for the interception of an individual by the predator, as with all the vertical black and white stripes the end of one and beginning of another becomes less obvious. This way young and injured can be hidden in, and by the group.

© Lee Gutteridge – 2 December 2005

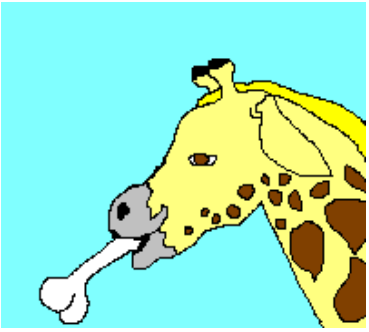
Temperature regulation: there is one discussion which mentions the black and white stripes causing a miniature wind flow system over the body of the Zebra. By the black stripes absorbing heat the air in contact with the stripes heats and rises, and the white stripes reflect heat, and stay cool, air is not forced to rise but cool, and drop. These little up and down systems supposedly cause miniature convection currents, with air flow taking away perspired moisture and cooling the animal.

Energy conservation: under the skin of the Zebra there is a layer of permanent fat (also known as black fat). This fat is slightly thicker in depth below the black stripes of the Zebra, so the story goes, and would therefore get slightly warm on a cool winters afternoon with direct sunlight. Fat insulates in mammals, or to put it another way retains heat. Perhaps this coincidence of facts could lead to a conclusion of the fatty layer remaining warm for some time after the sun has set on a cool winter evening, providing the Zebra with a solar powered source of residual heat. This way the animal would use less energy on staying warm, during the season where the least food is available. The heat received and stored would depend upon the angle the animal stands to the sun, and on the utilisation of available shade. This way the Zebra could prevent over heating on a hot summers day.

These are a few stories about the Zebra and its stripes.

8**. Which animals in our area Osteophage and which Geophage.**

Osteophagia, or the chewing of bones, is practised by Giraffe, Kudu, Porcupine, Tortoises (obviously not a mammal) and many different scavengers.
Geophagia, or the eating of soil, is practised by many herbivores such as Rhino, Elephant, Zebra, Giraffe and antelope.



A Giraffe chewing a bone. This is an example of Osteophagia.

9**. Comparative feeding behaviours of termite and ant eaters.**

The Aardvark, Pangolin and Aardwolf all feed on termites and ants, but use different feeding methods.
The Aardvark digs a foraging burrow, and then inserts its long shoelace like tongue into the termite burrows. The tongue is sticky and when extracted will be covered with termites and soil. The termites are eaten with little or no chewing.
The Pangolin has a tongue as long as its head and body combined. Much of it is stored in a throat pouch when not in use. (When pushing the tongue out the pouch becomes visibly smaller). The back of the tongue is anchored to the last pair of ribs which are a free floating prong of bone attached to the sternum. The muscles are attached to this prong. When the tongue, which is ribbon-like, is extended into insect burrows, the insects stick to it, and then the tongue whips back into the mouth propelled by the muscles attached to this rib based prong. Pangolins have no teeth, and the bottom jaw is not functional as regards chewing.

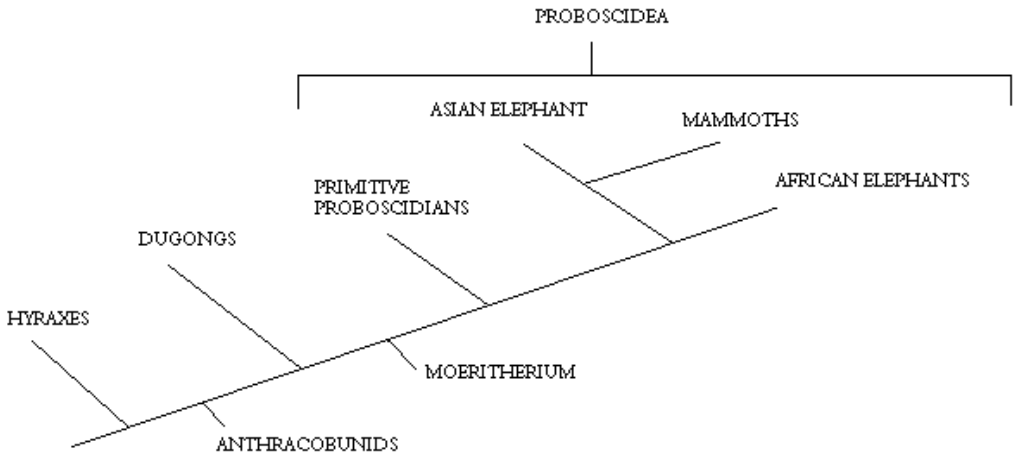
© Lee Gutteridge – 2 December 2005

The Aardwolf's primary specialisation is in its ability to digest termites efficiently. It can also tolerate the noxious terpenes squirted by soldier termites. It digs a shallow scrape in the ground and laps up all the termites it can with its rough tongue. The tongue has backward facing projections which scrape up the food. The Aardwolf can eat between 250 000 and 400 000 termites per night.

10**. The Elephant and the Hyrax**

These animals have been accepted as distant relatives due to certain corresponding features, such as the shape of the feet and position of the mammary glands (pectoral). Biochemical evidence confirms this. Anthracobunids are the most ancient fossil relatives of the proboscidians. These animals were alive prior to the split in the family tree of Elephants and Dugongs, but slightly after the split with the Hyrax. The fossil evidence is sketchy, but anatomical and molecular data corroborates these theories.

ELEPHANT FAMILY TREE



11. **Paen-ungulata**

See question 10 for details on this group.

12. **Sexual apparatus in Hyaena**

The Spotted Hyaena has been referred to in the past as hermaphroditic, meaning both male and female in the same animal. This is due to the fact that the female's genetalia resembles the males. The labia of the female are swollen to look almost like testicles and the clitoris is enlarged, and erectable like the penis of the male. The female is larger in size than the male and is dominant in Hyaena society.

© Lee Gutteridge – 2 December 2005

13. **Brown hyaena**

The Brown Hyaena is a scavenger, and uses its sense of smell to good accord. It has been recorded as smelling carrion over a distance of 14 kilometres (some books greatly reduce this distance however). The Brown Hyaena will hunt baby animals, birds, and rodents and also forage for eggs and bird fledglings. It will not hunt adult animals usually. They have been known to drive Leopard and Cheetah from their kills but Lions are given a wide birth. The Brown Hyaena will eat fruit occasionally, and are known to eat tsamma melons to obtain water in dry regions.

14. **Populations and communities**

A population is a group of a specific species i.e. the population of Wildebeest in the Serengeti.

A community is a group of different species filling up a particular habitat i.e. the number of herbivores in a grassland community.

15. **Digestive systems**

Ruminants

Artiodactyls such as Giraffe, Buffalo, Kudu and Impala are ruminants. In the ruminant stomach there are four major chambers. The rumen, the reticulum, the omasum and then the abomasum. The rumen is the 1st chamber, and houses bacteria which assist in the breakdown of cellulose. The food is regurgitated from the rumen in the form of a bolus and rechewed and swallowed until it is fairly fine in consistency. It then passes into the reticulum where further fermentation by bacterial processes takes place. In the omasum and abomasum the stomach produces acids, which breaks down the already fermented food. The micro organisms and bacteria are also digested, and comprise an important part of the protein intake of the animal.

Hind gut fermenters

Perisodactyls such as Zebra and Rhino, artiodactyls such as Warthog, and paenungulates such as Elephant are hind gut fermenters. These animals ingest food and swallow it into the fundus. The fundus secretes acids which assist in the break down of the plant material.
The hind gut fermenters have one major stomach chamber, and a small chamber attached to the small intestine called the cecum. Micro organisms occur here which will break down the food material, facilitating absorption. Gasses are a by product of the fermentation process. Hind gut fermentation is not a very efficient process, and many of these animals will bulk graze.

Carnivores

Carnivores have acidic muscular stomachs. These stomachs are designed to break down protein. The stomach is an enlarged area of the alimentary canal.

Insectivores

Insectivores have special enzymes produced by bacteria which assist in the breakdown of chitinous material. Some insectivores extrude their anus in order to lick and re-ingest bacteria essential for this function.

© Lee Gutteridge – 2 December 2005

16. **The Niche Theory**

This discussion states that each animal has an exclusive niche, or list of habitat requirements, which help the individual to exclude competition in its region. For example the Lion and the Leopard are both large nocturnal predators. This is however where the similarities stop. They live in different habitats over most of their corresponding range I.e. Leopard in dense bush, rocky slope and river valley with Lions on open grassland and mixed woodland. The Leopard focuses on medium to small antelope, with the occasional large, and the Lions on medium to large herbivores, with occasional small animals. The hunting methods of these two large predators are adapted to their environment as are their social structures. This is how the niche theory compliments the competitive exclusion principles to ensure that there is not too much competition for resources in any given area. In order to determine the functions of the animal's niche it is good to think along the lines of its competitors and how they avoid over competing.

Examples

- Insect eating bats (Microchiroptera) fill an exclusive mammalian niche of a nocturnal flying insectivore.
It has no competitor in the mammal world and no real competition in the bird world as no bird's echolocate to search for food.

- Giraffe fills an exclusive mammalian niche too, feeding on foliage over three metres above the ground during the day. No other large browser can feed that high.

- Aardvark are nocturnal insectivores. They locate prey by smell and dig deep burrows readily to obtain termites. They dig more readily than Pangolin, and Aardwolf does not dig deep to feed, but makes shallow scrapes on the ground. Aardvark is more common than Pangolin.

- Hippo share a feeding niche with grazers such as Rhino, and there is a limit as to how many bulk grazers an area can carry. It occupies a unique daytime niche by resting up during the hot hours of the day in open water. This has lead to physiological changes in the Hippo making it streamlined, buoyant and unable to sweat due to a lack of glands designed for this.

17. **Mongoose**

Species	Social habits	Preferred food	Activity period
Banded Mongoose	Gregarious.	Insects, eggs, birds, rodents, snakes.	Diurnal.
Dwarf Mongoose	Gregarious.	Insects, eggs, birds, any mammal smaller than themselves.	Diurnal.
White tailed Mongoose	Solitary.	Predatory.	Nocturnal.
Slender Mongoose	Solitary or in pairs.	Birds, snakes, small mammals, eggs.	Diurnal.
Marsh Mongoose	Solitary or in pairs.	Crustaceans, reptiles, snails, fish, birds eggs, amphibians, fruit, small mammals.	Nocturnal, mainly.

© Lee Gutteridge – 2 December 2005

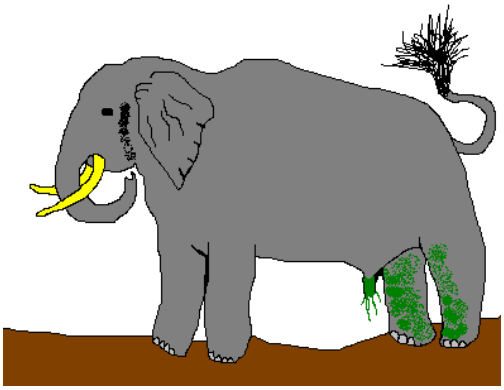
18. **Giraffe Communication**
Giraffes communicate by means of bellows, grunts and snorts. Individuals call their offspring by using a whistling sound. One captive individual was recorded as mooing when lonely, and bellowing when hungry. White markings behind the ears are purportedly used as a visual following signal.

19. **Zebra Birth**
When a Zebra foal is born its mother will separate it from the rest of the family group and she will then insert herself between the foal and the other Zebra in the herd, basically forcing the young animal to look at only her stripe pattern. This pattern will become imprinted into the memory of the foal, almost a kind of maternal bar coding, and will enable the foal to identify mother at a distance if dangerous situations should arise. This is a unique survival technique.

20. **Rabbits and Hares**

Difference.	Rabbit.	Hare.
Adult names	Buck and doe.	-
Young names.	Kitten.	Leveret.
Den name.	Warren.	Form.
Condition at birth.	Altricial.	Precocial.
Locomotion.	Mostly hopping.	Mostly walking.

21. **Musth in bull Elephants**
When Elephant bulls reach a state of sexual readiness they enter a stage known as musth. This is an Urdu word which means ‘intoxicated or angry’. This word was originally described in scientific literature hundreds of years ago and again in the mid nineteen century by Darwin. The Elephant bull will begin to experience musth in his early twenties or late teens, but in a normal Elephant population the presence of other older bulls will suppress the musth cycle until the young bull is able to compete with larger, stronger bulls. As a young Elephant bull, the musth cycle is therefore very short, a few days to two weeks. An older bull may come into musth for months. This depends on the physical condition of the older bull however. If a bull is in poor condition it may not even come into musth. Testosterone plays a key role in musth, and causes aggression (along with androgen), super production of sperm, dribbling urine (greenish in colour) and a secretion from the temporal gland. In the guiding context it is best to give these bull Elephants a wide berth as they can be very aggressive.



Musth bull Elephant with Green urine and a temporal secretion.

© Lee Gutteridge – 2 December 2005

22. **Behavioural differences between *Acinonyx* and *Panthera.***

Behavioural difference.	*Acinonyx.*	*Panthera.*
Vocalisation.	Cannot roar. Chirrups, whistles, growls, purrs. The Suspensorium (Hyoidean processes) are ossified, restricting movement of the larynx. Cannot open wide to vocalise deeply.	Roars. Growls, purrs. Suspensorium is cartilaginous, and allows for expansion of the voice box (larynx), and therefore deep vocalisations.
Habitat usage.	Cheetahs predominantly occur in open, to semi-open grassland.	*Panthera* occur in all habitats from grassland to rocky mountain slope and dry river beds.
Hunting style.	A short stalk followed by a chasing hunt over open ground depending entirely upon speed of the hunter.	Mainly stalking to close range with short chases ensuing, or a co-ordinated group effort, or ambush.
Activity period.	Predominantly diurnal, with some activity when moonlight is bright.	Predominantly nocturnal, with some diurnal opportunism.

23. **Elephant Life Span**

The life span of an Elephant depends upon its teeth. Basically speaking an Elephant has six sets of teeth during its life time. One set erupt at 0yrs and will be exchanged at 1.5 to 2 years, the next at 3.5 to 4yrs, then at 8 to10yrs, 20 to 25yrs and the last set at 40 to 45 yrs. These will be worn down by 55-70 years of age and result in the death of the Elephant due to malnutrition. Teeth erupt at the back of the mouth and move forward, to fall out in pieces at the front of the mouth. The Elephant has two sets of tusks during its life, milk or deciduous tusks which usually do not protrude beyond the lip, and are shed at about 1 year old, and adult tusks which will grow throughout life. (References – the Elephant Encyclopaedia – Eltringham). Elephant grave yards are a myth which may have a basis in the fact that older elephants with reduced masticative ability due to worn down teeth often move into habitats such as large perennial rivers to obtain softer aquatic vegetation. These animals often die close to the water, and the bones may be picked up by large floods and deposited on the wide bends of the rivers where on may sometimes encounter the carcasses of several large old elephants within a reasonably small area. This would have been quite an accumulation of bones and tusks before the days of intensive ivory hunting and collecting by Europeans and indigenous tribes. Food for thought.

24. **Giraffe Blood Flow Regulation**

There are many stories as regards the ‘valve system’ in the neck of a Giraffe. Kingdon refers to pressure reducing valves and elastic veins to accommodate changing pressure as per position of the head. Basically speaking the Giraffes long neck requires considerable blood pressure to force blood up to the brain against the pull of gravity and the friction of arterial walls. When the head is lowered the resistance becomes less, and could theoretically cause damage to the brain with the potential increment in blood flow and speed. Other authors give reference to spreading capillaries which slow down the blood by means of friction, by putting the blood into smaller and smaller vessels thereby increasing resistance.

© Lee Gutteridge – 2 December 2005

25. ***Antidorcas marsupialis***

This is the scientific name of the Springbok. I have heard mention from several guides over the years that the Springbok is partly marsupial. **It is not a marsupial at all.** It does however have a small, glandular pouch on its lower back, called a **Marsupium**, which contains white hair which is erected during pronking displays. A marsupial has not got glandular skin in its belly pouch, but an actual nipple attached to a functional mammary gland, where the newborn animal will live, suckle and shelter. A Springbok certainly does not carry a baby in its pouch, and is **certainly not related to the marsupials in any way**, even though they share one similar feature.

26. **Impala Breeding Cycles and Synchronised Lambing**

It is often said that the Impala can retain the foetus of its lamb until it is ready to give birth. This is not a hundred percent accurate. We can not state that the female Impala knowingly decides on a lambing time, and wakes up one day and lambs. These bodily processes are governed by hormones and chemicals such as prolactin (which causes separation of placenta from uterus and induces several other birth processes such as maintaining lactation) and progesterone (which maintains pregnancy). The Impala is basically slave to its bodily functions as is any other mammal female due to give birth. There are however outside influences which will affect the lambing time. The Impala is a short day breeder and it will therefore breed when the day length is short, and therefore optimal for triggering this behaviour. Usually the mating occurs at night with a bright or full moon. This would be at the beginning of winter if day length is to be accounted for. This is ideal to support a six and a half month gestation, and lambing during mid-rainy season, or early summer. However if the rains are later than usual, a second set of biological trigger mechanisms will govern birthing. This could be attributed to chemicals required to trigger production of hormones such as prolactin, without which birthing will not occur. Grasses form most of the diet of the mixed feeding Impala at this time of the year, and so the chemical levels and nutritional quality of the grasses would affect chemical and hormone levels in the Impala. By the levels of rain at this stage of the year, one would be able to determine grass quality, and therefore nutritional values (obviously this is species dependant).

27. **Lions Reproduction**

Lionesses undergo an Oestral cycle of 2-4 days on average. During this time males are in attendance continually. The male tests the female's readiness using the Flehmen grimace. Lionesses are induced ovulator's and require a period of mating to produce a state of fertility for mating successfully.

Over a few days the Lions will mate repeatedly every 10 to 25 minutes. Each mating lasts 7-15 seconds or so. After a while the female eggs become receptive and she will fall pregnant. During mating the male covers the female, and holds the back of the neck of the Lioness, and after mating there is often aggression, and usually the female will lie on her back for a while.

The Lioness will gestate for 115 days and give birth to 2-5 cubs in a secluded spot away from the rest of the pride.

© Lee Gutteridge – 2 December 2005

TABLE OF MAMMAL INFO FOR QUICK ACCESS

Animal	Gest. Period in days	No. of young	Order	Family	Weight of male kg's
Lions	115 days	1-6	Carnivora	Felidae	Up to 260
Leopard	105 days	1-4	Carnivora	Felidae	80
Buffalo	330 days	1	Artiodactyla	Bovidae	850
Elephant	660 days	1	Proboscidia	Elephantidae	5000-6000
W. Rhino	450 days	1	Perisodactyla	Rhinocerotidae	2300
Wildebeest	225 days	1	Artiodactyla	Bovidae	250
Zebra	360 days	1-2	Perisodactyla	Equidae	320
Aardvark	210 days	1-2	Tubilidentata	Oryceropodidae	50
Blesbok	190 days	1	Artiodactyla	Bovidae	50
Eland	271 days	1	Artiodactyla	Bovidae	800
Bushbuck	200 days	1	Artiodactyla	Bovidae	60
Kudu	210 days	1	Artiodactyla	Bovidae	220
Giraffe	440 days	1-2	Artiodactyla	Giraffidae	1200
Large spotted genet	70 days	1-4	Carnivora	Viverridae	2
African Wild Cat	58days	2-16	Carnivora	Felidae	5
Warthog	165 days	2-4	Artiodactyla	Suidae	80
Impala	195 days	1	Artiodactyla	Bovidae	55
Baboons	180 days	1-2	Primates	Circopithecedae	27
Vervet Monkey	200days	1-2	Primates	Circopithecedae	5
Rock Hyrax	230days	1-6	Hyracoidea	Procavidae	4

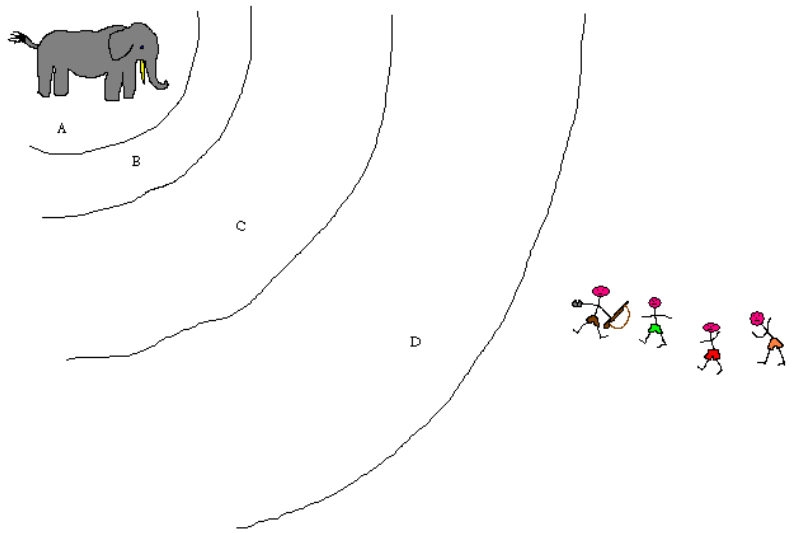
FOLLOWING SIGNALS IN NATURE

Following signals are markings on the skin or fur of animals, or postural features which are used for gregarious animals to follow one another. Below are some examples and their following signals.

Species.	Signal.
Lions.	Black markings behind ears and on tail tip.
Warthog.	Erect tail.
Waterbuck.	White circle around tail.
Giraffe.	White behind ears, and ears held out to display.
Kudu.	White under tail.
Impala.	White under tail and 3 Black stripes.
Leopard.	White tail tip.

© Lee Gutteridge – 2 December 2005

PERSONAL ZONES OF MAMMALS

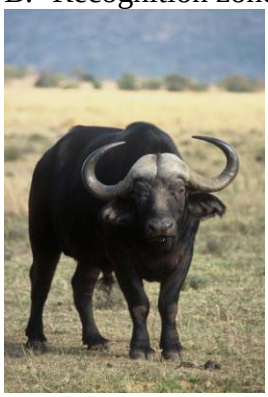


The picture above depicts the danger zones around animals and gives a rough representation as per behaviour of the animal. Distance of each zone will vary from individual to individual as regards its comfort with the proximity of humans.

A. Critical zone – too close, the animal will either attack or flee.

A charging male lion. He was approached too closely

B. Recognition zone – the animal stares intently at you.



This buffalo has stopped feeding and is watching the approaching guide.

© Lee Gutteridge – 2 December 2005

C. Alert zone – the animal is aware of you but may continue feeding etc., but behavioural changes will take place due to your presence.

This rhino is watching but still feeds occasionally.

D. Comfort zone – here the animal may be aware of you but you are far away enough not to change the animals behaviour.

This hippo continues feeding, and is unaware that he is being watched.

Ideally on a guided walk we would keep to Zone D, where we would be able to view natural behaviour, and not disturb the animals.

© Lee Gutteridge – 2 December 2005

BIRDS
GLOSSARY OF TERMS

1. Allopreening – this is where one bird preens another, for courtship or other social reasons.
2. Altricial – when a bird is hatched naked and featherless.
3. Brood parasite – when a bird does not incubate and rear its own chicks and eggs, but uses an unwitting host instead.
4. Cainism – where one sibling kills the other in raivalry over resourses such as food.
5. Carotenoid – yellow and red pigment type.
6. Casque – the horny chamber on the beak of some birds such as trumpeter hornbills.
7. Cere – the naked skin at the base of a birds beak.
8. Culmen – ridge along the top of a birds beak from the tip to the forehead.
9. Gape – angle at the corners of the mouth(beak).
10. Heronry – nesting site of herons and Egrets.
11. Malar – a stripe below the chin, down the throat.
12. Melanin – dark pigment, usually grey.
13. Passerine – three toes forward,one back songbirds.
14. Polyandry – where a female mates with numerous males in a season.
15. Polygamy – where one bird has many mates.
16. Porphyrin – a pigment type which is of a green, brown or red colour.
17. Precocial – where the chick hatches with feathers and the ability to move around.
18. Refraction – selective reflection of certain colour wavelengths.
19. Syrinx – a birds voice box.
20. Zygodactyl – two toes forward and two back foot structure.
21. Preen gland – a gland at the base of the tail of most birds which dispenses a type of oil for feather maintenance.
22. Antiphonal duetting – where two birds call in turn to make one song. Often bonding between mated pairs.
23. Cloaca – the common orifice for excreta in birds and reptiles.
24. Lores – the area between the base of the bill and the eys of a bird.
25. Migrate – the process whereby birds seek out better climates for feeding and breeding, by travelling to different regions with seasonal change.
26. Palearctic – a type of migration which invilves travel to Eurasia from Africa south of the Equator.
27. Intra-africa – a type of migration which involves movement within the African continent.
28. Breeding resident – these are birds which breed in a specific area and do not migrate in the winter.

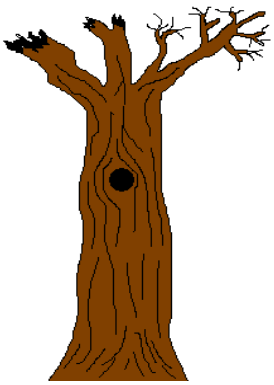
© Lee Gutteridge – 2 December 2005

NESTING AND FEEDING BEHAVIOR

Here we will be looking at basic nest designs, as per drawings, local species, prefered food, and unusual relationships of various groups of birds.

Barbets

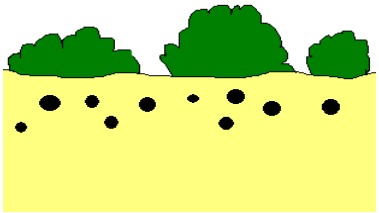
These birds are hole nesters. They bore nests into tree trunks. Common species are Crested barbet, Black Collared Barbet, Pied Barbet and the Yellow Tinkerbird. Some of these species are parasitised by Honey guides. Some barbets eat fruit, including mistletoe, and some species eat insects.



Bee Eaters

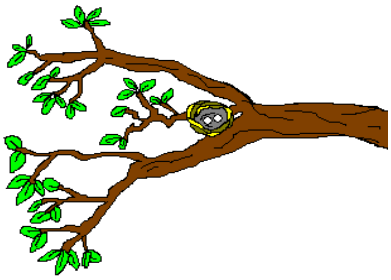
Bee Eaters nest in holes they dig into sand banks, often along riversides. Common species include Little Bee Eater, Carmine Bee Eater, White Fronted Bee Eater and European Bee Eater.

They eat insects.



Bulbuls

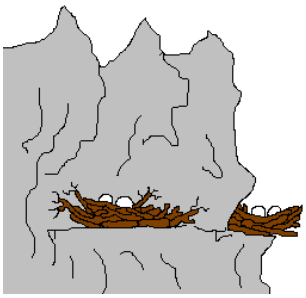
Bulbuls are mainly insectivorous, and nest in cup shaped nests in tree branches. Common species include the Red Eyed bulbul and the Dark Capped Bulbul.



© Lee Gutteridge – 2 December 2005

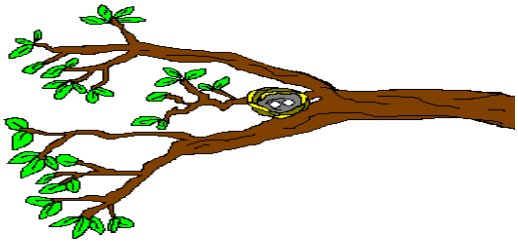
Buzzards

Common species include cliff nesters such as Jackal Buzzard and Steppe Buzzards. These birds actively hunt Rodents, Lagomorphs and Hyraxes.



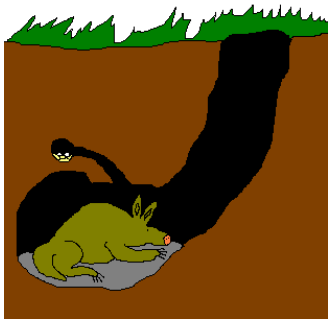
Canaries

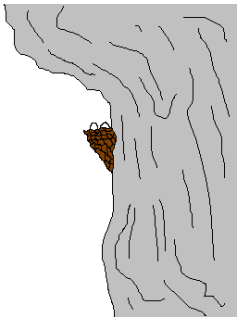
Canaries are mainly seed eaters. Common species include Yellow Eyed Canary and Black Throated Canary. They build a cup nest in a tree.

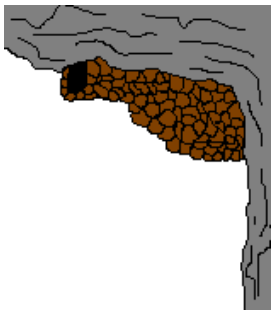


Chats

Some chats such as Cliff Mocking Chat use swallows nests, and others such as Ant Eating Chats nest underground in antbear holes. These birds eat insects. Another common example is the Familiar Chat.



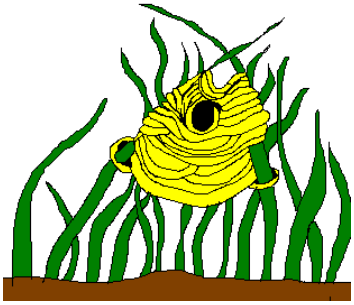




© Lee Gutteridge – 2 December 2005

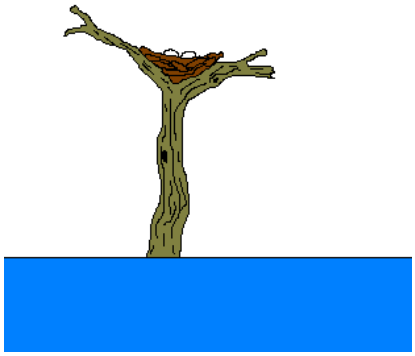
Cisticolas

These small birds are insectivores. They build intricate weaved grass nests in amongst grass in grasslands. Cloud Cisticola, Zitting Cisticola and Ayres Cisticola are three common species.



Cormorants and Darters

These birds hunt and eat fish. They nest over water in trees. Reed Cormorant, White Breasted Cormorant and the African Darter are common species.



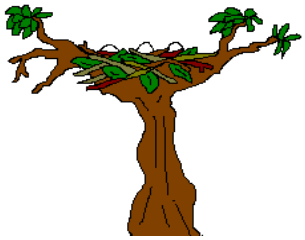
Coucals

These birds belong to the same family as cuckoos, but build their own nests in trees using grass and raise their own chicks. They eat most invertebrates, snails, baby birds and insects. The Burchells Coucal is the only locally common representative in the Limpopo province.

© Lee Gutteridge – 2 December 2005

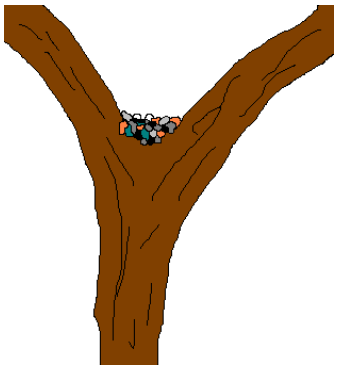
Cuckoohawk

The Cuckoohawk builds a stick nest which it lines with leaves to look like debris, as a form of camouflage. Cuckoohawks eat mainly rodents, but reptiles are taken.



Cuckoo Shrikes

Cuckoo Shrikes eat caterpillars mainly. The Black Cuckoo Shrike is a common example of this group of birds. They build cup nests from lichen.

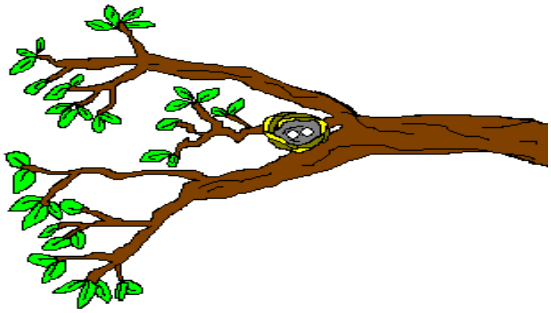


Cuckoos

These birds are brood parasites and do not build nests. Common species are the Red Chested Cuckoo, Diedericks Cuckoo, Klaas' Cuckoo, Jacobin Cuckoo, Black Cuckoo, European Cuckoo and Striped Cuckoo.

Drongos

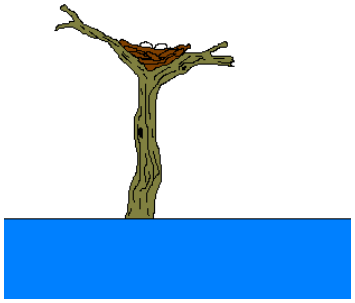
The nest is held between two horizontal forked branches. These birds are insectivores. The Fork Tailed Drongo is a common species found throughout southern africa.

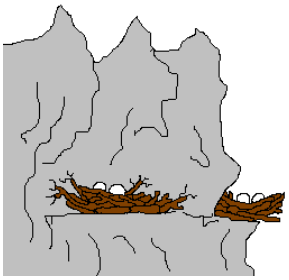


© Lee Gutteridge – 2 December 2005

Eagles

There are many varieties of Eagle in south africa. Fish Eagles nest over water, and eat fish. Verreuxs Eagle nests on cliff faces and eats Hyrax. The Tawny eats rodents and small mammals and nests in stick nests in grassland trees, and the African Hawk Eagle which also feeds on mammals lives in the same tree stick nest type.



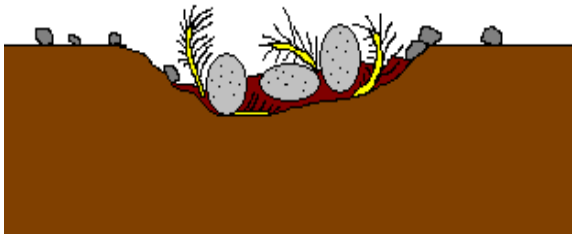


Fly catchers and Batises.

Fly Catchers and Batises are insect eaters. They buid their nests from spider webs and lichen in a cup shape. Common species include the Chinspot Batis , Cape Batis, Paradise Fly Catcher, Black Fly Catcher, Marico Fly Catcher and Pallid Fly Catcher.

Francolin and Guinea fowls.

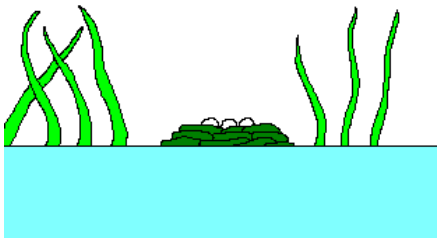
These birds use feather lined scrapes in the ground as nests. They eat seeds, shoots , bulbs, roots, snails and insects. Common representetives are Helmeted Guinea Fowl, Crested Francolin, Swainsons Francolin, Natal Francolin and Coqui Francolin.

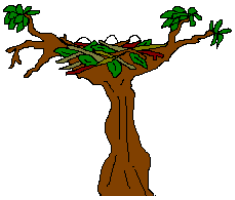


© Lee Gutteridge – 2 December 2005

Geese and Ducks

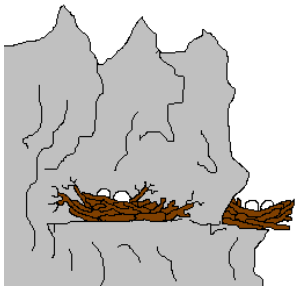
These aquatic birds sometimes tree nesters, and others nest in reeds and grasses, or even build floating nests. They eat grasses, seeds and aquatic vegetation. Common representatives include Egyptian Geese, White Faced Ducks, White Backed Ducks, African Black Ducks, Spurwing Geese and Yellow Billed Ducks.





Gymnogenes

These cliff nesters eat other bird species and their chicks, and have a double jointed knee for reaching into holes in trees to steal chicks.



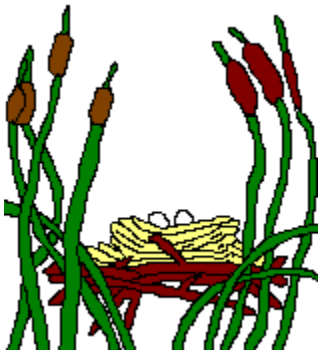
Hammerkop

These waders build huge stick nests of up to 50kg. A breeding pair may have several of these nests within their territory and will add to them each year. They feed on small fish, amphibians and crustaceans at the waters edge.

© Lee Gutteridge – 2 December 2005

Harriers

Birds such as the African Marsh Harrier and the Black Harrier are mainly hunters of rodents. They often live in wetland environments, but the Black Harrier also nests in fynbos areas in the Cape. The nests are often built on stick platforms in reed beds. If on the ground it is often in dense surrounding vegetation.



Herons and Egrets

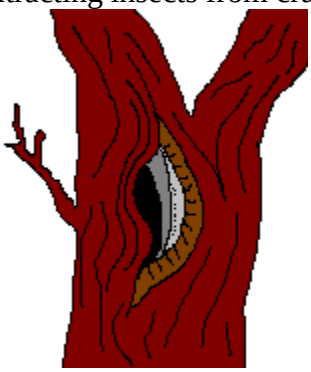
These birds nest communally in heronries. They build nests of sticks in reed beds. These birds eat mainly fish. Common examples include Great White Egret, Little Egret, Cattle Egret, Green Backed Heron, Grey Headed Heron, Purple Heron and Goliath Heron.

Honey guides

These birds are brood parasites. They do not build nests. They eat insects, honey and bees wax amongst other items. The Lesser and Greater Honey guides are two of the more common species.

Hoopoes

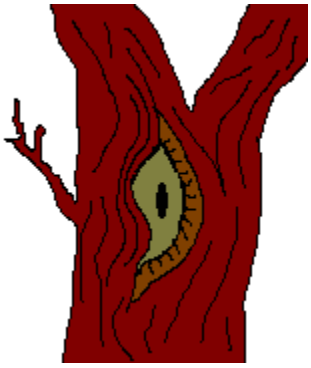
Hoopes and Woodhoopoes are hole nesters, using natural holes in tree trunks the Red Billed Wood Hoopoes are a gregarious group of birds, but the Scimitar Bill and African Hoopoe live in pairs. They use their long beaks for extracting insects from cracks and crevices in the bark



© Lee Gutteridge – 2 December 2005

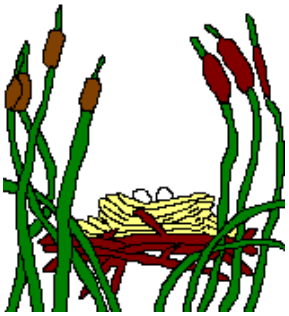
Hornbills

These birds use natural holes in trees and seal them with mud, leaving a small hole. The male will feed the female while she is enclosed through this hole. These birds eat fruit, seeds, insects and even small reptiles. Ground hornbills do not seal in the female, but use a very large natural hole in the tree and leave it open.



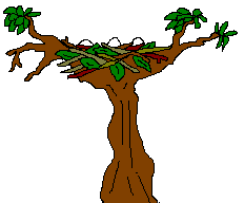
Ibis

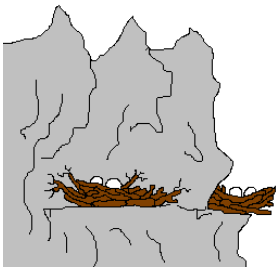
These birds use their long recurved beaks to probe into the ground to dig out subterranean food such as worms and larvae, crustaceans, fish and reptiles.



Kestrels

These birds build stick nests in trees and on cliffs. They eat mainly rodents.

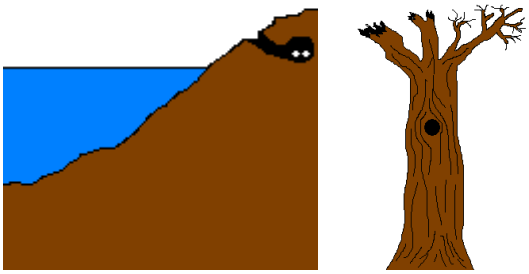




© Lee Gutteridge – 2 December 2005

Kingfishers

These birds are hole nesters, burrowing into the ground near water, or using a hole in a tree, and eat fish or insects. Common species include the Pied, Brown Hooded, Grey Headed, Striped, Malachite, Giant, Pygmy and Woodlands.



Kites

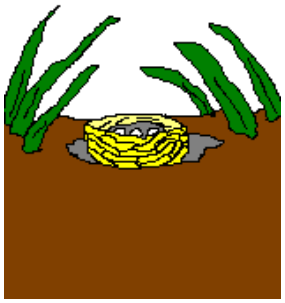
These birds build stick nests in trees, and eat mainly rodents. Common species inlude Yellow Billed, Black Billed and Black Shouldered kites.

Lannarius Shrikes

These birds build cup nests of various shapes and are parasitized by Black Cuckoos. They eat insects, reptiles and small rodents. Common species include the Crimson Breasted, Swamp and Southern Boubou's.

Larks and Pipits

These birds build grass nests on the ground. They eat insects and worms. Common species include the Roufous Naped, Clapper, Flappet and Sabota Larks, and the Plainbacked and Buffy Pipits.



© Lee Gutteridge – 2 December 2005

Louries

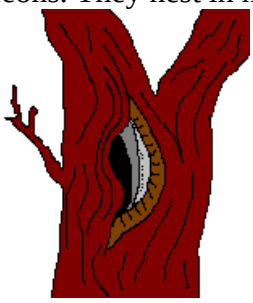
These birds build nests of sticks in trees. They eat fruits and leaves. Common species include the Grey, Knysna, Livingstones and the Purple Crested Louries.

Mousebirds

These birds build arboreal cup nests. Some live in groups. They eat fruits mainly. Common species include Speckled, Redfaced and White Backed Mousebirds.

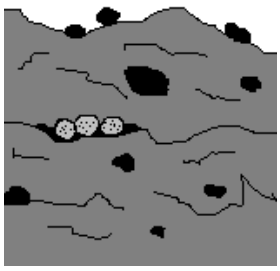
Narina trogon

These birds eat fruit, insects and chameleons. They nest in holes in trees.



Night Jar

These birds lay their camoflaged eggs on bare ground or rock. They are nocturnal insectivores. Common species include the Firey necked, Pennant Winged, Roufous Cheeked and Mozambique Night Jars.



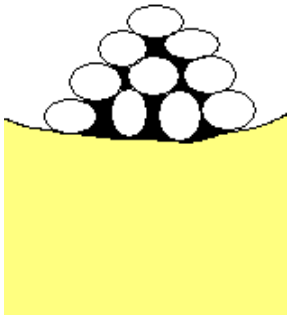
© Lee Gutteridge – 2 December 2005

Orioles

These birds eat insects, fruit and nectar. They build suspended nests in trees. Species include the Black Headed, Golden, European and Green Headed (found only at mount Gorongosa in Mozambique).

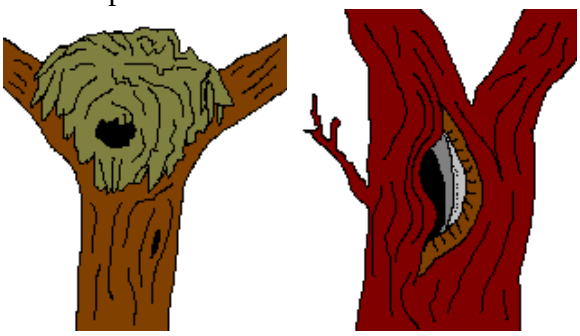
Ostrich

These birds are ground nesters, and practise egg dumping, where many females use the same nest and mate with the same male. They eat grasses and insects.



Owls

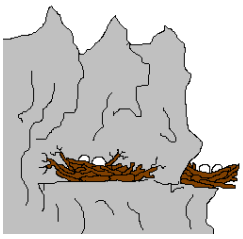
These birds are nocturnal carnivores. They use old Hammerkop nests and holes in trees to nest. They feed mainly on rodents and reptiles.



© Lee Gutteridge – 2 December 2005

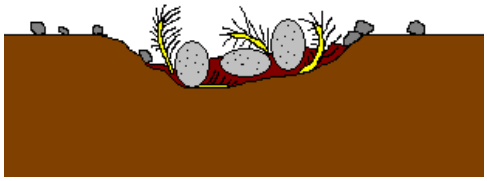
Pigeons and Doves

These birds eat seeds, and insects. They nest on cliffs, in trees and on man made structures. Common species include Rock Pigeon, Feral Pigeon, Green Pigeon, Green Spotted Dove, Namaqua Dove, Cape Turtle Dove and Laughing and Mourning Doves.



Plovers

These ground dwelling insectivores lay camouflaged eggs in scrapes in the ground. Common species include Three Banded, Blacksmith, Crowned and Wattled Plovers.



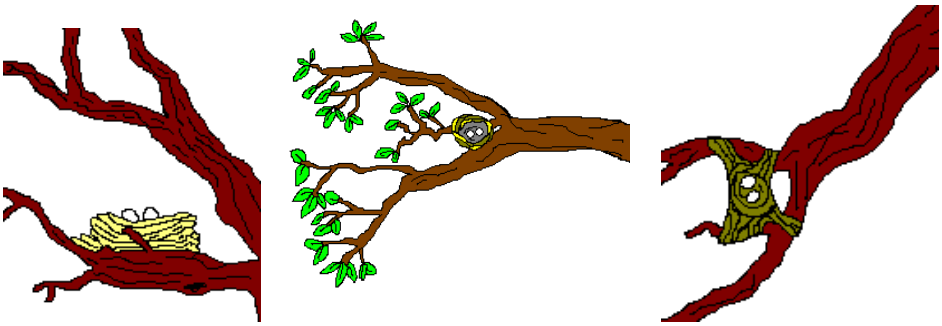
Prinias

These insectivores weave a basket nest of grass in small trees. Common species include the Tawny Flanked and Blackchested Prinias.

© Lee Gutteridge – 2 December 2005

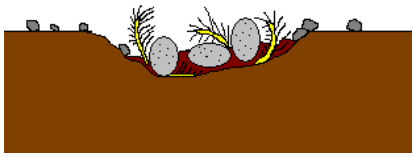
Robins

These insectivores nest in a variety of places, but usually in trees in a variety of cup shaped nests. Some species are parasitized by Red Chested Cuckoo.



Sandgrouses

These birds are ground nesters and eat seeds. Yellow Throated, Namaqua, Burchells and Doublebanded Sandgrouses are well known species.



Secretary Bird

Secretary Birds hunt rodents and snakes, and build platform nests on top of trees.

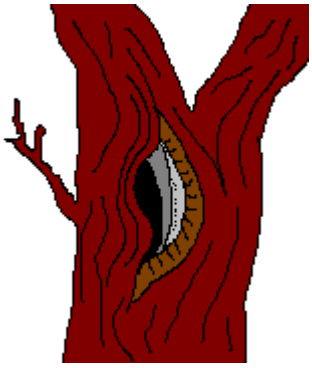
© Lee Gutteridge – 2 December 2005

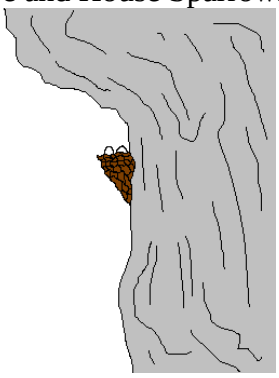
Shrikes

Shrikes build cup nests in trees, and will feed on insects, reptiles and small rodents. Common species include the Fiscal, Red Backed, Grey and Magpie or Longtailed Shrikes.

Sparrows

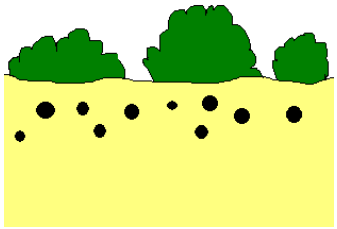
Sparrows eat seeds. They nest in a variety of places, using old swallow nests, holes in trees and purse nests. Common species include the Grey headed, Great, Cape and House Sparrows.

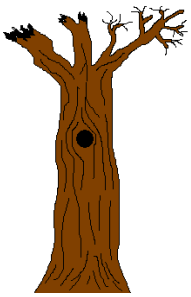




Starlings

These birds are insectivores, and they nest in holes in the ground or trees, and in cup nests in tree made of twigs and grass. Common species include the Plum Coloured, Cape Glossy, Burchells Glossy, Pied and Red Winged.





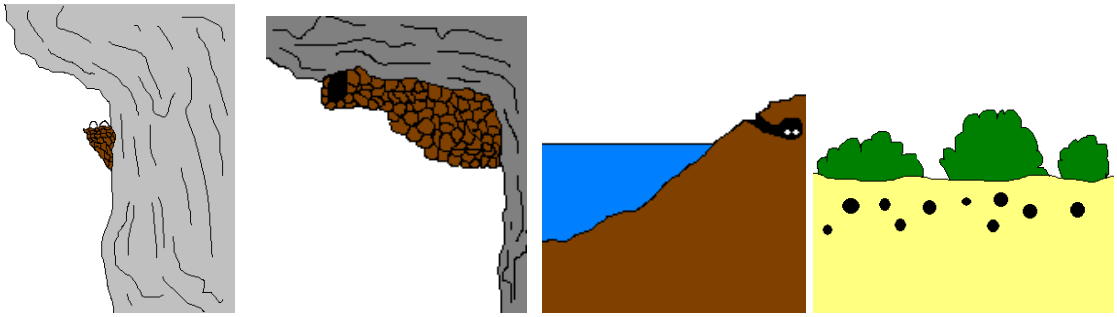
© Lee Gutteridge – 2 December 2005

Sunbirds

Nectar feeding sunbirds nest in purse nests, made of vegetation, lichen and spiderwebs. Common species include Malachite, Double Collared, White Bellied, Marico, Black and Scarlet Chested.

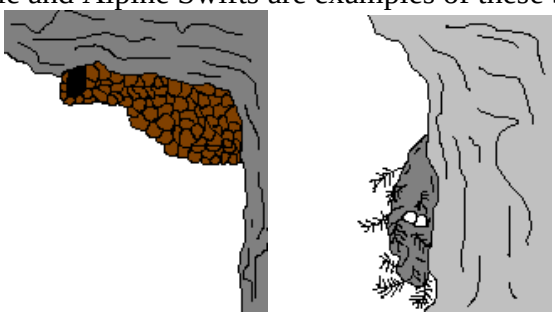
Swallows and Martins

Swallows build mud nests on cliffs or buildings. They feed on insects. Common types are Lesser Striped, European, White Throated, Pearl Breasted and Red Breasted Swallows. Martins nest underground in holes in river banks and in grasslands. Common Martins include Rock and Brown Throated Martins.



Swifts

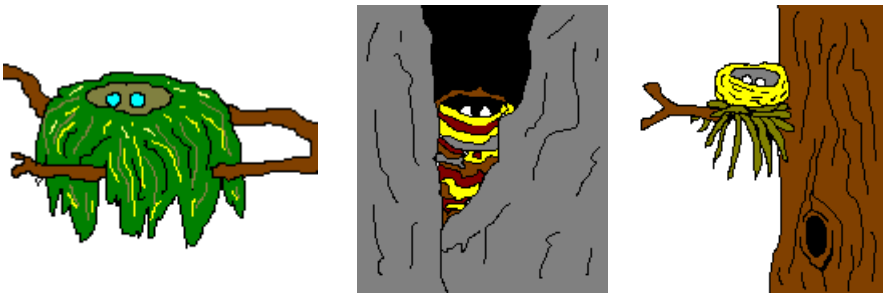
Swifts build mud nests or use feathers and spittle to glue eggs to cliff faces. These insectivores seldom touch ground, and battle to take off from the ground, needing a drop to begin flying such as off a cliff or tree. Palm, Little and Alpine Swifts are examples of these birds.



© Lee Gutteridge – 2 December 2005

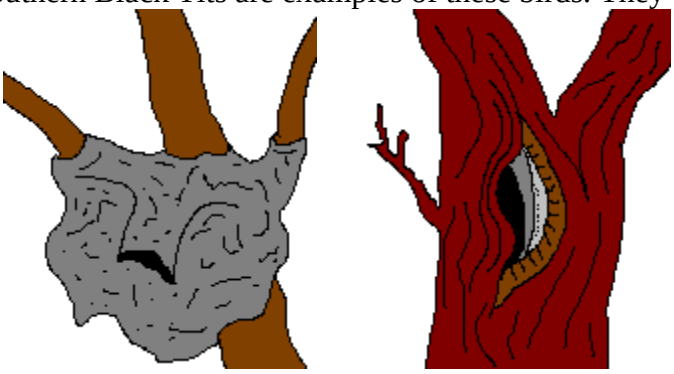
Thrushes

These birds are insectivores. They have a variety of nest types such as lichen nests, nests in rock cracks, and cup nests of grass. Olive, Kurrichane, Cape Rock and Groundscraper are examples of Thrushes.



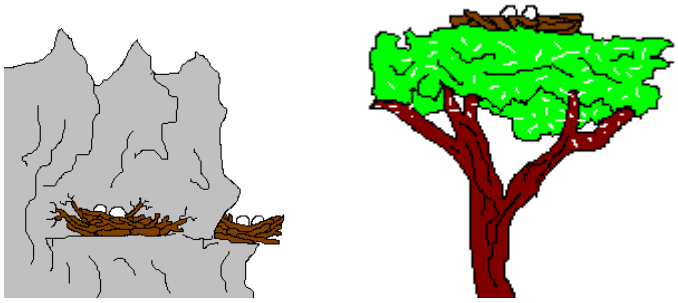
Tits

These small birds sometimes weave intricate purse nests. They also nest in holes in trees. Penduline, Grey and Southern Black Tits are examples of these birds. They eat insects.



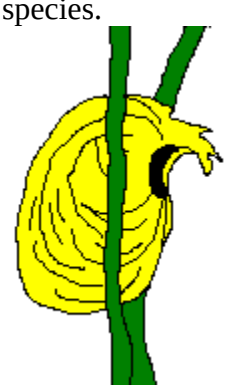
Vultures

Vultures are scavengers of carrion. They nest on platforms in trees and on cliffs. Species include Cape, Whitebacked, Lappet Face, Bearded, Hooded and White Headed Vultures.

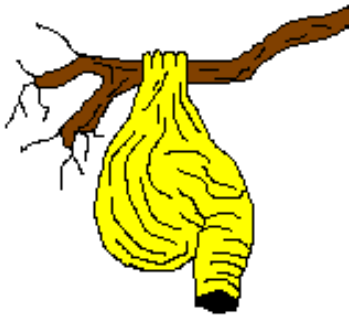


© Lee Gutteridge – 2 December 2005

Waxbills and firefinches
These small birds weave grass nests in reeds or on the ground, and eat seeds. They are parasitized by Wydahs and Widowfinches. Blue, Common and Orange Breasted Waxbills and Brown and Jamesons Fire Finches are examples of species.



Weavers
Weavers all weave nests of grass of various shapes and sizes. They are seed eaters. Red Headed, Masked, Cape, Spectacled, Sparrow and Sociable Weavers are examples.



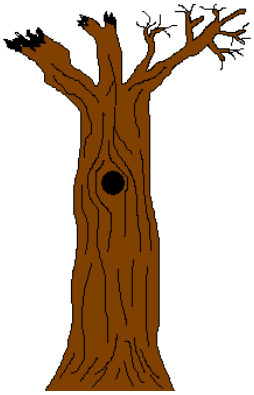
White Eyes
The Cape and Yellow are the only White Eyes in south africa. They eat insects, spiders, spider eggs, flower petals and honeydew from aphids. They weave a flimsy basket nest.

Wydahs
These birds parasitize other birds and do not build nests. They are seed eaters, but some will eat insects too. Common representitives are the Pintailed and Paradise Wydahs.

© Lee Gutteridge – 2 December 2005

Wood peckers

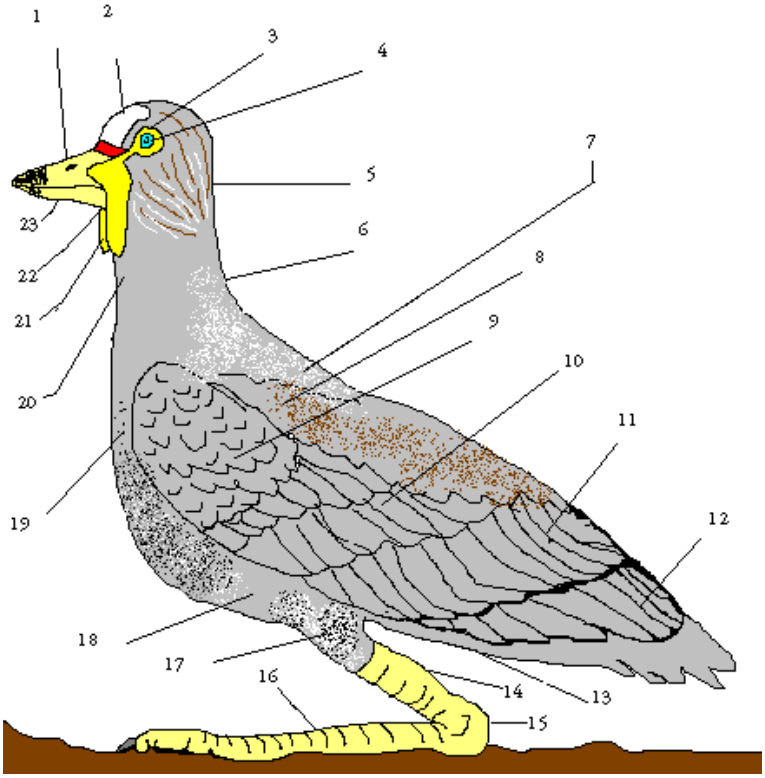
Woodpeckers bore holes into trees to build their nests. They eat insects and seeds. Species include Goldentailed, Cardinal, Bearded and Bennets Woodpeckers.



© Lee Gutteridge – 2 December 2005

BASIC ANATOMY OF BIRDS

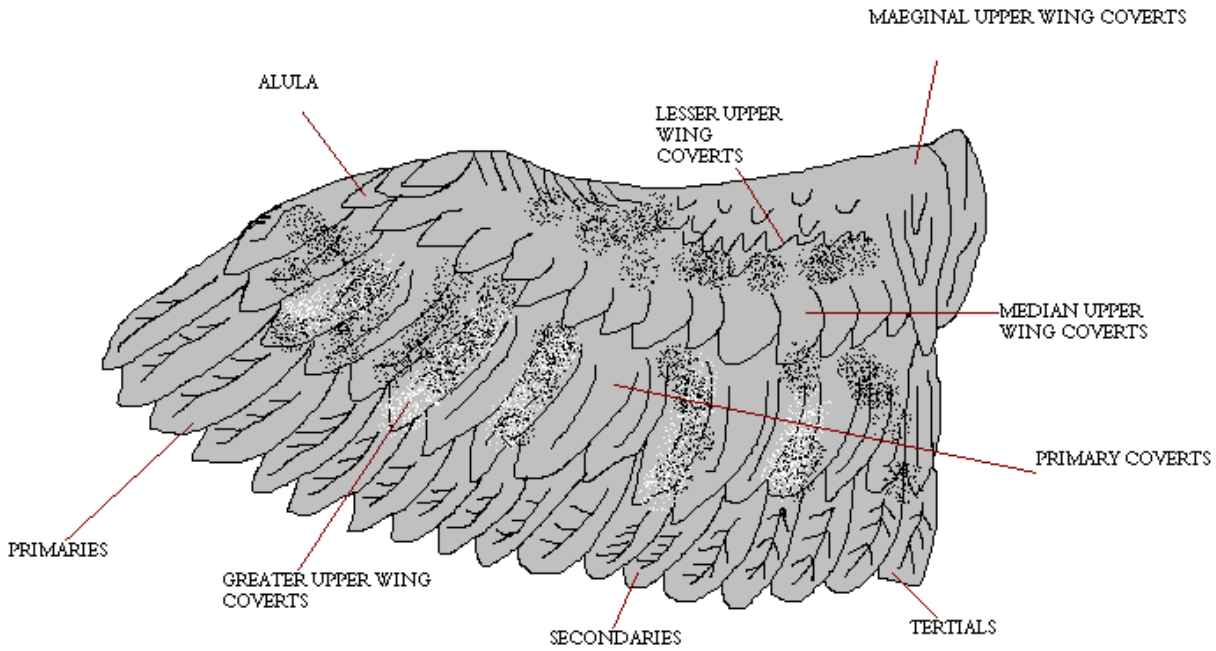
Body parts of a bird.



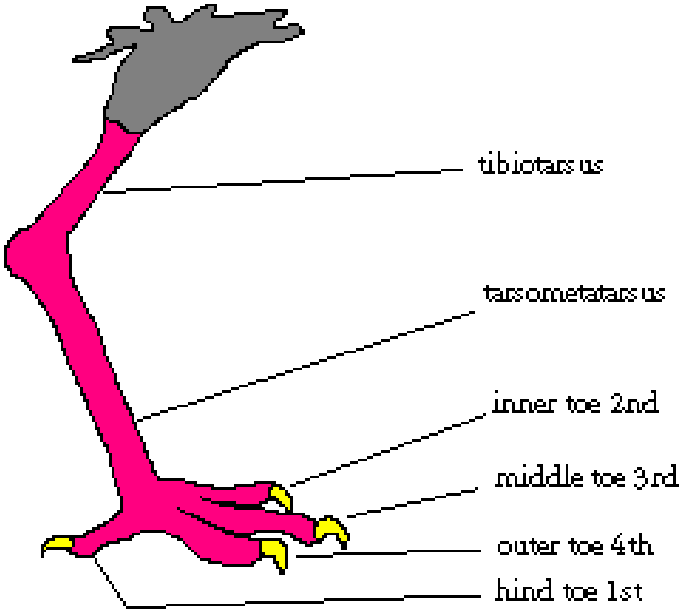
1. upper mandible
2. forehead
3. eyering
4. eye
5. nape
6. hind neck
7. mantle
8. scapulars
9. lesser coverts
10. greater wing coverts
11. secondaries
12. tertials
13. vent
14. tibia
15. tibio-tarsal joint
16. tarsus
17. thigh
18. belly
19. breast
20. throat
21. wattle
22. chin
23. lower mandible

© Lee Gutteridge – 2 December 2005

The wing of a bird



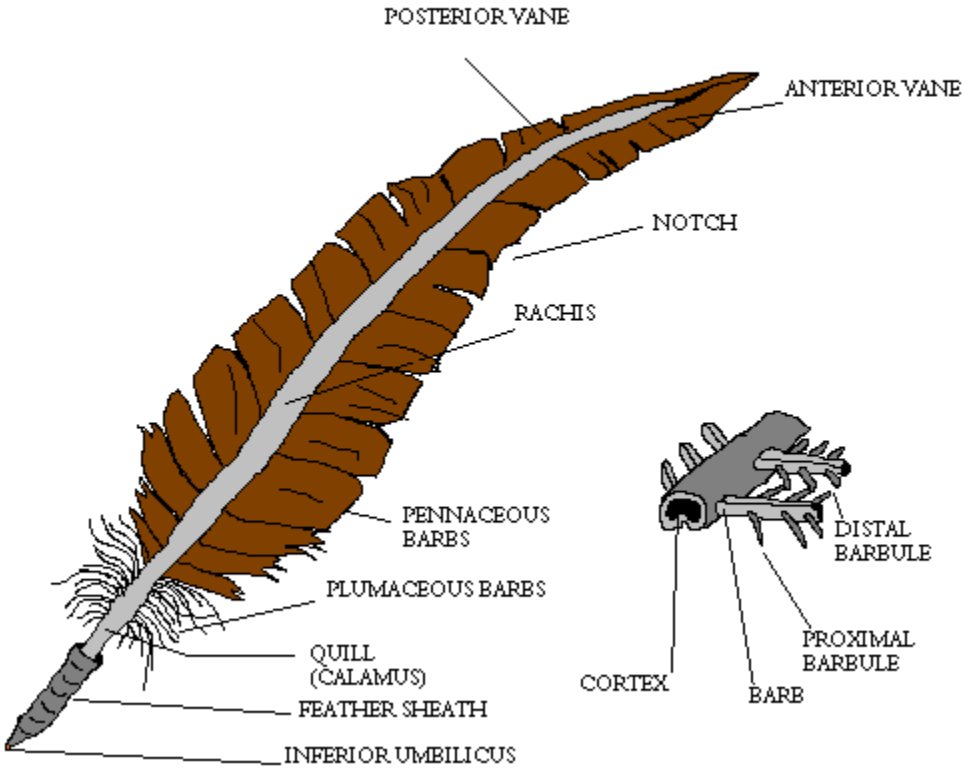
The feet of a bird (passerine)



© Lee Gutteridge – 2 December 2005

The head of a bird

The feather of a bird



© Lee Gutteridge – 2 December 2005

PIGMENTATION IN BIRDS

The three main pigments in birds are Carotenoids, Porphyrins and Melanins.

Carotenoids
These are bright yellow and bright red coloured pigments. Lutein and beta carotene are two yellow pigment types. Astaxanthin and rhodoxanthin are red coloured pigments. These pigments are derived from plant food eaten by the birds such as grains and seeds.

Porphyrins
These are red, green, brown and reddish brown coloured pigments. These include turacoverdin which is bright green, touracin which is bright crimson / red and coproporphyrin III which is brown, or brown red. Porphyrins are pigments related to haemoglobin, and are formed by haemoglobin being broken down in the liver. These pigments are found in louries, gallinules, owls and pigeons.

Melanins
These pigments are black, grey, brown, dull yellow and brick red. Eumelanin produces black, grey and dark brown. Phaeomelanin produces light brown, brick red and dull yellow.
It is caused by the oxidation of the amino acid tyrosene.

SOME SPECIALLY ADAPTED BIRD SPECIES

This is a brief discussion about a few interesting bird species and their special adaptations to their environments.

Ant eating chat
The ant eating chat is a grassland species, which has adapted to survive using two major commodities available in the open veld. One of these is ants. Ants are common and easily located throughout the year. Another commodity is the abundance of Aardvark burrows, which this bird has adapted to use as a nesting site in the absence of trees and cliffs. It also uses an energy saving territorial display, by simply perching on a twig or grass stalk or termite mound. In the open grassland habitat where it lives it can be see from a great distance by other birds.

Ostrich
The Ostrich has lost its ability to fly, and is incredibly big, so it can defend itself in four ways. One is aggressive displays, which can be very intimidating to a predator. They also lay flat and still while brooding eggs, the female by day, so that her grey feathers are good camoflage, and the male by night. The Ostrich is a very good runner, and can achieve about sixty km per hour. The last defence method it has is to actually kick an attacker, or rival. These birds nest on open grassland in a shallow scrape in the ground. There are often two or three females per nest, with one male. Baby birds are well camouflaged, to be able to hide. They feed on grass and insects.

Cape Vulture
These birds use thermals to save their energy in flight and have broad fingered wings to facilitate this. These birds have learned to use other bird species to indicate food sources. They have naked heads to prevent hygene problems when feeding on carcasses and inserting their entire heads into the carcass. They nest in stick nests on cliff faces.

© Lee Gutteridge – 2 December 2005

Coqui Francolin

These small francolins are well camouflaged, and depend upon this for survival. They are preyed upon by mammals, reptiles and other birds. When a coqui crosses an open piece of ground it will take one step, and then stand for a while before taking the next. This is because there may be birds of prey in the area, and they will sense any movement immediately, but if the movement stops they may loose sight of the well camouflaged bird while it is standing still. Then on the next step it will do the same. Because they live in grassland, where they cannot see each other all the time they communicate vocally, quite often.

Black Sunbird

The Black Sunbird is specially adapted in its form, with a light body for climbing slender flower stalks, and with a long beak for extracting nectar.

Cape White eye

These tiny birds have a very diverse diets, eating spiders, spider eggs, flower petals, insects, nectar, fruit and even honeydew from aphids. They are fast flying, and nest in tiny cup nests in tree branch forks.

Reed Cormorant

These aquatic birds have learned to swim, in order to catch fish, which they spear with their sharp pointed beaks, using the recoiled neck as a spring to launch the spear at its target. They lack preen oil and preen glands so the feathers absorb water reducing their bouyancy, enabling efficent diving. They will also swallow stones if neccesary. When they come out of water they will dry their wings by spreading them out, often using the same perch over and over again.

Red Chested Cuckoo

These intra africa migrants lay their eggs in the nest of other birds and have developed special behaviours to allow this to be successful. It has a very common and distinctive call. They eat caterpillars, insects and even seeds. The Lappet moth is a favourite (*Pachypasa*). These moths feed on *rhus spp.* Courtship feeding takes place. The host species are Cape Robins, Mocking Chats, Olive Thrushes, Cape Wagtail and even, in an accidental case, a Cape Siskin. There are some other species parasitised. The process of laying one of her own eggs in the host nest takes the secretive female less than a minute. Her egg is pre-incubated in her oviduct for some 12 hours, and will hatch around the same time as the host eggs, and then the chick will use its specially adapted broad back and wings to cradle the hosts eggs or chicks on its back and climb to the lip of the nest and pitch them out. This process is repeated in the absence of the foster parents untill it has the nest to itself. It then has all the food its foster mother (according to roberts only the female feeds the chick in Cape Robin) can bring to its self. This instinctive behaviour is lost after 4 days. The colour of the egg is usually olive Green or chocolate brown, but if Boulder Chats are the host, the egg is Greenish White speckled with Red-brown. If a cuckoo has developed an egg colour to match a host egg it is called a *gens*, plural is *gentes.* The egg will incubate within 13-15 days. The Cape Robin, for example, will incubate for 14-18 days.

Cape Weaver

Cape Weavers use grasses and strips of palm to weave nests. The males face and chest become orange when breeding. He will build a nest of sufficient standard (he thinks) and advertise this to females by fluttering his wings and calling. If she likes his nest she will mate and lay eggs in it, if she does not, she will dismantle all his hard work.

© Lee Gutteridge – 2 December 2005

Giant Kingfisher
These large piscivores are superbly designed for diving for fish. They have a long dark beak and are able to hover. In areas near the sea they will even dive in between breaking waves to snatch fish from the sea.

These Eagles hunt in pairs. They fly along a mountain or hill range using thermals, and often at great height. If they sight a colony of Hyrax's, they may split up. One bird remaining high and within sight of the prey to attract their attention, and the other flying lower than the prey, out of sight close to the cliffs, and then attempting to surprise the Hyrax with an attack from below. They will also scavenge where possible, and eat guinea fowl, francolin, small antelope, Hares, Monkeys, reptiles and squirrels. They nest on cliff faces. They lay 2 eggs but the older chick will kill the younger, this is called siblicide, or cain and abel syndrome. One chick in a study situation pecked its younger sibling 1300 times in its 3 days of life.

CUCKOOS IN SOUTH AFRICA

In Southern Africa we have several different brood parasites. Brood parasites will lay their eggs in the nest of a host bird, where their larger stronger chicks will evict the hosts chicks, or even the egg in some cases. In this question we will concentrate on the cuckoo species in the area. They belong to the order *CUCULIFORMES*. Cuckoos are zygodactyl. They also seldom display sexual dimorphism, except Klaas' Cockoo. They are related to Coucals.

Red Chested Cuckoo
Cuculus solitarius
Breeding migrant.Also known as Piet-my-vrou. A very common and distinctive call. They eat caterpillars, insects and even seeds. The Lappet moth is a favourite (*Pachypasa*). These moths feed on *rhus spp.* Courtship feeding takes place. The host species are Cape Robins, Mocking Chats, Olive Thrushes, Cape Wagtail and even, in an accidental case, a Cape Siskin. There are some other species parasitised. The process of laying one of her own eggs in the host nest takes the secretive female less than a minute. Her egg is pre-incubated in her oviduct for some 12 hours, and will hatch around the same time as the host eggs, and then the chick will use its specially adapted broad back and wings to cradle the hosts eggs or chicks on its back and climb to the lip of the nest and pitch them out. This process is repeated in the absence of the foster parents untill it has the nest to itself. It then has all the food its foster mother (according to roberts only the female feeds the chick in Cape Robin) can bring to itsself. This instinctive behaviour is lost after 4 days. The colour of the egg is usually olive green or chocolate brown, but if Boulder Chats are the host, the egg is greenish white speckled with red-brown. If a cuckoo has developed an egg colour to match a host egg it is called a *gens* ,plural is *gentes.* The egg will incubate within 13-15 days. The Cape Robin, for example, will incuBate for 14-18 days.

African Cuckoo
Cuculus gularis
Intra-Africa migrant. They eat almost entirely caterpillars. They are hosted only by the Fork Tailed Drongo. 11 to 17 days incubation. The Drongo incubates for 16-17days.

© Lee Gutteridge – 2 December 2005

Jacobin Cuckoo
Clamator jacobinus
C j jacobinus and *C j picatus* breed in India and N Africa respectively, both migrating to South Africa. *C j serratus* breed in S.A. but migrates to tropical Africa. They eat hairy caterpillars and termite alates. When breeding the male flies noisily to distract the host species, while the female lays her egg in the host nest. This usually happens 3-4 hours after sunrise. Hosts are Black Eyed Bulbuls, Fiscal Shrikes, Fork Tailed Drongos, and, accidentally Cape White Eye. Other unconfirmed and probably accidental hosts include the Southern Boubou and the Cape Wagtail. Usually 1 egg per hosts nest, but as many as 7 recorded. 11 days incubation. The hosts chick or egg is not evicted, but trampled to death in the nest. Sometimes they are even successfully raised along with the cuckoo. The Fiscal Shrike incubates for 15-16,5 days.

Klaas's Cuckoo
Chrysococcyx klaas
Also known as Meitjie. The Greek word *Chrysos* means gold, and *kokkyx* means cuckoo. This refers to the metallic sheen of colour, which is not, as in all metallic birds a pigment based colour, but caused by the refraction of light, or reflection of certain wavelengths (colours). The refractive index of a feather can be changed by wetting it. As regards the call this is onomatopoeic, as the afrikaans name Meitjie sounds like the call. Uncommon breeding intra-Africa migrant. Males call often from an exposed perch, but females are seldom seen. Sexually dimorphic. 22 different hosts in S.A. these include Long Billed Crombec, Yellow Bellied Eromomela, Neddicky, Tawny Flanked Prinia, Puffback, Whitebellied Sunbird and Black Sunbird, to name but a few. One egg is layed per hosts nest, closely resembling the hosts own eggs. 12 days incubation, young and eggs of host evicted. Tawny Flanked Prinia incubates for 13-14 days.

Black Cuckoo
Cuculus clamosus
Common breeding migrant. They eat insects and caterpillars. Only hosted by *Laniarius* shrikes such as the Southern Boubou.13-14 day incubation, with host chicks and eggs evicted within 48 hours. Southern Boubou incubate their eggs for 16-17 days.

Great Spotted Cuckoo
Clamator glandarius
C g glandarius breed in Europe and Middle East but migrate to S.A. *C g choragium* breed in S.A. but migrate to tropical Africa. These two sub-species are indistinguishable in the field. They eat hairy caterpillars and other insects. Hosts include Red Winged Starlings and Pied Crows. As many as 13 cuckoo eggs may be laid, and some hosts eggs may be broken by the harder cuckoo eggs. 14 days of incubation, no host eggs or chicks are evicted, but may be reared with the cuckoo chicks. Host chicks usually dissappear during nestling period. Late-hatched chicks or eggs may be trampled however. Red Winged Starlings incubate their eggs for 12,5 to 23 days.

Striped Cuckoo
Clamator levaillantii
Uncommon breeding intra-Africa migrant. Eats caterpillars and insects. Hosted by the Arrowmarked Babbler. Incubates for 11 days. Sometimes there is embryonic development before the egg is laid. Usually tramples host eggs and chicks to death but may be reared together, and will be fed by hosts for up to 35 days. The Arrowmarked Babblers incubation period is unrecorded in Roberts, but Steyn records 14 days.

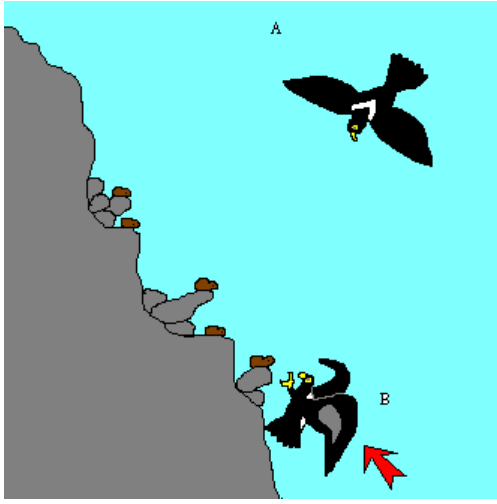
© Lee Gutteridge – 2 December 2005

Diederick Cuckoo
Chrysococcyx caprius
Common intra-Africa migrant. Not at all shy. Males feed females with caterpillars as courtship, and this is sometimes erroneously mistaken for the feeding of their own chicks.
Amongst the host species are Paradise Fly Catchers, Cape Weavers, Cape Sparrows and Golden Breasted Buntings. One egg per host nest, female cuckoo will remove and eat one of the hosts eggs. Eggs usually match the hosts eggs. The incubation is 10-12 days, and the hosts chicks or eggs are evicted within 4 days. Postnestling dependence is up to 32 days. Cape Weavers incubate for 13,5 days.

European Cuckoo
Cuculus canorus
Uncommon migrant. Breeds extralimitally. Feeds on caterpillars and insects.

HUNTING METHODS OF A FEW SPECIES

Black Eagle (Verreauxs Eagle)
These Eagles hunt in pairs. They fly along a mountain or hill range using thermals, and often at great height. If they sight a colony of Hyrax's, they may split up. One bird remaining high and within sight of the prey to attract their attention, and the other flying lower than the prey, out of sight close to the cliffs, and then attempting to surprise the Hyrax with an attack from below. They will also scavenge where possible and eat Guinea Fowl, Francolin small antelope hares, monkeys, reptiles and squirrels.



Black Breasted Snake Eagle
These birds usually hunt alone, although occasionally in groups. They drop like a parachutist onto their prey. They eat snakes up to 2m long, rodents, lizards ,amphibians, bats and even occasionally catch fish swimming near the surface of open water.

African Fish Eagle
These birds fish on open water snatching up prey as they fly over. Medium sized fish are carried and large fish are skimmed over the waters surface. They have rough feet for this purpose and bare legs. They also eat dassies, carrion, monkeys, waterbirds, monitor lizards and nestlings of birds.

© Lee Gutteridge – 2 December 2005

Jackal buzzards
These birds eat reptiles, carrion, dassies, rodents, birds and insects. They hover on updraughts, and stoop to make kills.

Black Shouldered Kite
These birds hover, and drop onto prey, often in stages. Mainly they eat rodents, but will take reptiles, birds and insects.

Rock Kestrel
These birds hover frequently in the wind, dropping parachute like in stages onto prey. Birds are taken in flight as are bats. Small mammals are the main food type, along with lizards snakes and insects.

Gymnogene
These bird have a double jointed tarsal joint and can bend the knee forwards or backwards to take nestling birds from their nests. They also eat reptiles, amphibians, small mammals and insects.

GENERAL BIRD INFORMATION

1. Nesting and breeding in the African Jacana is unusual in that the male builds the floating nest, does all the incubating of the egg and all the rearing and protection of the chicks. These are a polyandrous species, literally meaning many males, and this means that a female jacana will search for and mate with as many males as possible in a breeding season, lay eggs in their nests and then leave. Painted snipes breed on the same system.

2. Magnetic navigation during migration is still for the most part a mystery to science, but there have been several research programs on the subject. In one program the birds were fitted with magnetically charged iron bars which excluded the earths magnetic field, and these birds got lost. Other birds were fitted with bars which did not affect the impulses of the earths magnetic field, and they all found their way successfully. There have been traces of the iron oxide Magnatite found in the brains of some birds, maybe this is one of the instruments used by birds for magnetic navigation.

3. Bird senses.

   Sight
   This is the primary sense of most birds. Some birds can see polarised light, and most have full colour vision. Sight is used for food location, and for identifying sexually mature partners for mating. Vultures have many more light receptors in their eyes than humans, and have special lenses in the eyes for magnification. Nocturnal birds have a tapetum lucidum in the eye to enhance nocturnal vision.

   Smell
   Smell is not of major importance to most birds. The turkey vulture of South America and the kiwi of New Zealand being notable exceptions. Smell may also be a migratory aid.

© Lee Gutteridge – 2 December 2005

Hearing
Sound is of vital importance to birds in their day to day communication. Birds can determine the minute differences in timing in very similar calls. Some birds such as owls use hearing as a primary hunting sense. The frequencies heard are for the most part similar to the frequencies we hear. Birds call by using a combination of air sacs in the body to fill the lungs, each of which has its own syrinx on its bronchii. The syrinx has a lip like set of structures, which change shape to produce different sounds. One syrinx-lung-air sac combination can breathe while the other sings, or the bird can even handle food in its beak and call at the same time.

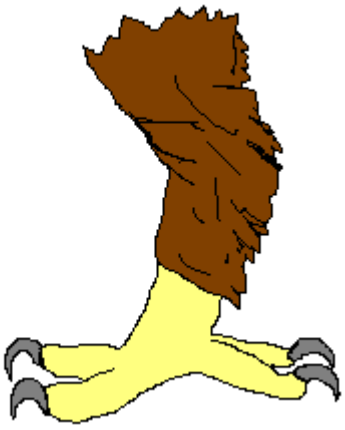
4. Old world vultures include the African species such as Whitebacked, Cape, egyptian and lappet faced vultures. These birds locate food, in the form of carrion, by sight. They either directly observe the carcass themselves or they use the indicator of other carrion feeders flying down to a food source as a visual signal of a possible meal. New world vultures also use sight for food location, but one of the species in the Americas uses smell. The turkey buzzard catches scent particles in the air, and following the winds downward, locates prey. These birds live in the southern USA, Central America and northern South America. Many of these regions are covered in forest, so the birds will not be able to see carcasses at ground level. This has also been used to human advantage on the gas pipelines in the USA, where it has been found that turkey buzzards are attracted to the gas mercaptan. So when there is a suspected leak in a pipe line, the mercaptan levels are increased, and then the repair teams drive along and look for flocks of vultures around the pipe, and this will help to identify the leaks location.

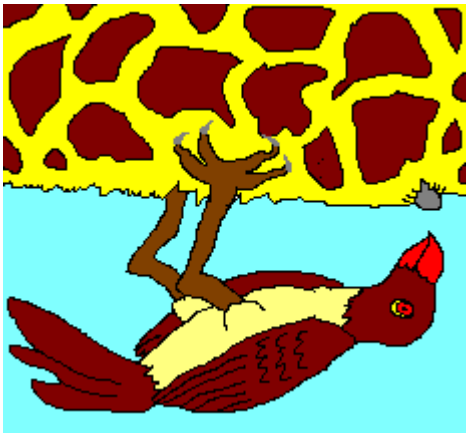
5. The call of the pearl spotted owl, which is often heard in the morning and afternoon, often attracts small songbirds to investigate. The pearl spotted owl is very small, and can climb into holes in tree trunks, or open cup nests and kill and eat chicks of song birds. In respose to the threat of pearl spotted owls in an area the small birds may mob the owl, and try to chase it as far from their nesting sites as possible to protect their offspring.

6. Zygodactylous birds have an interesting foot structure with two toes forward, and two toes back. This may be to serve a function such as in wood peckers, who need a strong grip on a tree trunk to bore a nest, or as in the cuckoos, who search the underside of branches and leaves for caterpillars. Other zygodactyls include owls, coucals, ox-peckers, parrots, lovebirds, honey guides and barbets. All of these birds have special reasons for this increased strength of foot structure and grip. Ox-peckers for example need to clamber down to the undersides of the host animals which they are removing ticks from, and owls need to cover as large a suface area as possible with their feet, like a fishing net, when attempting a strike on ground dwelling prey in total darkness. Parrots and love bird climb into peculiar positions when attempting to obtain seeds and pips from tough fruits like sausage tree fruits.

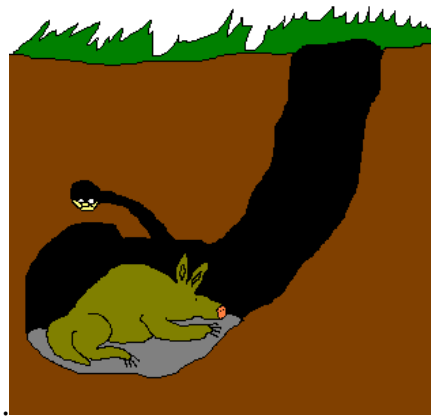
© Lee Gutteridge – 2 December 2005

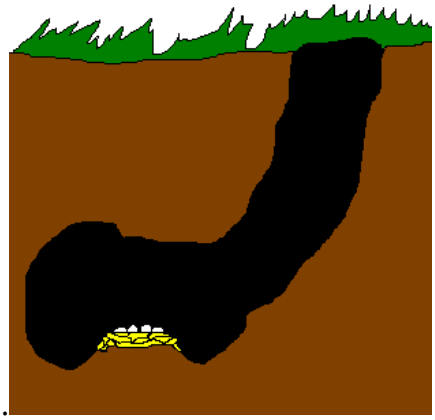
7. See previous question for uses of zygodactylous feet. Here is a drawing of an example of a zygodactylous foot. Also a picture of an Ox-pecker using its zygodactylous foot to grasp the underside of a giraffe and remove a tick.





8. Two of the birds in South Africa which nest below ground are the Ant Eating Chat, and the African Shelduck. Chats dig a tunnel into the roof of the Aardvark burrow, between 45 and 90 cm long, with a small nesting chamber at the end. The Shelduck uses an abandoned Aardvark burrow, and places grass and nesting materials at the end. These birds nest over a kilometre from water sometimes. Drawing #1 is a Chat nest and Drawing #2 is a Shelduck nest. Capped wheatears and Blue swallows are also subterranean nesters.

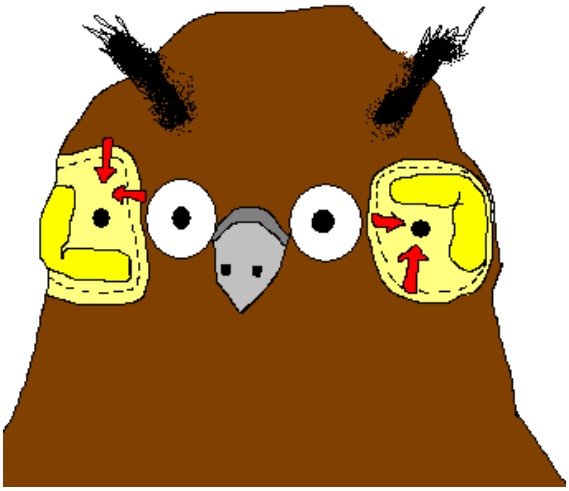
1. 

2. 

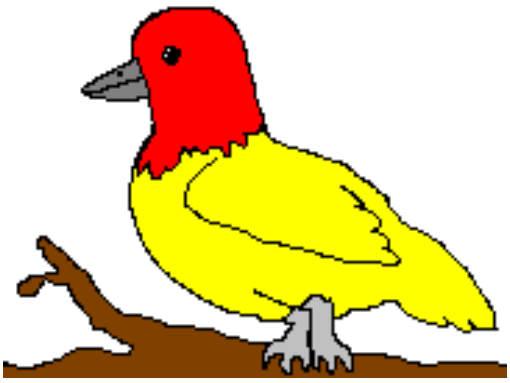
9. Kestrels have an unique ability amongst animals to see UV light. When a rodent uses a trail regularly, they will urinate on the trail, leaving a visual trail which can only be seen if you can see into the ultra violet wavelengths like the kestrel. The kestrel can use these urine trails to find rodents, or predict its path to safety when it attempts to flee.

© Lee Gutteridge – 2 December 2005

10. Owls have specially shaped hearing apparatus on their disk shaped face. The flat face assists with the channelling of sound to the ears. In the diagram the ear holes are positioned out side the eyes. Above the one ear there is a ridge, and below the other there is also a ridge. On the outside of each ear there is another ridge. Basically sounds from above would be best heard through the ear on the left, and sounds from below would be best heard by the ear on the right hand side. The outside ridges will trap sounds from the opposite side of the head. Basically each set of ridges is designed to trap sound from different angles of origin, and so through the quality of hearing of a sound by each ear, the owl can determine the exact direction of the sound and the distance, even in total darkness. (arrows indicate the optimum directions of origin for the sounds picked up best by each ear).



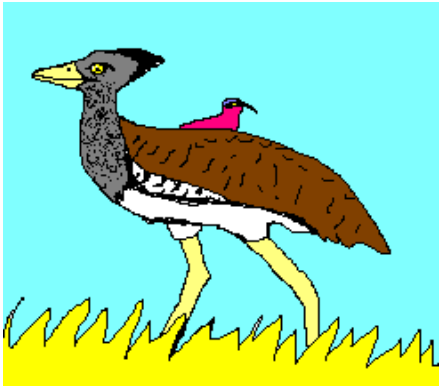
11. Birds sometimes display a change in their plumage or skin colour during breeding seasons. This is to display to the female that they are in prime condition, and having surplus energy to create long, colouRed feathers is proof of this. Examples of groups of birds which do this include whydahs, Weavers, Ostrich, fly catchers, Bishops and widows.



A Red Headed Weaver in breeding plumage.

© Lee Gutteridge – 2 December 2005

12. An interesting relationship between the carmine bee eater and the kori bustard has developed, in certain grassland areas of Southern Africa. The carmine bee eaters ride on the back of the bustard, and hunt insects from this mobile perch. They in turn would be an early warning system for the bustard.



A Carmine Bee Eater on the back of a Kori Bustard.

13. Birds sometimes fly in a V formation when travelling long distances because the birds behind benefit from a small energy saving slipstream, and the bird in the front recieves a little benefit from the bird behinds upwash.

Birds flying in an energy saving formation.

14. Visually the difference between Snake Eagles and true Eagles is that Snake Eagles have bare legs, covered in hard scales. True Eagles have feathered legs.

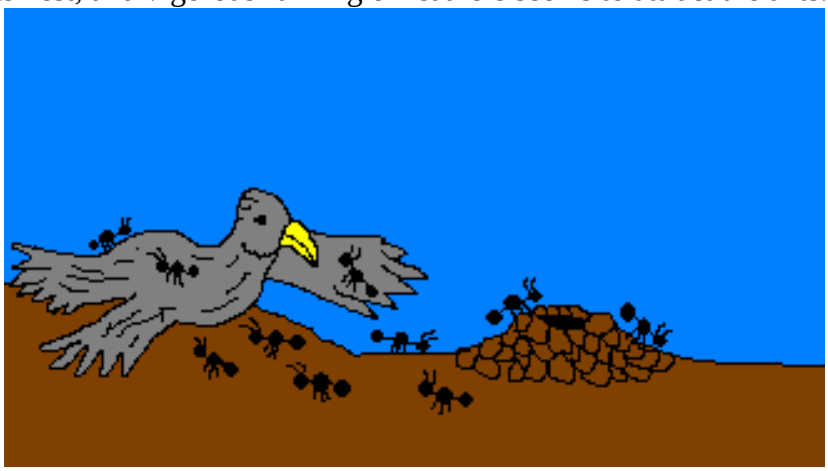
15. Sandgrouse have special spiral feathers on their underbelly, which absorb water. These feathers are saturated in a pool of water and then the bird flies back to the nest. This water can either cool the eggs or be used as drinking water for the chicks.

16. Soaring dynamics relates to carrion feeding birds. The lowest flying carrion feeders are Batteleurs and tawny Eagles (which also hunt). When these birds, which fly at tree top height see carrion they will descend. The next position in height order is filled by the hooded vulture. He will watch out for Batteleurs and Tawny Eagles descending. Then higher still is the Whiteback, who watches hooded vultures. After that the Cape and White headed, and finally the largest of them all the lappet face. These birds do not need to see the carrion themselves in a healthy ecosystem, as the other birds in the soaring dynamics will be food indicators. In areas where components of the scavenging team are lacking adaptations will take place. In the Waterberg of Northern S.A. black eagles have filled the avian scavenging niche, along with Cape Vultures. In the Soutpansberg there is also one East African Ruppells Vulture with one of the Cape vulture colonies. It is believed to be the only individual in the sub region.

© Lee Gutteridge – 2 December 2005

17. Roufous naped larks can be heard all spring and summer in many areas of South Africa. Their call is distinctive, with three notes. They sit on top of a tree or termite mound, with their crests raised and call for hours, sometimes within 50 metres of another bird.

18. Birds of many species perform a cleaning function called anting. This takes place in two ways, passive and active. During active anting an ant is picked up and rubbed on the feathers. During passive anting the bird will lie or crouch on the ground and spread the wing and tail feathers, allowing the ants to crawl all over the bird. This takes place next to or on an ants nest, and vigorous ruffling of feathers seems to attract the ants.



A bird anting.

The ant species most commonly involved in this behaviour is the pugnacious ant, *Anoplolepis custodiens,* which squirts formic acid from its abdomen. It is believed generally that the acid has a detrimental effect on the ectoparasites such as louse flies of the family *Hippoboscidae*, bird ticks of family *Ixodidae*, body lice of family *Mallophagidae* and feather mites of family *Analgesidae*. There is however a dispute as to the validity of this function as during active anting the ants are rubbed against the tips and outer edges of the primary remiges and retrices and the majority of the mites and lice are actually in the down, or at the base of the feathers and on the innermost feathers, so how much of the acid actually reaches the parasites? (Solomon Dec 2001 FGASA newsletter). A Russian researcher found that a Pippit had reduced mite loads after anting but this is the only time that this has been scientifically demonstrated. According to Solomon there are 17 species of bird in South Africa which participate in anting. Passive – Rock Kestrel, African Finfoot, African Hoopoe. Active – White-backed Mouse bird, Fork Tailed Drongo, Cape Robin, Black-eyed Bul bul, Red-eyed Bul bul, White Crowned Shrike, Fiscal Fly-catcher, paradise Fly-catcher, Cape White-eye, Wattled Starling, greater Blue-eared Starling, Red-winged Starling, Cape Weaver, Spotted Backed Weaver and Red Bishop. An article by Peter Ryan in Africa birds and birding discusses possible anti-bacterial properties of the excretions of certain glands in ants, which may assist in the Reduction of feather eating bacterial loads. Moulting at certain times of the year may also help with this process, along with sunning and dust Bathing.

19. Dust Bathing is also common practise amongst birds. The birds cover themselves in a fine layer of dust, which helps prevent the mouthparts of Hippoboscid flies and other biting parasites from being able to adhere properly to the skin.

© Lee Gutteridge – 2 December 2005

20. Swifts spend most of their life cycle in flight. They mate in flight, eat in flight, drink in flight and sleep in flight. Nesting is done in an abadoned mud nest or in a nest of feathers and spittle glued to a rock face. Swifts Battle to take off from the ground due to their long wings and poorly developed legs. They will not perch on the ground on purpose, as they need a drop to begin flying.

A spittle and feather nest of a Swift, glued to a cliff face.

21. Bird identification keys
There are seven major features to be used during bird identification attempts these are:
1. Size of the bird.
2. Beak shape, and colour.
3. Leg length, and colour.
4. Eye colour.
5. Plumage colour and distinctive markings.
6. What habitat is it in.
7. What is it doing.

22. Some brood parasite examples and hosts from various families of birds
Greater Honey Guide – Black collared Barbet
Red Chested Cuckoo – Natal Robin
Pin Tailed Whydah – Common Waxbill

© Lee Gutteridge – 2 December 2005

23. Taxonomic classification examples of some common birds

Kingdom Animalia
Phylum Chordata
Subphylum Vertabrata
Class Aves
Order Aseriformes
Family Anatidae
Genus Dendrocygna
Species Viduata
White Faced Duck

Kingdom Animalia
Phylum Chordata
Subphylum Vertabrata
Class Aves
Order Passeriformes
Family Laniidae
Genus Lanius
Species Collaris
Fiscal Shrike

Kingdom Animalia
Phylum Chordata
Subphylum Vertabrata
Class Aves
Order Strigiformes
Family Tytonidae
Genus Tyto
Species alba
Barn Owl

24. Allelomimetic behaviour
As per Scott, 1972, this is the behaviour that conspecific birds use to imitate each other. Also known as mimicking or socially facilitated behaviour. This is apparent where on bird from a flock flies down to water or food, and then the entire flock follows. This is not entirely confined to conspecifics, as there may be instances where, for example, a sparrow begins to bathe at a birdbath and then he is joined by a mannekin or a finch.

25. Hyperlipogenesis and hyperphagy
Hyperlipogenesis – super production of fat for fuel reserves in migration.
Hyperphagy – over eating to super produce fats for migration.

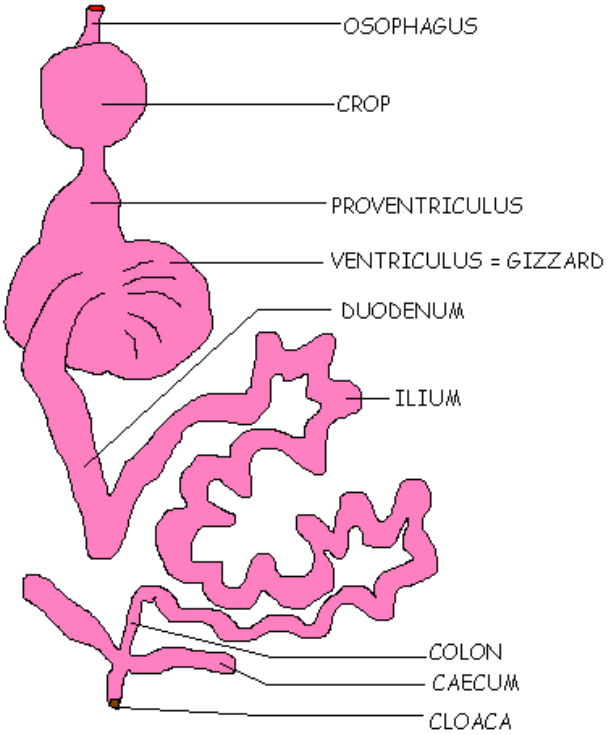
26. Migration types
Palaearctic – to Europe, north of the tropic of cancer from South Africa.
Intra African – within Africa
Altitudinal – across different altitudes
Local – within a region

© Lee Gutteridge – 2 December 2005

27. Scattering and iridescence
Iridescence i.e. glossy starlings caused by structured keratinous plates containing melanin in layers in the feathers. Scattering is caused by scattered particles of melanin in the cortex of feathers, causing light to be reflected in all directions i.e. kingfishers and green pigeons.

28. Breeding behaviour types
Monogamy – one mate for life.
Polygamy – multiple mates to one or the other of each sex.
Polygany - one male many females.
Polyandry – one female many males.

29. Bird digestive system or alimentary canal
Mouth – food is taken in through the mouth, which is covered in a beak, or rhamphotheca.
Crop – the crop is a single or double expansion of the oesophagus which expands to one or both sides. It is used for storing food before it moves to the stomach.
Stomach – this is divided into two parts the first is the proventriculus or glandular stomach.
Gizzard – the second is the muscular stomach known as a gizzard or ventriculus. The gizzard of a bird that eats hard food is muscular and strong, and has a well developed cuticle which is quite tough and can handle stones and other hard substances swallowed to help the muscular stomach grind up food. In birds which eat soft food the stomach is weakly muscled by comparison.
Duodenum – the stomach leads into the duodenum, which is the first part of the intestine which receives the bile duct from the liver, and in most birds there is a well formed separate gall bladder.
Jejulium and Ilium – the small intestine of a bird lead to the cloaca.
Caecum – Paired blind-ending sacs which seem to facilitate further digestion in birds, which lead off the colon.
Cloaca – the common orifice, at the end of a short rectum.



© Lee Gutteridge – 2 December 2005

30. Bird origins

The oldest feathered bird ancestor fossil is *Archaeopteryx lithographica* which was found in Solnhofen in Bavaria in 1861. Birds and Archaeopteryx are believed to be monophyletic, that is with a common ancestor. This is because the genetic coding involved with the production of feathers is extremely complex and it is not likely that it could have arisen more than once. Some features which link birds and reptiles may be the following:

- Birds have similar pelvises to some reptiles.
- Fossil reptiles such as Archaeopteryx have bird like skulls.
- Dinosaurs were said to be endothermic like birds, but Archaeopteryx is believed to have been ectothermic like today's reptiles.
- V-shaped abdominal ribs were found in some ancient reptiles and Archaeopteryx but they are not found in <u>most</u> living birds, but are still found in some reptiles and birds.
- Claws on the wing used for climbing occur in the chicks one modern species called the Hoatzin, found in Venezuela. Archaeopteryx had the same type of claws although no direct line can be found in fossil evidence of the two. Some ducks, jacanas and swans have claw like protrusions hidden below the feathers of the wings.

31. Brood patches

A naked patch of skin on the belly of a bird used for incubation of eggs.

32. Comparative eye positions of predators and prey species

Binocular vision with both eyes positioned on the front of the head assists with depth perception. Peripheral vision in prey species is used to give all round views of the surrounding area to provide as early a warning as possible.

N.B. Kestrels have a unique ability amongst animals to see UV light. When a rodent uses a trail regularly, they will urinate on the trail, leaving a visual trail which can only be seen if you can see into the ultra violet wavelengths like the kestrel. The kestrel can use these urine trails to find rodents, or predict its path to safety when it attempts to flee.

33. Leks

Small arenas for males to demonstrate and attract females.

34. Accipiters

Eagles, hawks, buzzards, kites and vultures fall into the family Accipitridae, of the order Falconiformes.

35. Duetting and antiphonal duetting

Duetting is where two birds will call together like the pied kingfisher.

Antiphonal duetting is where two birds form a continuous call with one calling and then the other taking over to make a combined sound or call like the black collared barbet spotted eagle owl.

36. Dawn chorus

Advertising that they have made it through the night, good time to call as insects usually have not started to move so no feeding can take place. Reduces confusion of calls due to insect noise. Cool time of day allows calls to travel better.

37. Sound resonation

Casques on the beak of some birds such as hornbills are used to resonate sound. Other birds have a chamber off the oesophagus to resonate sound such as korhaans. Bitterns use an inflatable air sac to produce sound.

© Lee Gutteridge – 2 December 2005

38. Bird records
Smallest birds in S.A. are grey penduline tit at 8-9cm, Cape penduline tit is bigger at 9-10cm and the Orange breasted waxbill is also 9-10cm.
Largest bird in S.A. is the ostrich.
Largest flying bird in S.A. is the Kori bustard.
Largest flying bird in the World is the European great bustard.
Heaviest soaring bird is the pelican, up to 15kg in weight.
Greatest wing span of S.A. bird Royal albatross at 351cm.
Greatest inland bird wingspan Martial eagle at 260cm.

39. Pelagic
This refers to the open ocean.

40. Allopreening
This refers to one bird preening another.

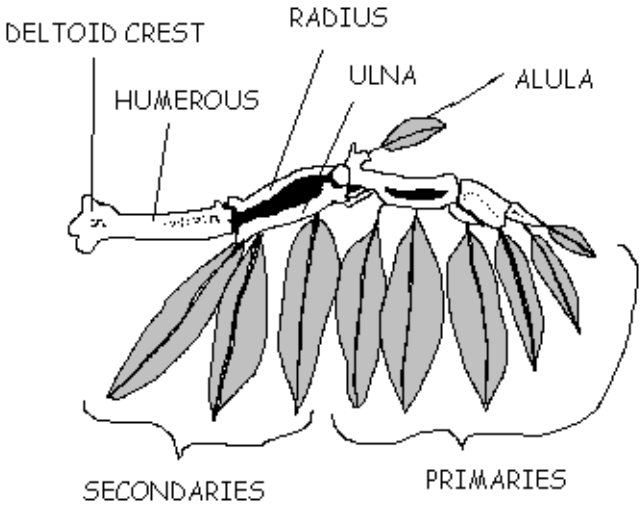
41. Crepuscularity in birds
Activity intensification around dusk and dawn. I.e. Bat hawk, which catches bats leaving and arriving at their roosts. This allows for greater concentrations of prey before they dissipate to feed.

42. Speculum
Iridescent window on the wing of a duck

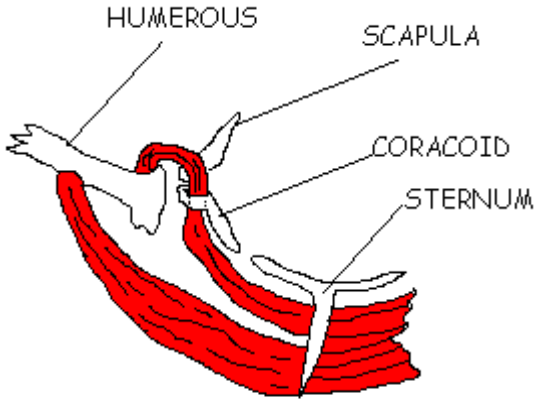
© Lee Gutteridge – 2 December 2005

43. Parts of a birds skeletal structure

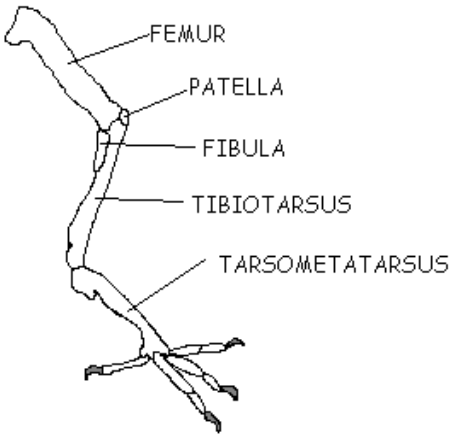
Wing



Flight bones in the chest



Leg bones



© Lee Gutteridge – 2 December 2005

REPTILES

GLOSSARY OF TERMS

Define the following terms.

1. amino acid – carbon, hydrogen, oxygen and nitrogen combined into a chain. There are about twenty five known forms. These in turn form proteins.
2. analgesic – a drug which helps prevent pain but will not render the patient unconcious.
3. anaphylaxis – allergic shock.
4. anticoagulant – a substance which prevents clotting.
5. aposematic colouration – colouration which warns of danger.
6. cardiotoxin – heart affecting venoms.
7. caudal – pertaining to the tail.
8. coagulopathy – a disorder in the blood preventing coagulation.
9. cytotoxin – venom which destroys cellular tissue.
10. dorsal – on the back.
11. dorso-lateral – on the sides, above the midline.
12. elapid – a family of snakes with fixed front fangs, and venom.
13. endemic – occuring only in a perticular region.
14. fang – hollow tooth used for injecting venom.
15. gangrene – death of body tissue.
16. gular – a flap, pouch (crocodyla) or scale (chelonii) in the throat.
17. heamotoxin – blood affecting venom.
18. hemipene – a snake or other reptiles penis. They are usually paiRed, and contained inside the body.
19. interstitial skin – skin between scales.
20. keeled – scales with a ridge .
21. labial – scales near the mouth.
22. loreal – the area on the side of the head between the nostril and eye.
23. lymphatic system – a systems of glands and fluid in mammals for dispersing toxins and foreign waste.
24. melanistic – dark colouration, caused by excess melanin.
25. mimicry – to look like something you are not, which is to your benefit.
26. myotoxin – venom which affects the muscular system.
27. necrosis – rotting or cellular destruction of tissue.
28. neurotoxin – venom affecting the nervous system.
29. parotid gland – a gland on the back of the head of toad, which secretes toxins.
30. plastron – the underside of a chelonian shell.
31. poison – a toxic substance which is ingested.
32. ptosis – drooping of the eyelids, a neurotoxic effect.
33. rostrum - a nose.
34. scale – a hard overlapping cover on the skin of reptiles.
35. scute – a scale on the carapace of a tortoise, or an enlarged reptile scale.
36. venom – toxins which are injected.
37. venom gland – a gland in the throat of a snake which produces modified saliva.
38. ventral – underside.
39. vestigial – the remains of something, like vestigial limbs.
40. xanthic – Red coloured.

© Lee Gutteridge – 2 December 2005

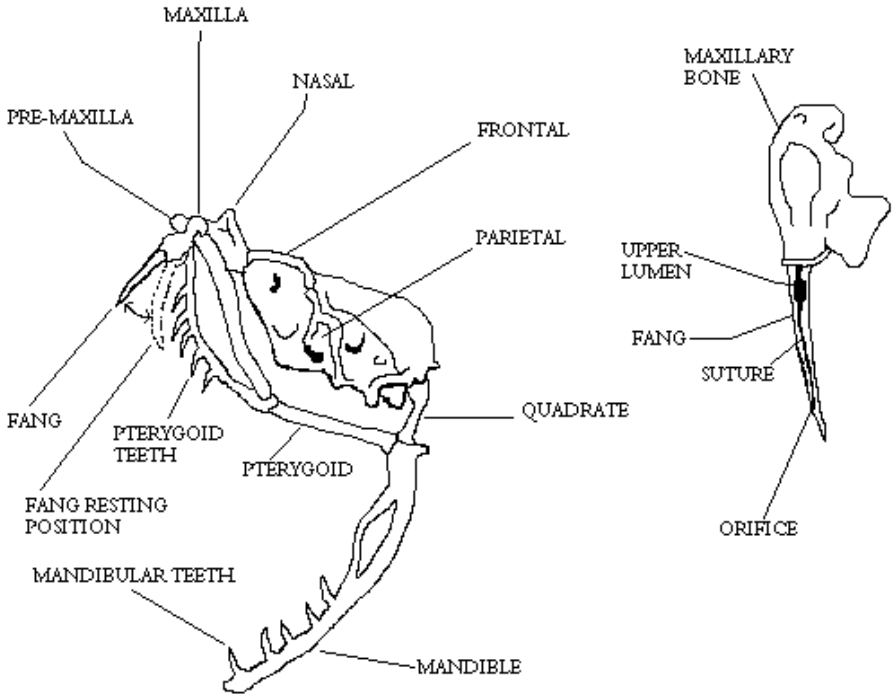
MAJOR SNAKE FAMILIES

The three major families of snakes found in our area are Colubridae, Elapidae and Viperidae. List as many species as possible from our area which represent these families.
Discuss the venom types and hunting methods found in these families, and if there is more than one for a family list them all.
Draw a diagram of the side veiw of the skull of each family listing the following.

1. Fang position
2. Maxilla
3. Mandible/dentary
4. Frontal
5. Quadrate
6. Pterygotid teeth
7. Mandibular or dentary teeth
8. Nasal
9. Pre maxilla
10. Parietal

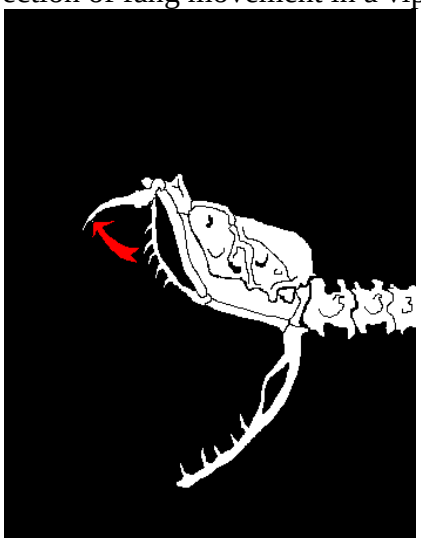
Viperidae

The adder and viper family of snakes. Well known species include the Puff adder, Gaboon adder, Horned adder, Many horned adder, Albany adder, Berg adder, Common night adder and Snouted night adder. The predominant venom type for the group is cytotoxic. Most adders bite prey then release, and follow a scent trail later. These snakes have hinged front fangs in the *Bitis* genus (see diagram) and fixed front fangs in the *Causus* genus.



© Lee Gutteridge – 2 December 2005

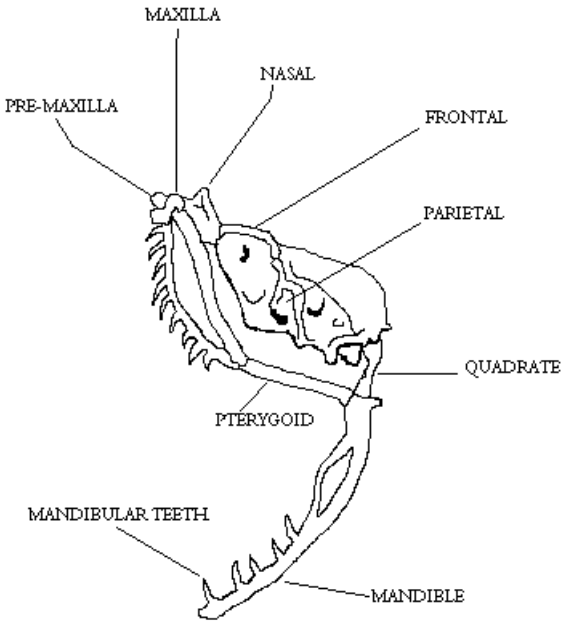
This is a diagram showing the direction of fang movement in a viperid strike.



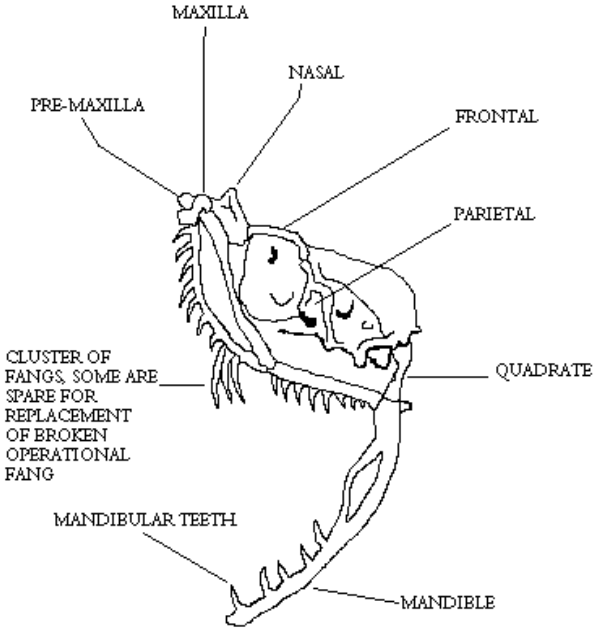
Colubridae

Colubrid snakes either have no venom fangs or are back fanged. Well known colubrids include Boomslang, Twig snakes, House snakes, Grass snakes, Sand snakes, Herald snakes, Water snakes, Egg eaters, File snakes, Wolf snakes, Slug eaters, Mole snakes, Beaked snakes, Skaapstekers and Centipede eaters. The killing methods of this group are incredibly diverse, from constrictors like house snakes, to bite, hang on and swallow hunters like Twig snakes. The methods of hunting vary from ambush, like the Boomslang, to actively hunting and wrestling with prey like the Wolf snakes, depending upon the prey and the presence or absence of venom glands. If the snake has venom in the Colubrid family it will be either a haemotoxin, as in the Twig snake and Boomslang, or a mild neurotoxin as in the Grass snakes.

1. No fangs



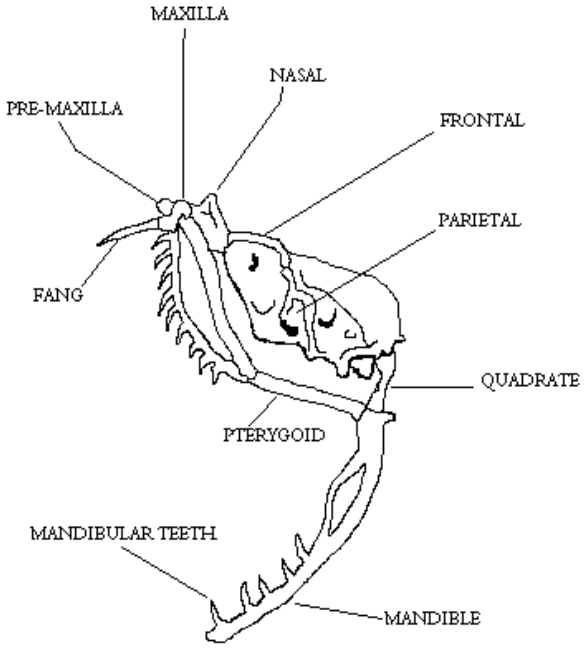
2. Back fanged



© Lee Gutteridge – 2 December 2005

Elapidae

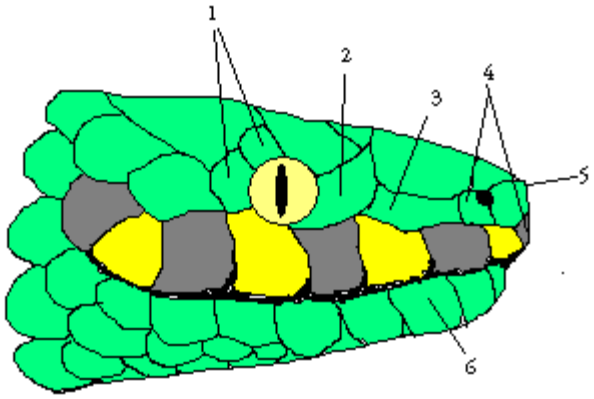
These are well known snakes, including groups such as the cobras, garter snakes, rinkhals, coral snakes, shield nosed snakes and mambas. These snakes are all neurotoxic as regards venom types, and all are fixed front fanged snakes. The venoms are fast acting and powerful, so the snake usually stalks its prey, and strikes quickly, biting and holding the soon subdued prey animal.



SCALATION

The side veiw of a snakes head listing the following scales

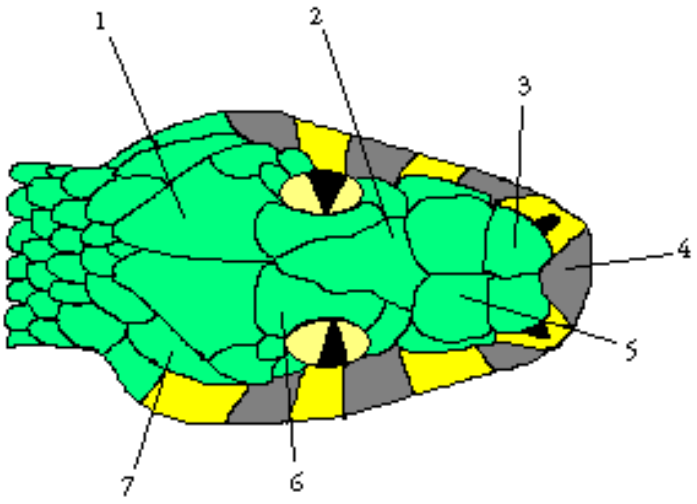
1. Postoculars
2. Preocular
3. Loreal
4. Nasals
5. Rostral
6. Upper liabals
7. Lower liabals



© Lee Gutteridge – 2 December 2005

The top veiw of a snakes head listing the following scales

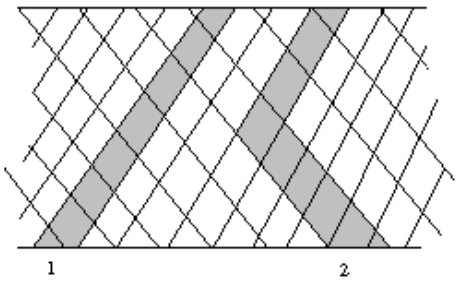
1. Parietal
2. Frontal
3. Internasal
4. Rostral
5. Prefrontal
6. Supraocular
7. Anterior temporal



This is a diagram explaining how you would count the bodies dorsal (top) scale rows.

Method one is to count the scales across the body in a single diagonal row, from ventral to ventral.

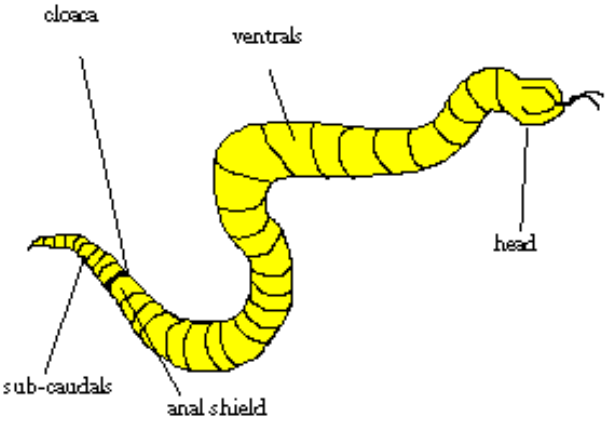
Method two is to count in a chevron shape from ventral to spine, and then towards the beginning point down the other side to the ventral scales. These counts help with the identification of species, and scale counts are included in most field guides.



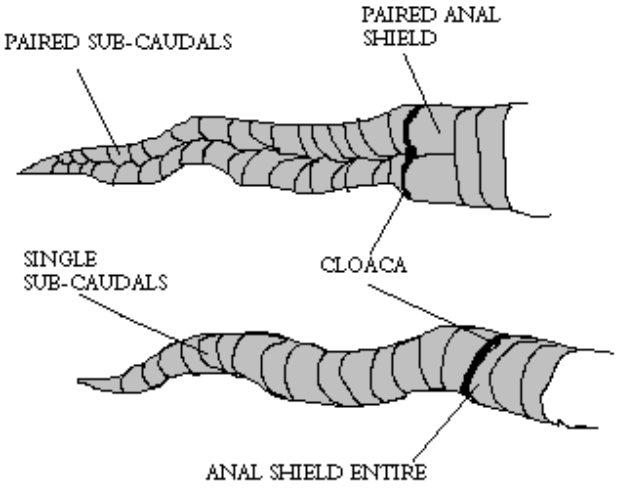
© Lee Gutteridge – 2 December 2005

Ventral and subcaudal scale counts.

A count of the ventral scales is from the throat to the anal shield. The sub-caudal count is from the anal shield (not included in the count), to the tip of the tail. These numbers can also assist with confirmation of identification.(this is an upside down snake showing ventral scales)



Two types of anal shield could you encounter when identifying a snake by scale. This is a picture of the underside of two snakes side by side.



© Lee Gutteridge – 2 December 2005

POTENTIAL IDENTIFICATION MISTAKES

Five snakes from our area which are potentially dangerous and have similar looking harmless snakes with which they can be confused are the night adder and the common egg eater, male boomslang and the natal Green snake, Snouted cobra and the common mole snake, bibrons burrowing asp and most of the wolf snakes and the horned adder and dwarf beaked snake.
The differences which can be used to identify one from the other (habitual, geographical, physical) are the following.

Egg eaters (*Dasypltis scabra*) when disturbed coil into a horse shoe shape and rub scales against one another in opposite directions to produce a hissing sound, wheras night adders (*Causus rhobeatus*) hiss with the lungs. Both have a brown chevron on the back of the neck. Egg eaters usually inhabit areas where birds would nest, and night adders would often be in wet or damp areas as they eat frogs and toads.

Male boomslang (*Dispholidius typus*) are a beautiful bright Green colour, and look similar to the harmless Green snakes (*Philothamnus spp.*). Green snakes are usually aquatic, and boomslang almost always arboreal. Boomslang have a small rounded head with a huge eye.

Snouted cobra (*Naja anulifera*) and the common mole snake (*Pseuadaspis* cana) look very similar in some colour forms. The cobra will raise a hood usually if disturbed, mole snakes do not, and will often hiss. The snout of a mole snake points down, cobra points slightly up.

Bibrons burrowing asp (*Atractaspis bibronii)* and the wolf snakes (*Lycophidion spp.*) look very similar indeed, and dwell in the same subterranean habitat. Caution should be exercised with all slender dark snakes without distinct head neck separation. The asp has a spine at the end of the tail and does not strike forwards. It pushes its fangs out of the side of the mouth and strikes sideways.

Horned adders (*Bitis caudalis*) and dwarf beaked snakes (*Dipsina multimaculata*) look very similar, and the beaked snake adopts a similar striking poition to its dangerous counterpart. The beaked snake however lacks the prominent raised horn like scales over the eyes, and its patterns across the body are more regularly composed in bars.

THE SCIENTIFIC NAMES OF A FEW WELL KNOWN SPECIES

The scientific names some of our commonly known snakes are the following:

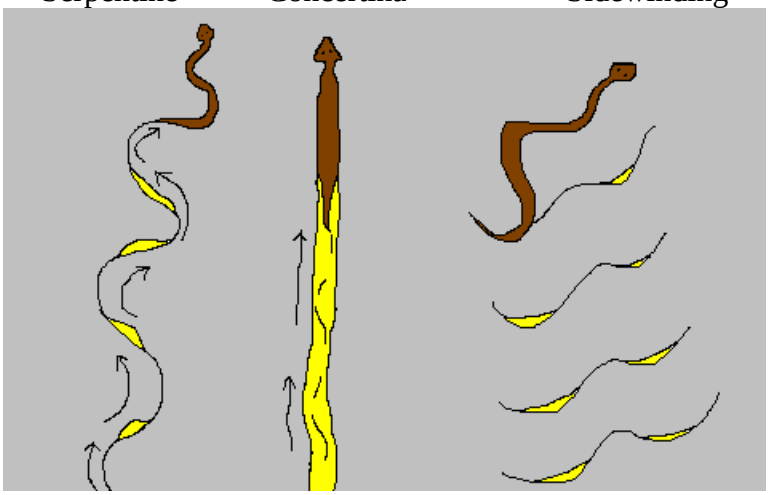
Puff adder – *Bitis arietans*
Boomslang – *Dispholidus typus*
Black mamba – *Dendroaspis polylepis*
African rock python – *Python natalensis (sebae natalensis)*
Mozambique spitting cobra – *Naja mossambica*
Snouted cobra – *Naja annulifera*
Twig snake – *Thelotornis capensis*
Eastern tiger snake – *Telescopus semiannulatus*
Brown house snake – *Lamprophis capensis (fuliginosus)*
Red lipped herald – *Crotaphopeltis hotamboeia*
Gaboon adder – *Bitis gabonica*
Common night adder – *Causus rhombeatus*
Green mamba – *Dendroaspis angusticeps*
Cape cobra – *Naja nivea*

© Lee Gutteridge – 2 December 2005

SNAKE LOCOMOTION

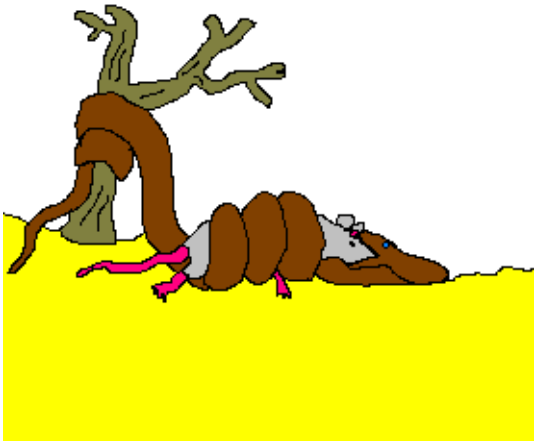
Snake locomotion takes place in several different ways, but here are three of the well known methods.

Serpentine Concertina Sidewinding



Constrictors

The process of constriction is not the random crushing to death of prey which many people envisage. It involves an almost gentle tightening of coils around the body of a prey animal, providing enough pressure to immobilise the prey, and to prevent inhalation of air into the lungs. Every time the prey exhales, the coils tighten slightly around the Reduced body area, until there is no space to breathe in. The constrictors often attach a coil or two of their bodies to nearby objects for stability and to prevent itself from being dragged.

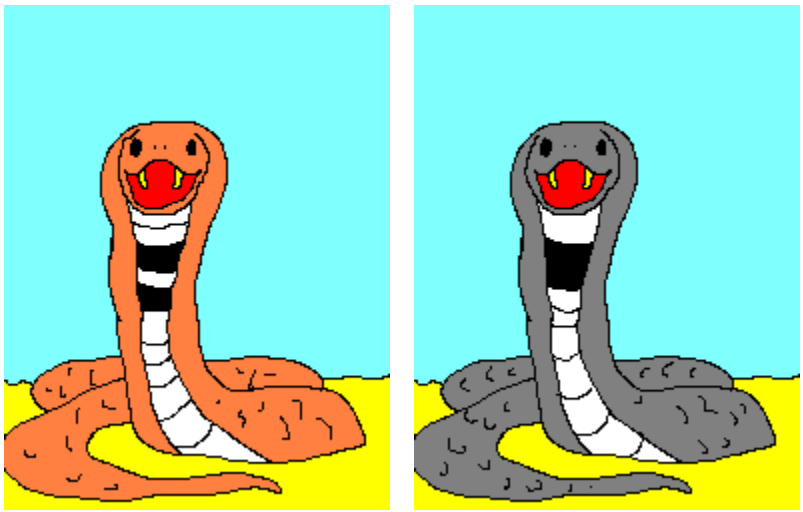


© Lee Gutteridge – 2 December 2005

GENERAL SNAKE AND REPTILE FACTS

Spitting snakes

The spitting snakes of the sub-region include various spitting cobra's and the rinkhals. Their venom types are predominantly cytotoxic with certain slower acting neurotoxic principles. The cytotoxin causes the immediate pain which is used as a form of protection against predators such as man, by disintegrating the tissues of the eyes or other membranes, and the neurotoxin causes the death of prey animals due to failed nervous capabilities, such as muscular cohesion. The rinkhals has a more dilute, and therefore weaker venom than the cobra. The methods of venom expulsion also vary slightly, as the Spitting cobras use muscular contraction around the venom glands to expel venom, and can spit from a laying position, under debris, over a reasonable distance and in the rinkhals the principle form of expulsion is by momentum, so to spit over any distance the rinkhals needs to be raised in to a striking position and be able to swing forward. Breeding methods vary in that the rinkhals gives birth to live young and the cobra's are egg laying. Rinkhals is therefore not a true cobra, it belongs to the Genus *Haemachatus*, not *Naja*, which is the Genus of the cobra's in Africa.



Comparison of the markings and base colour of the Mozambique Spitting Cobra (left) and the Rinkhals (right).

Back fanged snakes and their venom.

Two of our more dangerous snakes are back fanged with heamotoxic venom. These are the twig snake (*Thelotornis capensis*) and the boomslang (*Dispholidus typus*). Most other back fanged snakes in the colubrid family have mild neurotoxic venoms, very few of which are dangerous. Phillips sand snake is a notable exception and can produce fairly serious symptoms in young, old and sickly people.

Discuss anti-venoms in the Southern African context.

There are two main antivenoms in S.A., one referred to as a Polyvalent, which is used to treat cobra, mamba and adder bites, and a specific boomslang antivenom, developed at the CSIR in Pretoria. This boomslang antivenom is uneffective for the twig snakes bite. To treat twig snake bites complete blood transfusions are required. Deaths by twig snake bites are rare, mainly confined to professional handlers of these snakes.

© Lee Gutteridge – 2 December 2005

Discuss the senses as they pertain to snakes.

Sight

Many diurnal snakes have very good vision. Nocturnal species dilate their vertically elliptic pupils extensively during the evening. Fossorial species often have vestigial eyes covered by a scale to prevent damage while burrowing. Some of the fossorial species are only able to determine dark or light, not form. Twig snakes have a keyhole shaped pupil which may assist with telescopic vision or depth perception.

Taste

This is done by collecting scent particles on the forked tongue, which is then inserted into the Organs of Jacobsen for analysis.

Hearing

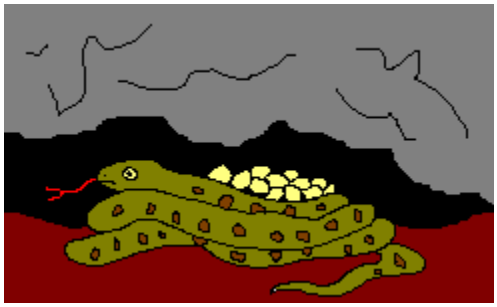
Snakes do not have external ear openings, but use the underbelly to transfer sound vibrations in the substrate below them into audible vibrations or sounds. These vibrations would be the type of signal which would warn of the approach of potential prey on a rodent trail.

Touch

Certain species of snakes feel heat, by means of heat sensory pits on the face around the mouth area. This form of touching, or feeling out prey assists with accurate strikes. Species such as pythons use this.

Discuss parental care in snakes.

Snakes do not attend their young at all, and would probably eat them if they had the chance. Some snakes such as the Vipers and Rinkhals and Slug eaters give birth to live young. The young do not stay with the parents for any length of time though, and move away to prevent themselves from being consumed by hungry parents. The mozambique cobra young are so wary of their adult counterparts that they are diurnal as babies to prevent the nocturnal adults from finding them. An interesting behaviour among snakes is that the African rock python and the Spotted skaapsteker both remain with their egg broods, and will assist with incubation by coiling around the eggs, to try and keep temperatures constant.

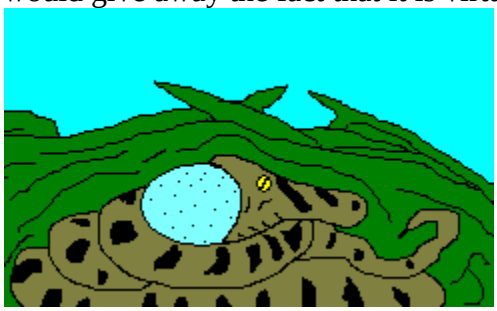


A Spotted Skaapsteker with her eggs, under a rock.

© Lee Gutteridge – 2 December 2005

Discuss Sub-family *Atractaspinae*, with regards to hunting method and fang position.
The burrowing asps are also known as side stabbing adders as they have a peculiar fang position. The venom fangs lay back in the mouth, pointing outwards and backwards. These fossorial snakes eat small rodents in their underground burrows, and due to confines of space cannot strike in the conventional manner, so they simply move past the prey animal, and when the prey is alongside the head of the asp it pulls back and to the side injecting venom out of the protruding sidewards fang closest to the prey. In the diagram the direction of the snake is shown by the arrow.

Discuss genus Dasypeltis with regards to food, tooth structure and defensive methods.
The egg eaters are a specially adapted group of snakes which eat mainly birds eggs. The teeth of this species have virtually dissapeared and cannot be seen in the mouth. They would just get in the way while the snake is swallowing eggs. There are however a number of spinal protrusions which assist in the cracking of the egg whilst it is being crushed in the throat of the snake. The shell is regurgitated as a neat little package. In defense the eggeater mimics the night adder, as its markings are very similar to this venomous species. It forms its body into a horseshoe shape and rubs its scales together causing a hissing sound. During this display it will strike repeatedly, but it takes care to miss, othewise it would give away the fact that it is virtually toothless.



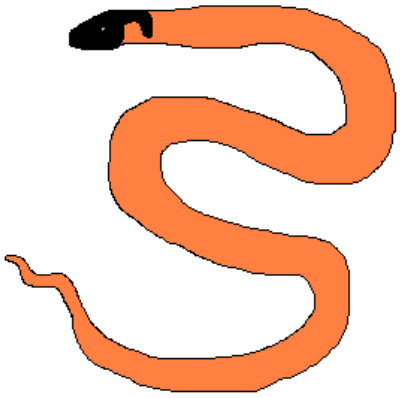
An Eggeater eating a birds egg.

Which snakes eat insects. List at least 6 species.
Many snakes and their young eat insects. Examples are:

- Brown house snakes
- Schlegels blind snakes
- Peters thread snakes
- Roufous beaked snakes
- Gunthers garter snake
- Mozambique spitting cobra.

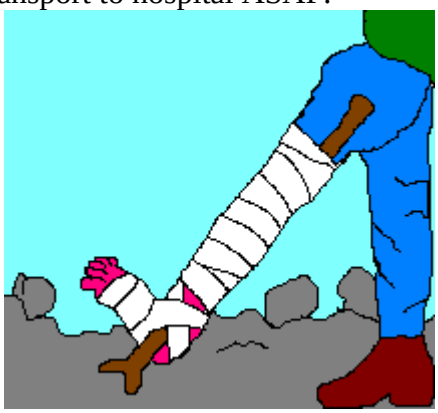
© Lee Gutteridge – 2 December 2005

Which local species will eat centipedes? Describe one of them.
Centipede eaters are a group of snakes with the Genus name *Aparralactus.*
One of our most common species is the Black headed or Cape centipede eater. It has a reddish brown body and a Black head and collar (see the picture below).



Discuss viviparity, ovo-viviparity and oviparity.
Most snakes are oviparus, and will lay eggs, which then hatch outside the females body. Viviparity and ovo-viviparity are basically the same in the sense that live young are born of the adult female, exiting in a snake from the cloaca. Viviparity would be more applicable to mammals, and ovo-viviparity more to reptiles, although both terms are commonly used for reptiles. Oviparity is simply the laying of eggs.

Discuss first aid a for snake bite by a large, dark coloured snake, which raised up off the ground before biting a guest on the upper leg during a morning walk on a rocky area. Which snake could this be?
The Black mamba is often found in rocky ground areas and hillsides. Mambas also often raise part of, or all of the anterior third of their bodies when threatening an agressor. The Black mamba is usually a dark gunmetal colour. The Black mamba is active during the day. I would conclude that this is the snake responsible in this instance, and would attempt to calm the guest, reassure him that we would get him to help. I would place him in the shade to rest. First I would either radio or send someone to fetch a vehicle and alert the nearest hospital of our situation. I would then begin to take crepe bandages and wrap them around the affected limb, from the bite site to the groin and then back down the entire leg. As tightly as for a sprain, not as tight as a torniquet. Keep the patient calm and either wait for help or a vehicle to arrive, or move the patient gently, supported or on a stretcher to the pick up point. Transport to hospital ASAP.



© Lee Gutteridge – 2 December 2005

Describe some different defensive behaviours of snakes.
There are many defensive behaviours to be found in snakes. These include:

- Spitting
- Hissing
- Mimicry
- Aposamatic warning colouration
- Thanatosis
- Camouflage
- Speed for escape.

Describe some of the major differences between agamas, skinks, geckos, monitors, plated lizards and flat lizards.

Type	Scales	Head shape	Habitat and food	Use of autotomy
Skinks	Smooth	Not distinct from neck	Mainly terrestrial, insectivores	Yes
Geckos	Granulated	Distinct from neck	Arboreal, insectivores	Yes
Monitors	Smooth	Slighly distinct from neck	Aquatic and terrestrial and arboreal, piscivores or carnivores	No
Plated lizards	Keeled	Slender, not distinct from neck	Rocky areas, insectivores or carnivores	Yes
Flat lizards	Keeled	Slightly distinct from neck	Rocky areas, insectivores and herbivores	Yes
Chameleons	Granulated	Vertically compressed, distinct	Arboreal, insectivores	No
Agamas	Rough, granulated	Very distinct, spade shaped	Arboreal, terrestrial insectivores	No

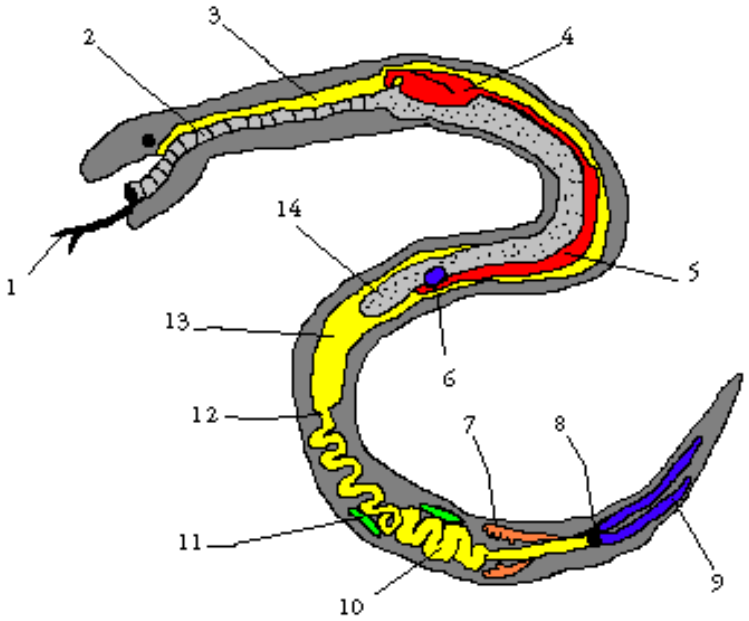
Discuss colour change as it pertains to chameleons, flat lizards and agamas. How do they do this?
Colour changes take place in these three lizard groups. Factors such as mood, temperature and sexual state affect this. Rapid expansion and contraction of pigment cells in the skin cause these colour changes. For example in tree agamas a bright blue head means a male is sexually ready to mate, and chameleons darken in colour to brown or blackish when stressed or threatened.

List the orders of reptiles in south africa.
Squamata – snakes and lizards
Crocodylia – crocodiles
Chelonii – tortoise, terrapins and sea turtles

© Lee Gutteridge – 2 December 2005

Describe the basic anatomy of a snake, by means of a diagram.

1. tongue
2. trachea
3. oesophagus
4. heart
5. liver
6. gall bladder
7. kidneys
8. cloaca
9. hemipenes
10. intestine
11. testes
12. pyloric valve
13. stomach
14. lung



How do snakes and leguaans perform the act of smelling?

Snakes taste the air. This is done by collecting scent particles on the forked tongue, which is then inserted into the Organs of Jacobsen for analysis. The leguaan does the same.

© Lee Gutteridge – 2 December 2005

SOME INTERESTING REPTILE SPECIES

Discuss the following reptiles in full as regards names, order, family, identification, biology and breeding, feeding, distribution and preferRed habitat and unusual features.

Leopard tortoise
Geochelone pardalis
Order *Chelonii.*
Family *Testudinae*
A very large tortoise species, achieving 20-40 kg in mass. Usually brown black and yellow speckled. Up to 30 (usually 6-15) hard shelled eggs are layed in a burrow, and hatch in 10-15 months. They eat plants including grasses and succulents. They also eat hyaena dung to obtain calcium. They occupy many different habitats and may live for over 100 years.

Marsh terrapin
Pelomedusa subrufa
Order *Chelonii*
Family *Pelomedusidae*
These aquatic animals eat meat of any kind including birds, fish, carrion and ticks. They are dark green, to brown and usually found in open water. 10-30 eggs are laid in a burrow and will hatch in 90-110 days. Mating takes place in the water, the male uses sensory tentacles under his chin to touch the females neck and will eject streams of water over her face from his nostrils. They live for longer than 15 years.

Flapnecked chameleon
Chameleo dilepsis
Order *Squamata*
Family *Chameleonidae*
These arboreal creatures eat insects. They catch these insects with their telescopic tongues. 25 to 50 eggs are laid in a tunnel in damp soil, and they hatch in 150 to 300 days. They are capable of changing colour by expanding and contracting pigment cells. They are usually green and a red ventrally flattened. The eyes can function independently.

Giant plated lizard
Gerrhosaurus validus
Order *Squamata*
Family *Cordylidae*
These animals live in areas with rocky out crops. They are dark brown to black, and up to 60 cm long. 2-5 eggs are laid in midsummer. They eat invertebrates, flowers, tortoises, lizards and fruits.

Striped skink
Mabuya striata
Order Squamata
Family Scincidae
These lizards give birth to 3-9 babies. They eat insects and are mainly arboreal. They are grey black, with two white to light grey stripes down the body. They reach up to 25cm in length.

© Lee Gutteridge – 2 December 2005

Waterberg Flat Lizard
(also known as the Common Flat Lizard, this is one of seven sub-species the *natalensis*)
Platysaurus intermedius natalensis
Order *Squamata*
Family *Cordylidae*
The males are greenish, with red brown tails, and a blue throat. Females are a drab brown with white stripes. They can live for longer than 14 years. They lay up to 25 eggs in leaf litter in a crack in rocks. There may be several in a colony. They eat invertebrates such as flies, beetles and larvae of insects.

Southern Rock Agama
Agama atra atra
Order *Squamata*
Family *Agamidae*
Up to 30 cm long, this large lizard is terrestrial and rock dwelling. It is ground coloured with orange blotches and a white spinal stripe. They eat ants and termites. 7-12 eggs are laid in a hole in the soil, and will hatch after 2-3 months.

Nile Monitor
Varanus niloticus
Order *Squamata*
Family *Varanidae*
Up to two metres in length this is a powerful predator and the largest lizard in Africa.. They eat rodents, amphibians, fish, birds, eggs, crabs and young crocodiles. Females lay 20-60 eggs in a living termite mound. The digging of the "nest" can take two or three days to do. The eggs hatch in 150 days.

Tree or Rock Monitor
Varianus exanthematicus albigularis
Order *Squamata*
Family *Varanidae*
Up to 120 cm long, it is a large species. It is arboreal, and feeds on millipedes, grasshoppers, snails, carrion and baby tortoises. The female lays 8-30 eggs in a hole she has excavated in the ground. They hatch after 120 days.

Wahlbergs Velvet Gecko
Homopholis wahlbergii
Order *Squamata*
Family *Gekkonidae*
This large gecko is a greyish colour, and about 15 cm long. They eat insects and millipedes. They lay 2 hard shelled eggs under bark.

Cape Dwarf Gecko
Lygodactylus Capensis
Order *Squamata*
Family *Gekkonidae*
A small gecko of about 8 cm in length. It has two light coloured stripes on its back, and a brown base colour. 1 or 2 eggs laid under bark may take 2-5 months to hatch. They eat ants and termites.

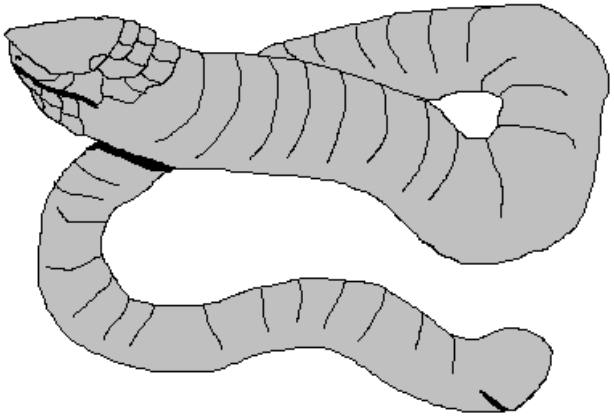
© Lee Gutteridge – 2 December 2005

Nile Crocodile
Crocodylus niloticus
Order *Crocodylia*
Family *Crocodylidae*
Quite an unmistakeable species. Up to 5,5 m long, and up to 1000kg in weight. They feed on fish, mammals (humans included) and birds. 16-80 white eggs are laid in a hole in a sand bank. This usually happens during November. Hatching takes place after 80-90 days.

AMPHISBAENIDS

What are family amphisbaenidae. What do they eat, where do they live and are there any species in our area of operation.

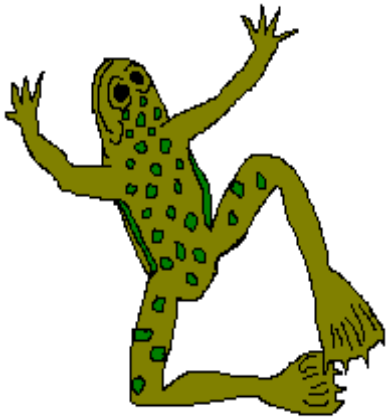
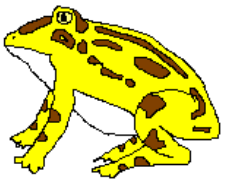
Amphisbaenidae is one of four families in the sub-order Amphisbaenia, or Worm Lizards. These strange fossorial creatures feed mainly on termites and beetle larvae. The body is surrounded by annuli or rings so it looks like a large worm. They usually reach a length of around 35 cm , with one South American species reaching 75 cm. They are usually fleshy pink in colour. In Northern South Africa we have the Cape Spade Snouted Worm Lizard (*Monopeltis Capensis*) and the Blunt Tailed Worm Lizard (*Dalophia pistillum*). Below is a picture of what amphisbaenids look like.



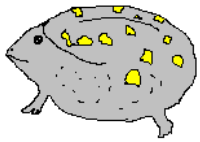
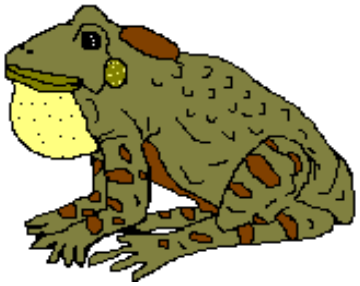
© Lee Gutteridge – 2 December 2005

FROG AND TOAD REPRODUCTION AND FEEDING

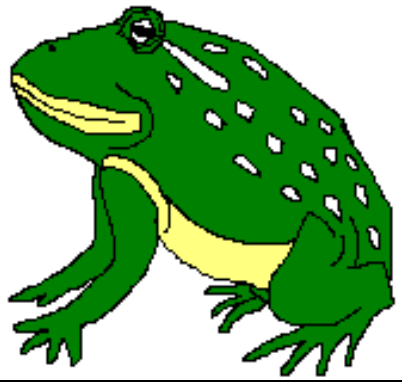
Information on some toads and frogs from Soth Africa. Descriptions of their habits, food, habitat, breeding, colouration and identifying features. This includes one poisonous frog, one frog which spends its entire life cycle in the water and a frog which lays its eggs on dry land.

Species	Habitat/ habits	Food	Breeding	Colour and features
Common platanna	Wholly aquatic.	Insects, rodents, fish, bird, small fish, fledglings etc.	Eggs laid singly or up to ten hatch in two days	
Banded rubber frog	Poisonous species. Lives in bushveld pans with vegetation.	Insects, worms etc.	600 eggs hatch after 4 days.	
Common rana	Lives in streams or pools with grassy edges. Can stay submerged for 40 minutes.	Insects, Crabs and rodents etc.	Thousands of eggs in shallow water. Slow development to adult, up to 9 months.	
Bubbling cassina	Pans in bushveld. Characteristic call.	Insects and insect larvae.	400 eggs hatch in 5 days.	

© Lee Gutteridge – 2 December 2005

Grey tree frog	Arboreal species. Can live for over four years.	Insects are eaten.	150 eggs in a foam nest in a tree over water. Tadpoles drop into water after two days. They climb into the trees before their tail is fully absorbed.	
Bushveld rain frog	Lives in damp bushveld, and will hibernate below ground. Adults glue together to mate.	Insects and also termite alates.	A burrow in the bushveld is dug out, and 30 eggs are laid in the hole. After six weeks well developed frogs come out of the hole.	
Red toad	In permanent or semi permanent pools. Has no visible parotid gland.	Eats insects such as Termites, worms, beetles scorpions , centipedes and spiders.	10 000 eggs hatch in 3 days, and swim actively in 7 days	
Raucous toad	Lives in open and bushy country.	Eats insects such as Termites, worms, beetles scorpions , centipedes and spiders.	Up to 2 km long strings of eggs are laid. Hatching after 4 days swimming after 6.	

© Lee Gutteridge – 2 December 2005

Bull frog	A very large frog, up to 40 cm long, living in seasonal pans, then burying itself for the dry season. They can live for 17 years. Africas largest frog species.	Eats rodents, snakes, lizards, insects, birds, frogs and toads. Bullfrogs eat every 2 to 3 months.	3000-4000 eggs in a shallow pool which hatch after 2 days.	

HOW TEMPERATURE AFFECTS SEXES IN EGGS OF CROCODYLA AND CHELONII

Discuss the relationship between sex and incubation temperature.
High temperatures in the range of 31 to 35 degrees celcius will result in males in Crocodylia or females in Chelonii, whereas lower temperatures of 26 to 30 degrees celcius will result in females in Crocodylia or males in Chelonii.

REPTILE DEFENCE METHODS

Discuss thanatosis, autotomy, camouflage, speed and regurgitation as defence methods.
Thanatosis – this is playing dead to deter a predator.
Autotomy – this is the shedding of the tail to escape predators, by distracting them.
Camouflage – this is simply cryptic colouring.
Speed – this is used simply by the prey being faster than the predator.
Regurgitation – this method simply lightens the prey animal to help it become faster or more agile in order to escape.

THE SMALLEST CHELONIAN
What is the smallest Chelonian in Southern Africa?
The Speckled Padloper (*Homopus signatus*) is in fact the worlds smallest tortoise.

TERRAPINS FEEDING HABITS
What do terrapins eat?
Terrapins are carnivores and will eat fish, tadpoles frogs, birds, ticks off wading animals and carrion.

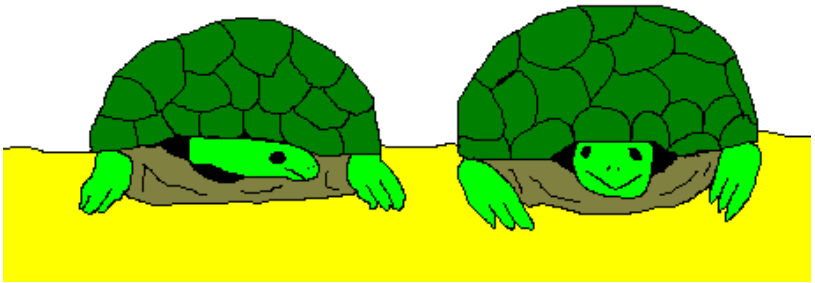
ANAL SAC'S IN CHELONII
What is the name of a tortoises anal sac, which it uses to store water?
The Bursa.

© Lee Gutteridge – 2 December 2005

NECK TYPES IN CHELONII

What is the difference between pleurodira and cryptodira?

Pleurodira pull their necks sideways into the shell (side necked), such as all the terrapins(left).
Cryptodira pull the neck straight into the shell (hidden necked), such as tortoises (right).



THE FIVE SEA LIVING TURTLES FOUND OFF SOUTH AFRICAN SHORES

These are the Olive Ridley, Green, leather Back, Hawksbill and the Loggerhead.

SOME OF THE SOUTH AFRICAN DINOSAURS

It is interesting to note that at the time of dinosaurs, about 200 million years ago, the Waterberg was already an ancient mountain range, about 1800 million years old. There are quite a few fossils of dinosaurs that have been unearthed in various parts of South Africa and on the following pages are drawings of some of them and a little bit of information on each. There is not much chance however, of seeing any of these creatures on your game drives. The colours used are not likely to be accurate as there is no record of skin which still retains the animals colours.

Lesothosaurus

Its name means 'lizard from Lesotho". It is one of the oldest african dinosaurs. This dinosaur was a herbivore which is believed to have lived in packs or herds. Its main form of defence appears to have been speed. It was discovered in 1978. It may however just be confused with the Fabrosaurus which was discovered in the 1960's and palaentologists are still busy debating this. Most palaentologists are, however, happy that these are in fact separate species. It was just 90 centimetres long.

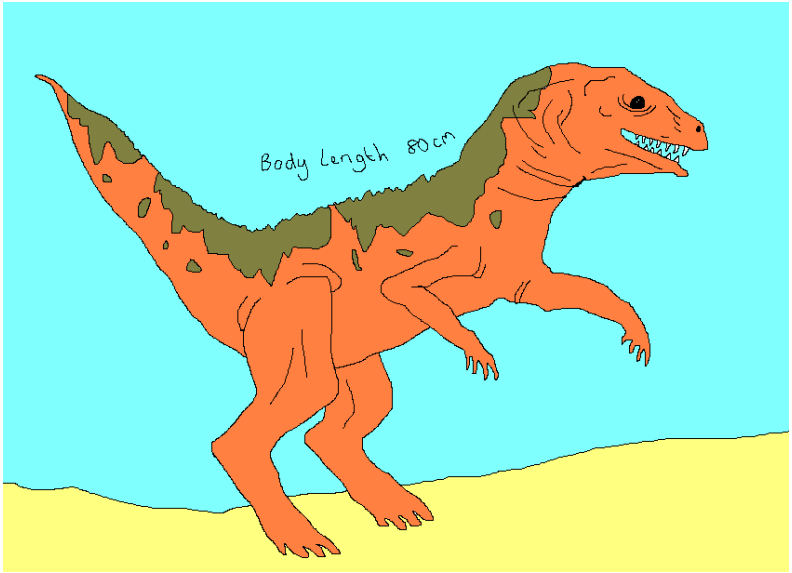
© Lee Gutteridge – 2 December 2005

Lycaenops

This creature was a ferocious predator. Its name means “wolf face”. It was built for speed with a long slender body, and it had long sharp teeth for tearing up prey. Total body length is 1.5 metres. This was also one of the early reptiles.

Euparkeria

This dinosaur was about 80 centimetres long. Its name means “Parkers true reptile”. It lived about 230 million years ago, and was one of the forerunners of the dinosaurs. It ate insects and scavenged off other carnivores kills. It could walk on all fours or run on its back legs only.



© Lee Gutteridge – 2 December 2005

Chasmatosaurus

This ancient reptile lived about 230 million years ago. It was 2 metres long and its name means "Chasm reptile". It was crocodile like but had a turned down snout. It lived in water and ate fish.

Melanosaurus

This name means "Black reptile". It lived 225 million years ago. It ate plants and was 10 metres long. It walked on all fours.

© Lee Gutteridge – 2 December 2005

ASTRONOMY
GLOSSARY OF TERMS

1. Aphelion – the furthest point in a bodies orbit from the sun.
2. Binary star – two stars orbiting one another so closely that they look like one star.
3. Black hole – areas in space who's gravitational force is so great that not even light can escape. Black holes cannot be seen, and are detected by their gravitational influence on other bodies.
4. Blue shift - When light travels, and increases in speed the wavelengths shorten, moving towards blue. This is blue shift.
5. Comet – a minor member of the solar system, made of a nucleus of dust and frozen water vapour. When comets approach the sun they develop a coma, and possibly also a tail.
6. Constellation – one of 88 areas of the sky, defined by the names of mythical creatures etc, dependant upon how people imagined stars were depicted to fit together.
7. Galaxy – Group of stars, planets, comets, dust and sattelites, sometimes numbering millions of planets.
8. Gibbous moon – More than half of the moon is visible.
9. Light year- This is a measurement of distance, not time. The distance that light travels in a year at the speed of light. This distance is 9.4607×10^{12} km.
10. Lunar – Pertaining to the moon.
11. Meteors – These small travelling particles, ranging from a speck of dust to small rocks, usually burn up in the earths atmosphere.
12. Meteorite – these travelling objects usually hit the earths surface.
13. Nebula – clouds of dust in space. Planets and stars could originate in these environments. Messier published a list of nebulae in 1781, and they were numbeRed M1, M42 etc, after him.
14. Parsec – parsec is a measurement of distance. 1 parsec = 3.2616 light years.
15. Perihelion – the closest point in a bodies orbit around the sun.
16. Planet – solid bodies of rock and gas which obit around a star, such as the earth. Planets reflect light, but do not produce it.
17. Red giant – stars near the end of their life cycle, with low gravity due to less gasses, and less frequent fusion become large and reddish in colour. i.e. Betelgeuse.
18. Red shift – when light slows down, its wavelength becomes longer, toward the red end of the spectrum.
19. Sattelite – this refers to moons, which are smallish orbiting bodies, moving around planets.
20. Shooting star – this is a reference to meteors and meteorites.
21. Solar system – The solar system is a group of planets, moons, dust, meteors, comets and minor planets revolving around a star.
22. Star – a burning gas ball, which remains, relative to other stars, in the same position.
23. Supernova – the explosion of a star at the end of its life cycle.
24. Waning moon – a moon in the part of its cycle where it is getting smaller.
25. Waxing moon – a moon in the part of its cycle where it is getting bigger.
26. White dwarf – a small, white, super hot star. i.e. Rigel in orion.

© Lee Gutteridge – 2 December 2005

PROMINENT CONSTELLATIONS

In this assignment we will discuss some of the prominent constellations. Reference to the stars is sometimes given using the Greek alphabet. I have included this information for reference only, in order to explain names of some of the stars in the major constellations.

α- alpha	η- eta	ν- nu	τ- tau
β- beta	θ- theta	ξ- xi	υ- upsilon
γ- gamma	ι- lota	ο- omicron	φ- phi
δ- delta	κ- kappa	π- pi	χ- chi
ε -epsilon	λ-lambada	ρ- ro	ψ- psi
ζ -zeta	μ- mu	σ- sigma	ω- omega

1. Orion

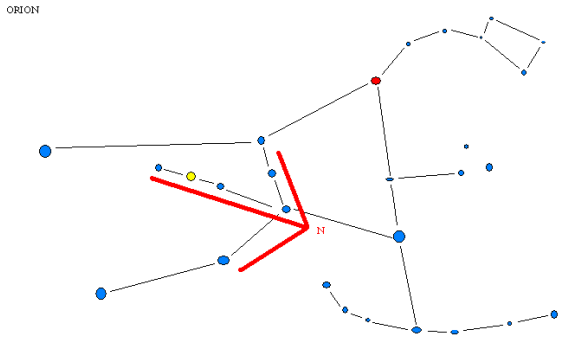
Orion is a very well known constellation, representing a hunter. It is visible from both hemispheres. It is the constellation where the great nebula is found. The great nebula (1500 light years away) is the clearest example of a nebula in the sky. Within the nebula are the four stars visible with a small telescope called the trapezium.(There are in fact six stars in this group however). This constellation is dominant in the southern summer skies.

The major stars include:

- Rigel (7th brightest star, 815.4 light years away, 250 parsecs, 57000 times brighter than the sun and 100 times as big). This star is binary.
- Betelgeuse (α orionis)(12th brightest star, 300-400 times as big as our sun, approximately 1000 million km across, 652.32 light years away, 200 parsecs, cooler than our sun at 3000ºc)
- Saiph
- Bellatrix (26th brightest star, 496.67 light years away, 144 parsecs)
- Alnilam (29th brightest star, 1598.18 light years away, 490 parsecs)
-

Finding direction.

Orions belt forms an arrow head with algiebba, and the sword forms a shaft of the arrow. This arrow points approximately north (see diagram). On rising the belt indicates east, and on setting indicates west.



Finding direction with Orion.

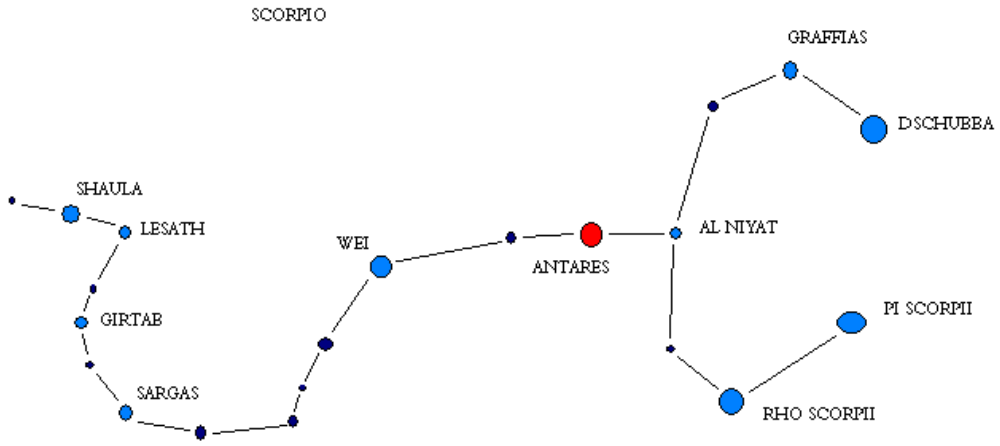
© Lee Gutteridge – 2 December 2005

2. Scorpio

A well known constellation, and sign of the zodiac, representing a scorpion. It is not usually used as a direction finding constellation. It is dominant in the southern winter skies.

Major stars include:

- Antares- (15th brightest star, 160 parsecs 521.856 light years away). The name Antares means rival of Mars, this is because of its red colour. It is 560 million km in diameter. Our entire solar system would fit into Antares. It is Binary. (α scorpii)
- Shaula-(24th brightest star, 310 parsecs, 1011.09 light years away). The sting.
- Dschubba – The left pincher.
- Al niyat – The face of scorpio.



3. Southern Cross

The southern cross is very well known and appears on the national flags of Australia and New Zealand. It is used to indicate celestial south.

Major stars include:

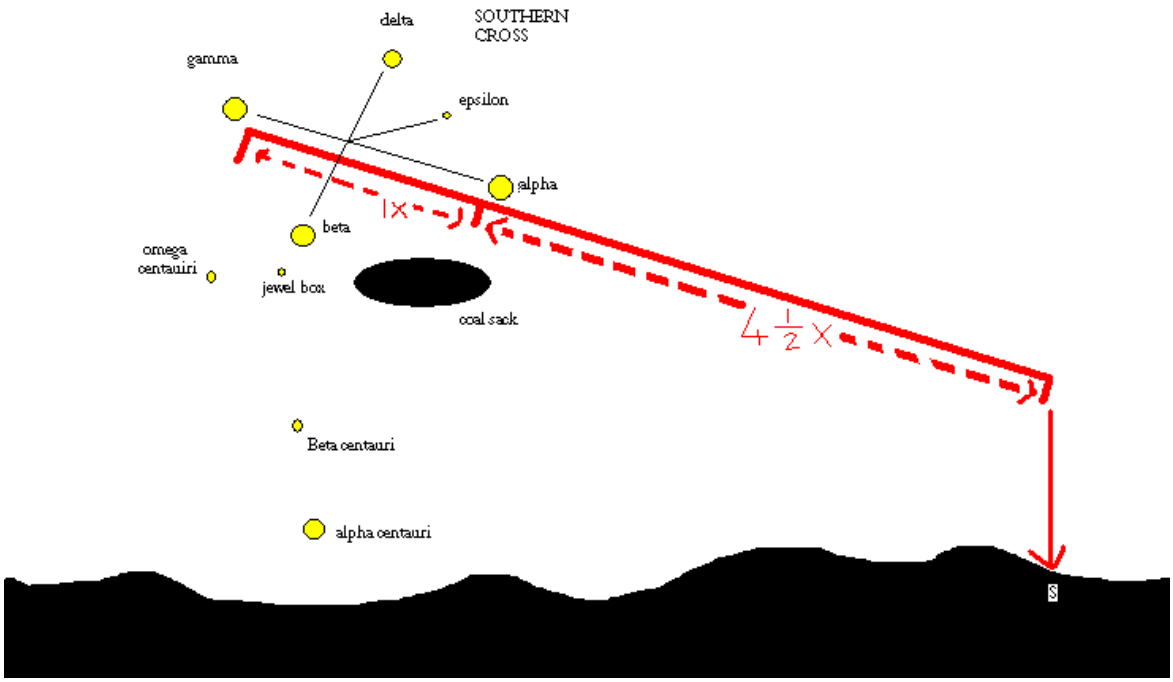
- Alpha crucis (α crux)- this is a binary star. (80 Parsecs, 260.92 light years away, 14 th brightest star).
- Beta crucis β – also known as Mimosa, (490 Parsecs, 1598.18 light years away, 20th brightest star)
- Gamma crucis γ – (68 Parsecs, 221.78 light years away, 25th brightest star)
- Delta crucis δ
- Epsilon crucis ε

© Lee Gutteridge – 2 December 2005

FINDING DIRECTION WITH THE SOUTHERN CROSS

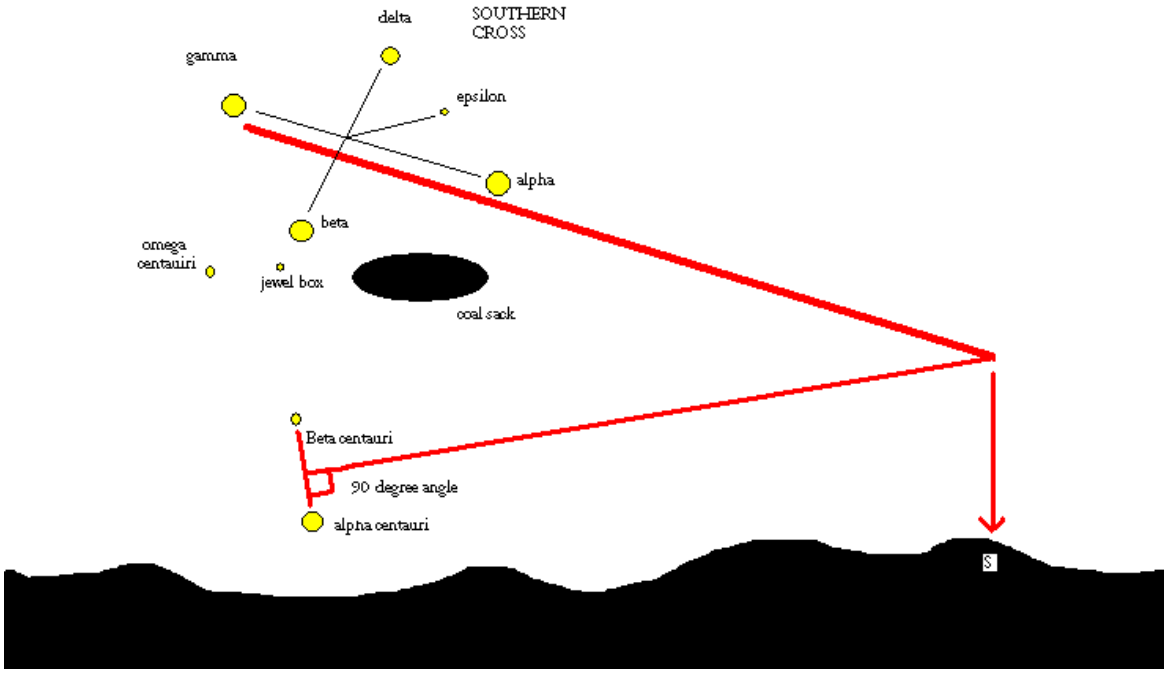
Method 1

Take the length of the cross from gamma to alpha, and imagine 4 and a half times this distance toward the direction of the bottom of the cross. At this point imagine a line straight down to the horizon and this should be south.



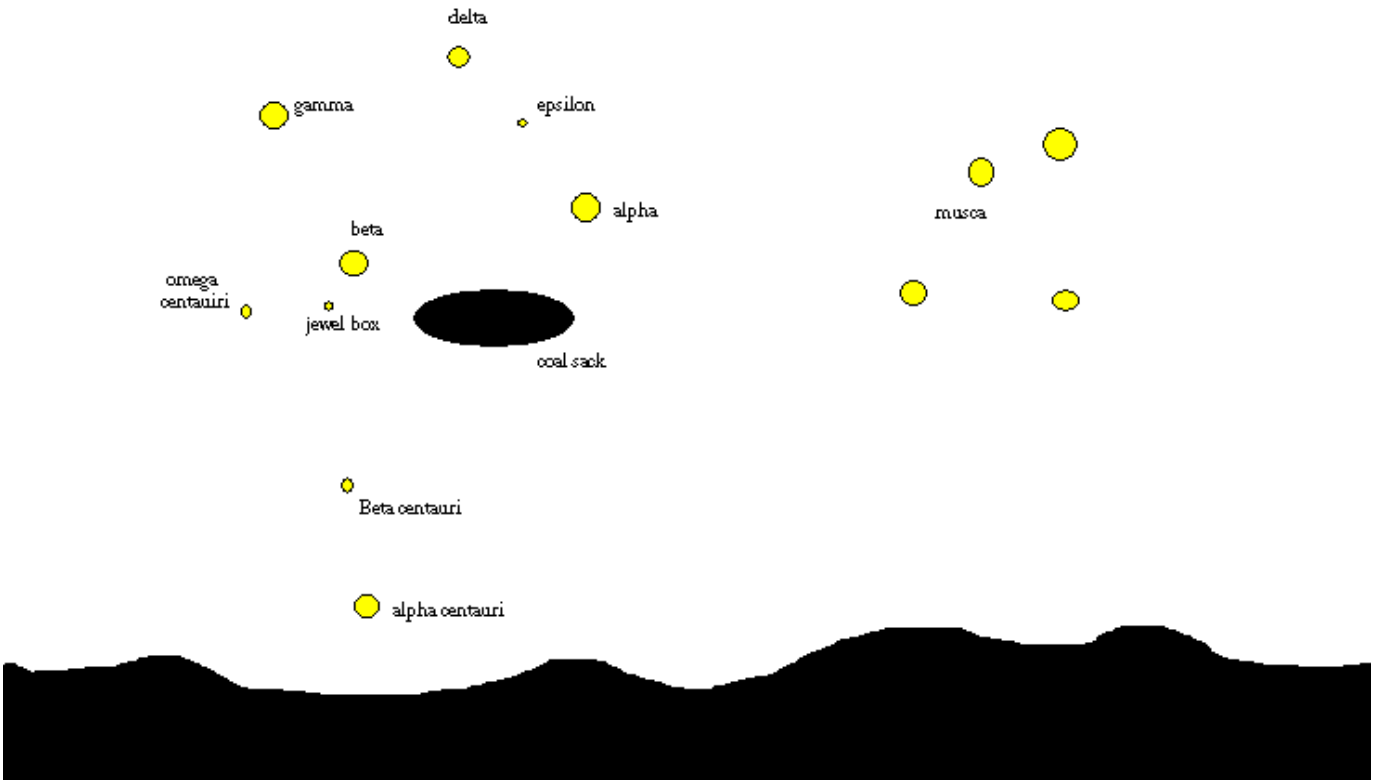
Method 2

Draw an imaginary line between alpha and beta centauri, and take a 90 degree angle toward the base of the cross. Also take an imaginary line from the top of the cross to the bottom and through, and where these two lines intercept is approximately south.



© Lee Gutteridge – 2 December 2005

The Southern Cross, including Musca the Fly, the only insect constellation in the sky, the coal sac (a dark nebula), and alpha, beta (the pointers) and omega centauri.



4. The Jewel Box
This star cluster is near the southern cross, and is also known as κ (kappa) Crucis. It is a group of stars which are red, yellow green and blue. Its star number is NGC4755. and was discovered by Herschel.

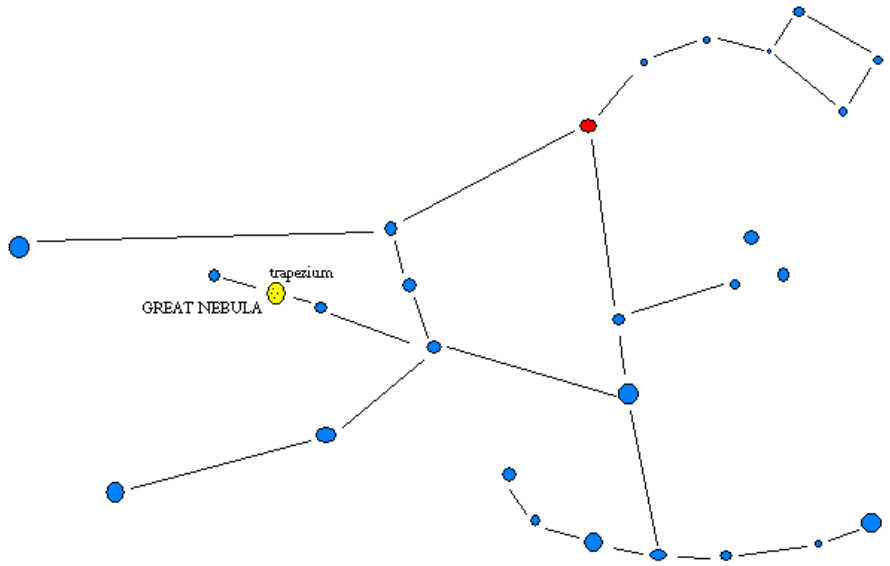
5. Alpha, Proxima, Beta and Omega Centauri.
These stars are part of the constellation Centaurus. Alpha and Proxima appear as a beautiful binary through a small telescope, but are in fact a part of a triple star system.
Proxima – This is the closest star to our own sun. this was measured by Henderson at the Cape of Good Hope in 1839.
Alpha α cen – Also known as Rigel Kentaurus. It is estimated to be 1.3 parsecs away, or 4.24 light years away. This triple system is the 3rd brightest star.
Beta β cen – This star is also known as Hadar or Agena. It is 391.23 light years away, 120 parsecs, 10th brightest star. It is estimated to be 10 000 times brighter than our sun.
Omega ω cen – Is a globular star cluster of over 1 000 000 stars, and can be seen with the naked eye. It was documented by Ptolemy 1800 years ago. It is 18 000 light years away

© Lee Gutteridge – 2 December 2005

6. The Megallenic or Cape Clouds.
These are distant galaxies. The larger of the two is 175 000 light years away and about 22 000 l.yrs wide and consists of 10 000 000 000 stars (ten thousand million), and the smaller of which is 210 000 light years away, 10 000 l.yrs wide and contains 2 000 000 000 (two thousand million) stars. These were observed by Magellan in 1552, and he believed these were pieces of our own galaxy which had broken away. These are two of the three galaxies visible with the naked eye. Andromeda is the third, and is 2.3 million light years away, and consists of about 400 000 000 000 stars, but only seen in the Northern Hemisphere.

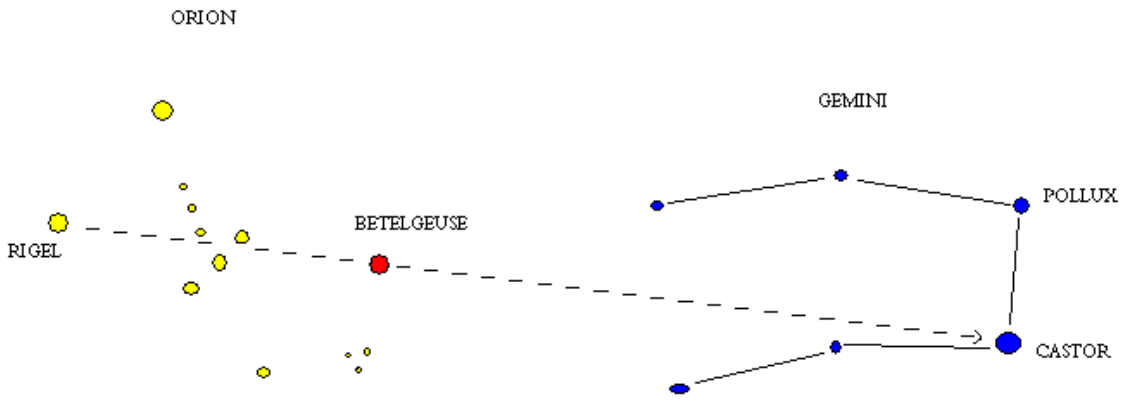
7. Crab Nebula
A nebula found between the horns of Taurus the bull, the result of an explosion on July the fourth, 1054 AD. This was witnessed by Chinese astronomers. The gas and dust cloud is still spreading today. The explosion caused a dense star to be formed in the nebula, which pulses as it spins at high speed, and can be detected by radio telescopes. In 1967 astronomers discovered that the star in the Crab nebula pulses 30 times a second. It is known as a neutron star. As the neutron star pulses it tranfers x-rays to the nebula and causes it to shine. It is 2 000 parsecs away, or 6523,20 light years away.

8. The Great Nebula of Orion
This is a huge gas and dust cloud, consisting mainly of hydrogen. It is studded with stars including the Trapezium. It looks like a star to the naked eye, in the middle of the sword of orion.
The Horsehead nebula is also in orion, near Sigma Orionis.



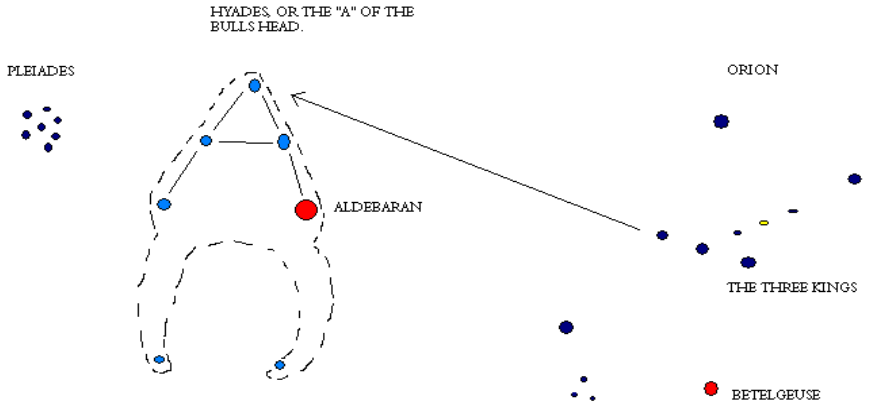
© Lee Gutteridge – 2 December 2005

9. Gemini
Castor and Pollux are the heavenly twins, and brightest two stars in this constellation.
Castor is a binary star, the 23rd brightest in the sky. It is 14 pasecs away, 45,66 light years.
How to find Gemini.



10. Pleiades
The seven sisters, or body of the bull is part of the Taurus constellation. Usually only six of the stars are visible with the naked eye, but if veiwed through a telescope there are many stars. Hundreds in fact.

11. Aldebaran
Aldebaran is the brightest star in the head of the bull, and is a Red giant. It is the 13th brightest star, 21 parsecs, 68.49 light years away.



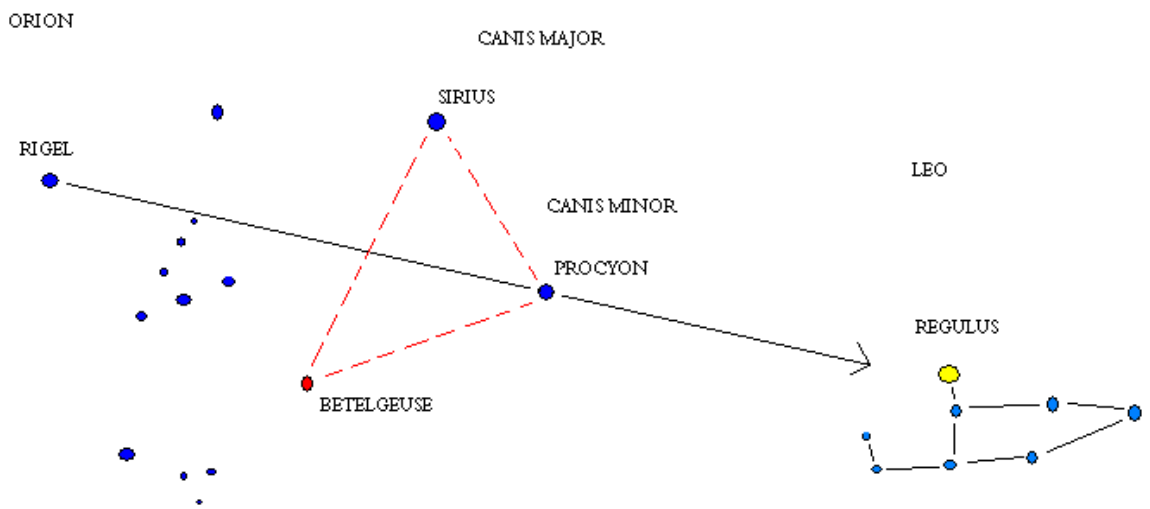
© Lee Gutteridge – 2 December 2005

12. Sirius
This is the brightest star in the sky. Also known as α Canis Major. This is a binary star, the second being Sirius B, or the Pup. The Pup orbits Sirius once every 50 years. It is 2.7 parsecs, or 8.80 light years away. It is part of the big dog constellation. It is Blue White, of spectral class A1, but may have been Red at some stage in its life.

13. Regulus
This star is the heart of Leo the Lion. The 21st brightest star in the skies. It is infact a triplet, there are three stars. Its companion star is a binary system. It is 26 parsecs away, or 82.22 light years. The constellation contains more than 70 galaxies.

14. Taurus
See 10 and 11 above.

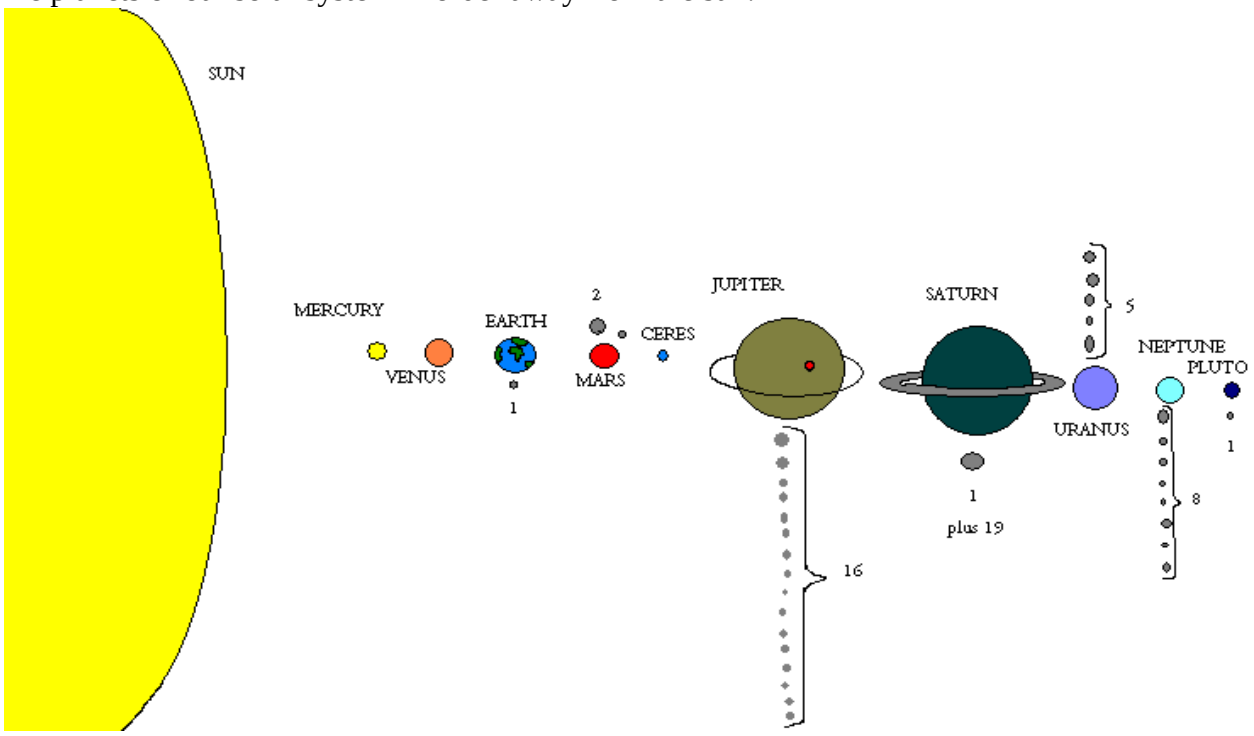
15. Leo
See 13 above.



© Lee Gutteridge – 2 December 2005

PLANETS

The planets of our solar system in order away from the sun.

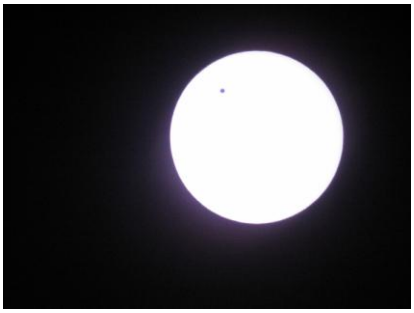


Mercury.

The closest planet to the sun. Because it is so close to the sun it is rarely seen however. It always rises or sets within 2 hours of the sun. Less than one percent of the earths population have ever seen this planet. It orbits the sun every 88 days, and one day on mercury = 58.65 earth days. It is about 350°c during the day, and 170°c during the night on mercury. Mercury's suface is heavily cratered due to meteoric bombardment. It is a geologically dormant planet.

Venus

The second closest to the sun and the easiest of the planets to observe. It is the hottest of the planets in our solar system. It is known as the evening or morning star, and spends approximately 8.5 months in each of these roles. Venus is about the same size as the earth, and spins in the opposite direction to the earth on its axis, a complete rotation being 243 earth days. Venus' journey around the sun takes 224.7 earth days, so a Venusian day is almost = to one Venusian year. Clouds of co2 and sulfuric acid surround venus, and reflect about 74 percent of the sunlight which strikes the planet. The atmosphere is very dense and the temperatures are very high due to the Greenhouse effect, about 475°c. The surface of venus has rolling plains and highlands, as well as active volcanoes.



The small spot on the face of the sun is in fact the planet venus passing between earth and the sun.

© Lee Gutteridge – 2 December 2005

Earth
The third planet. And the only planet known to have liquid water and support life. Earth has one sattelite, called the Moon. We should all know a little about this planet.

Mars
The red planet. A day on Mars is 24hrs 37 mins, and a year is 687 earth days. The red surface is dusty and rocky, with no water. There is however evidence of water erosion. There are strong turbulent winds, and occasionally global dust storms occur. There are frozen polar caps, consisting of frozen carbon dioxide, and the huge volcano Nix Olympia or Olympia Mons which is three times as high as mount Everest. There are two moons, called Phobos and Deimos. They are irregularly shaped, and about 30km in diameter, and may be the remains of a larger sattelite which was shattered by tidal forces.

Ceres
This minor planet is one of hundreds of thousands of small planets in our solar system. It is 800km in diameter. It was discovered in 1801 by Piazzi (Italy). Pallas, Juno and Vesta were other minor planets discovered during the following six years, and Astrea in 1845. Since 1948 there has been at least one minor planet found every year.

Jupiter
The planet with a red spot. This is the largest planet, more than twice as big as all of the other planets put together. It has a very strong gravitational field. Jupiter has not got a solid surface, but is a landscape of gasses, with a rocky molten core surrounded by liquid hydrogen. The surface is about -150°c, and the core is very hot, 30 000°c. This heat in the core is due to the great gravity causing heat through pressure, and the planet actually gives out more energy than it recieves from the sun. it spins on its axis once every 10 hours, a short day for such a large planet. It takes 11.86 earth years to orbit the sun. Jupiter therefore has about 11158 Jupiter days per Jupiter year! The great red spot is an enormous wind storm, and is the longest surviving feature of Jupiters atmosphere. There are 16 moons, the four largest of which are Io, Europa, Ganymede and Callisto. These are known as the Gallilean moons.

Saturn
The planet with rings. This planet is also gaseous, consisting of hydrogen, heliun, methane and ammonia. The surface of saturn flows as a liquid. Surface temperatures are around - 180°c. The rings are made of million of particles, ranging in size from tennis ball to football size. There are six separate rings.There are also at least 20 moons, the largest of which is Titan. It is larger than Mercury, and has an atmosphere of nitrogen and methane. There may be rivers of liquid methane on this moon, but it is obscured by red smog.

Uranus
It takes 84 earth years for Uranus to orbit the sun. Uranus does not spin, but rolls over on a horizontal axis (at 98° to the ecliptic). One day is 17.24 earth hours. Uranus' five largest sattelites are called Miranda (closest to planet), Ariel, Umbriel, Titania and Oberon (furthest from planet). Uranus has ten faint rings, made of material darker than coal dust, so they are very difficult to see, and reflect very little light. Uranus was discovered by herschel in 1781(England).

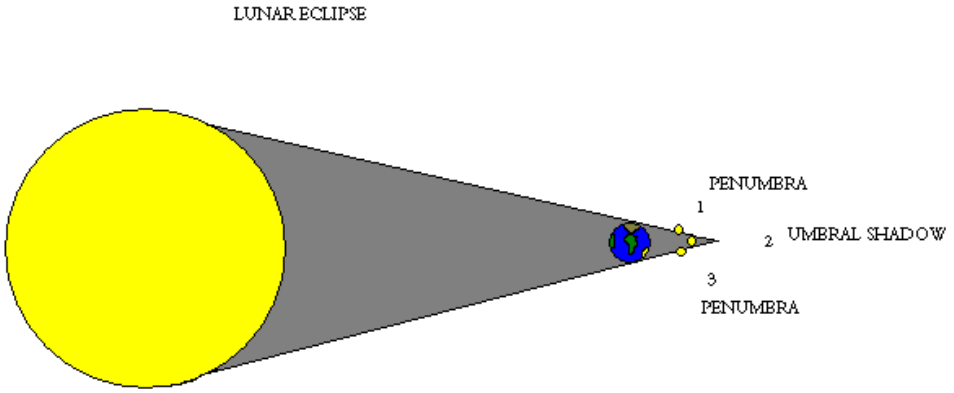
© Lee Gutteridge – 2 December 2005

Neptune
This planet was discovered in 1846 by D'arrest and Galle (France). The surface temperature of Neptune is about -228°c. There are at least 8 sattelites, being: Triton (largest), Proteus, Larissa, Despina, Galatea, Thalassa and Nereid. Triton has an incredibly weak atmosphere of nitrogen. There are six dark, narrow rings around this planet. The surface of Triton is made of frozen water, methane and carbon monoxide. It is composed of about two thirds rock and one third ice.

Pluto
The furthest planet from the sun. this planet was discovered by Tombough in 1930 (USA). Temperature on the planet is about -230°c. It has one known sattelite called Charon.

Sedna
A recently discovered planet orbiting outside pluto. It is believed to be a result of a collision in the Oort cloud. (Not included in the diagram).

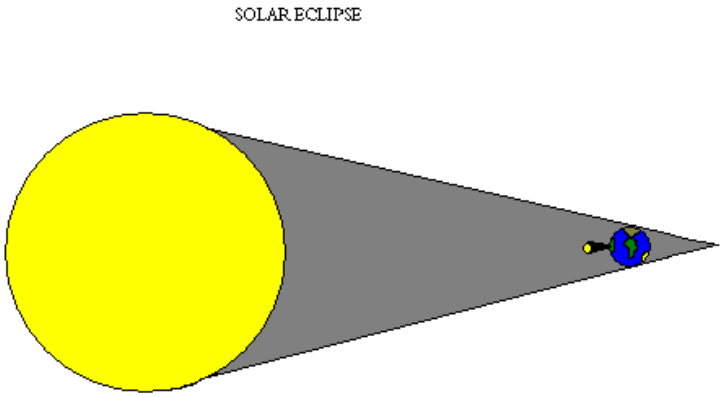
LUNAR ECLIPSES
Lunar eclipses.
The moon in complete shadow of the earth is umbral, and in partial shadow it is penumbral.



© Lee Gutteridge – 2 December 2005

SOLAR ECLIPSES

The moon between the earth and the sun, blocking light which would have struck the earths surface. The umbral cone where it strikes the earth will cause the sun not to be visible at a particular place.



OUR SUN

The Earth is about 150 000 000km from the sun, and its light takes about 8 minutes to reach us. The sun is about 333 000 times heavier than the earth. It is effectively a ball of hydrogen which is converting by means of nuclear fission to helium. Sun spots are magnetic flares or storms on the suns surface. These cycle from maximums of several dozen spots to none at all roughly every 11 years.

NEBULAE

Nebulae are clouds of gas and dust,which sometimes contain stars. These can be formed in the aftermath of Super Novae. They may also be the birth place of stars and planets. There are several Nebulae visible such as the Great Nebula of Orion and the Crab Nebula. There is a Nebula called the Coal Sac which is near the Southern Cross, and it is very dark, obscuring light from the stars behind it.

BLACK HOLES

Black holes are an astronomical mystery. The only thing known for sure is that they exist. They may be dense Neutron stars, which have such incRedible gravitational fields that nothing can escape them. Not even light. Black holes affect movement of other bodies in space, pulling with their immense gravities. Stars and planets and other bodies are pulled into Black holes and are assimilated into the neutron star or whatever may be at the centre of the Black hole. Neutron stars could form due to Super Novae.

© Lee Gutteridge – 2 December 2005

A MOON MAP

Seas of solidified basalt have formed on the surface of the moon, these are called Mares. Below are the locations of a few of these Mares visible from the Earth. This map also shows craters.

SEAS

A. MARE NUBIUM

B. MARE IMBRIUM

C. MARE SERENITATIS

D. MARE TRANQUILITATIS

CRATERS

1. ARCHIMEDES

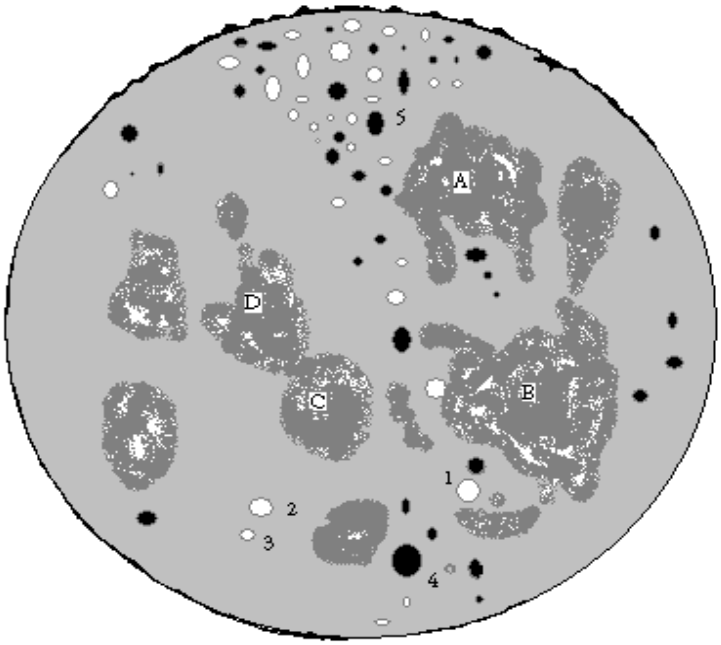
2. HERCULES

3. ATLAS

4. PLATO

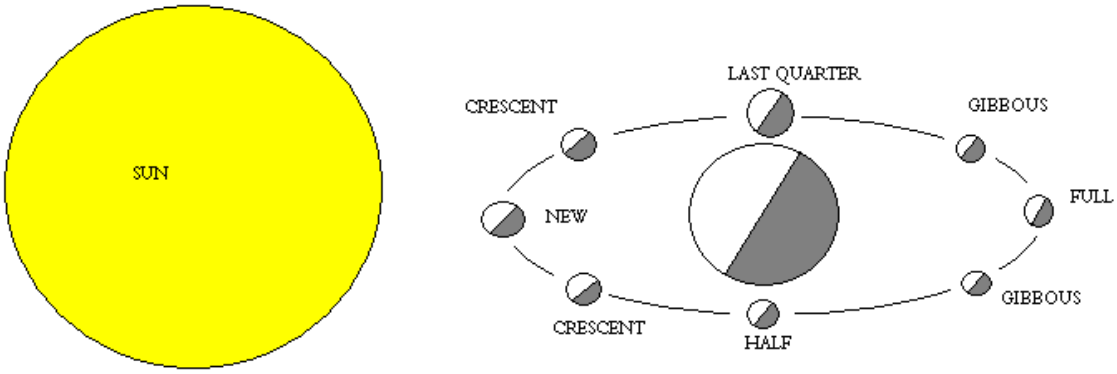
5. PTOLEMAEUS

THE MOON



MOON PHASES

MOON PHASES

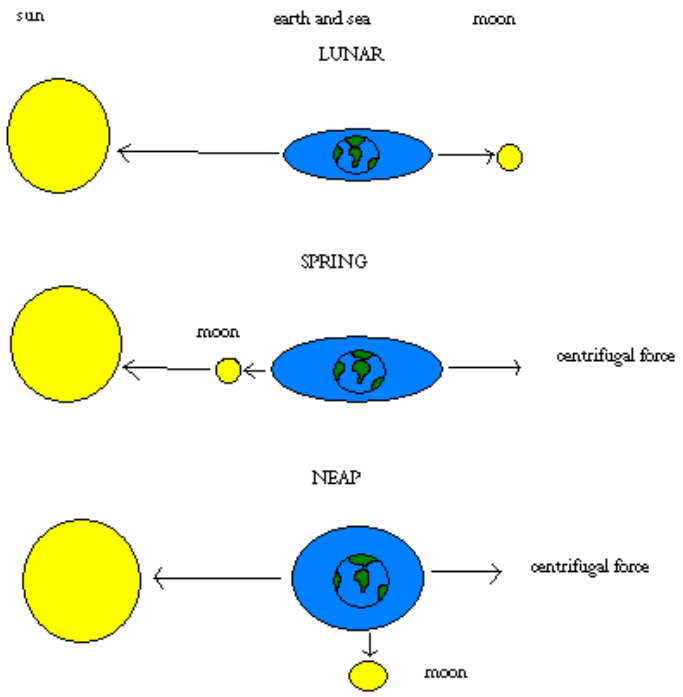


The moon is about 384 400km away from the earth on average.

© Lee Gutteridge – 2 December 2005

TIDES

The tide is affected by the moon and suns relative positions to the earth.



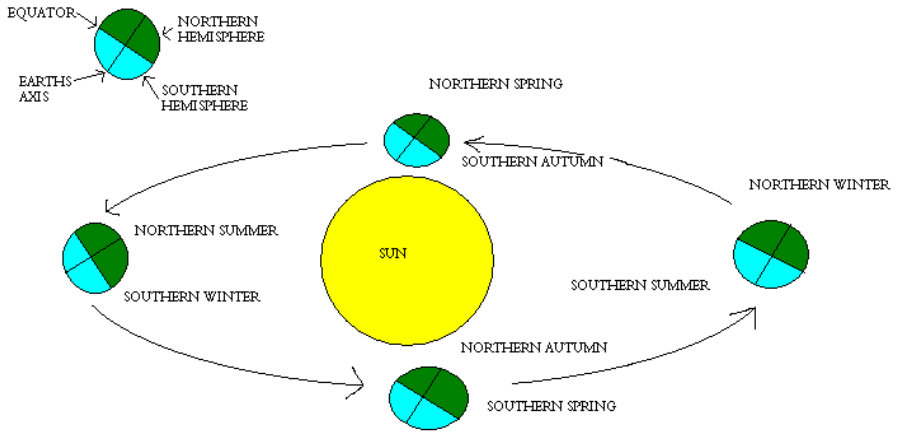
Neap tides are the lowes of tides, wheras Spring and Lunar are highest.

GENERAL ASTRONOMICAL INFORMATION

1. Leap years are caused by adding up the extra quarter of a day which it takes us each year to orbit the sun i.e. 365 ¼ days each year.

2. Sirius and Antares are binary.

3. Seasons are caused because of the distance from the sun and angle of our planet during its orbit around the sun.



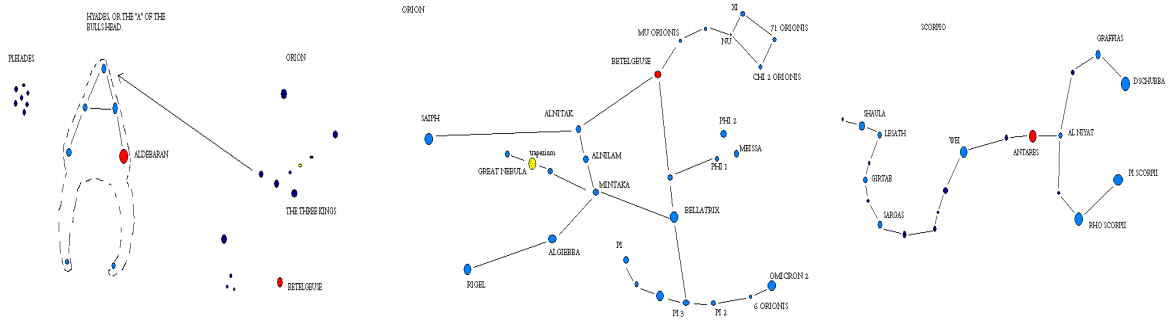
© Lee Gutteridge – 2 December 2005

4. Planets do not produce light, they reflect the light of the sun.

5. Five planets can be seen with the naked eye from the earth.

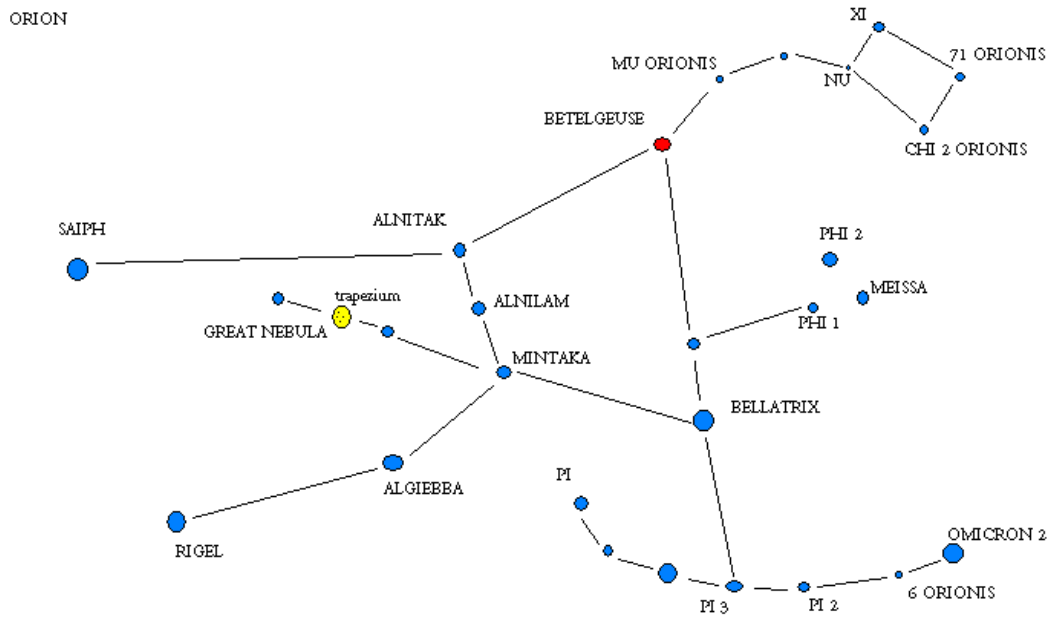
6. The red giant in Scorpio is Antares. In Taurus is Aldebaran and Betelgeuse is in Orion.

Taurus Orion Scorpio



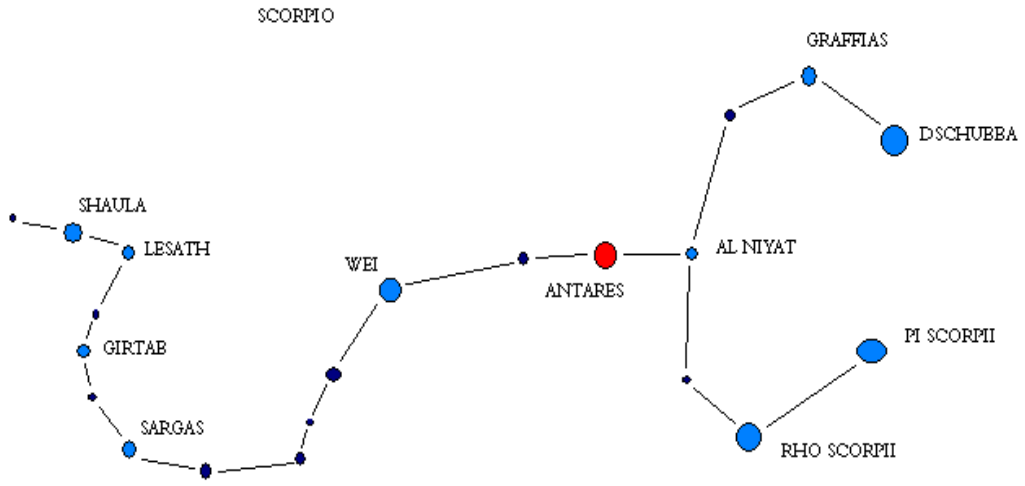
7. The Aurora Borealis, or Northern Lights are electrical ionizations taking place due to sun spots. They are spectacular light shows, of blues, greens and purples, on the northern horizon veiwed from within the arctic circle.

8. Orion contains the following stars:



© Lee Gutteridge – 2 December 2005

9. Scorpio contains the following stars:



10. Some planets that can be seen with the naked eye can only be seen for some of the year.

<u>2004</u>

Mercury can be seen in mar, apr, jun, aug, sep, oct, dec.
Venus can be seen in jan, feb, mar, apr, may in the evening and jun, jul, aug, sep,oct, nov, dec in the morning.
Mars can be seen in jan, feb, mar, apr, may, jun, jul, aug in the morning and oct, nov, dec in the evening.
Jupiter can be seen all year.
Saturn can be seen all year.

<u>2005</u>

Mercury can be seen in mar, jun, aug. nov.
Venus can be seen in the morning from jan to mar, and in the evening from mar to dec.
Mars can be seen all year, in the mornings from jan to sep, all night in oct anad nov and in the mornings during dec.
Jupiter can be seen all year.
Saturn can be seen all year.

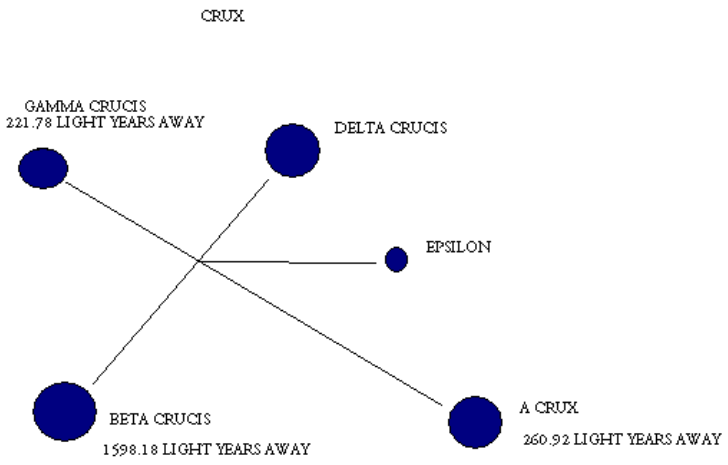
11. Our galaxy is called the Milky Way and is estimated to contain a Hundred Thousand Million stars.

12. The Great Nebula of Orion is a light, visible nebula. The Coal Sack is a Dark nebula which cannot be seen.

© Lee Gutteridge – 2 December 2005

13. A star maintains equilibrium by gravity holding gasses together and pulling them inwards toward the core, and nuclear explosions pushing out to give form to the star. As gasses deplete the star will have less gravity, and expand. These stars also do not have so much gas left to collide so they burn slower. These cooler stars become Red. i.e. Red Giants. White dwarfs. Eventually these Red Giants will contract again and begin to burn up helium, in nuclear reactions instead of hydrogen, and eventually gasses such as oxygen will be present and carbon. There after, with incresed mass some of the heavy metals will begin to form in the core of these super heavy stars. The pressure of the stars own gravity will cause a super heating, and this tiny star several kilometres across will have an unimaginable weight and great heat.

14. The Southern Cross and its relative distances to the Earth.



© Lee Gutteridge – 2 December 2005

BOTANY

GLOSSARY OF TERMS

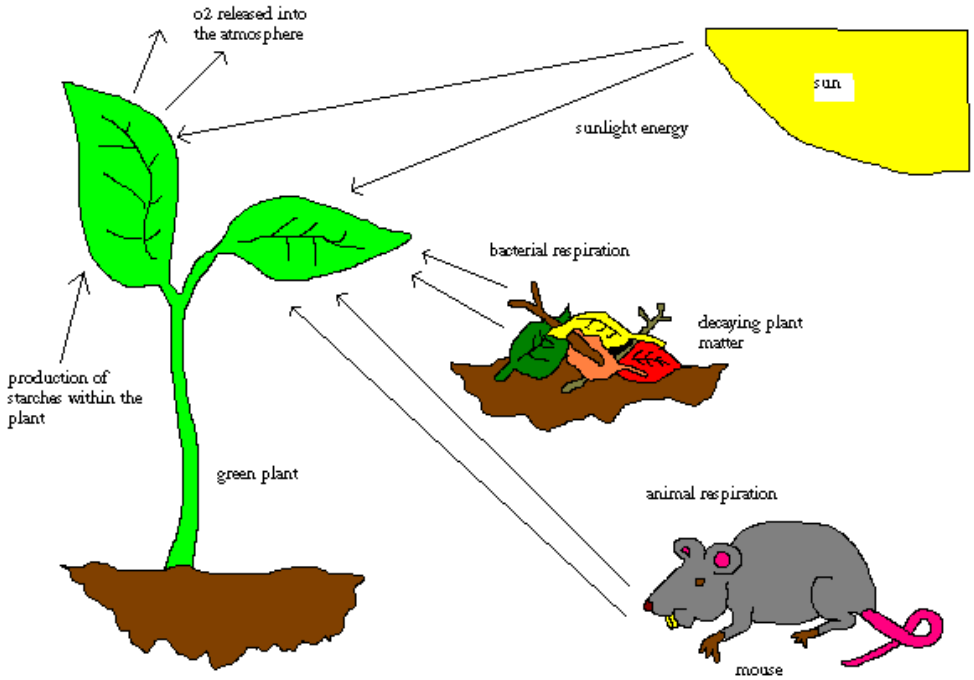
1. Photosynthesis – the production of plant starches in plants by using water, sunlight and co2.
2. Cellulase – the enzyme which can break down cell walls.
3. Cellulose – the material of which cell walls are made.
4. Cambium – inner bark of a tree.
5. Xylem – food travels in this series of channels under the bark of a tree.
6. Phloem – water travels in this series of channels under the bark of a tree.
7. Root – the part of a tree or plant under the ground which anchors a tree, and provides minerals and water.
8. Culm – a grass plants stem.
9. Rhizome – an underground horizontal stem of a grass plant.
10. Stolon – an over ground horizontal stem of a grass plant.
11. Inflorescence – a flower.
12. Stigma – the female part of a flower.
13. Anther – the male part of a flower.
14. Deciduous – a plant which looses its leaves in the winter.
15. Xerophytes – plants which do not need much water.
16. Stomata – holes in the leaves of a plant through which gasses and water pass.
17. Transpiration – loss of water throught the leaves of a plant.
18. Osmosis – movement of gasses or liquids from high to low pressures.
19. Chloroplast – the green cells of a plant leaf where photosynthesis takes place.
20. Starch – a type of plant produced sugar.

© Lee Gutteridge – 2 December 2005

PHOTOSYNTHESIS

Describe the process of photosynthesis, in as much detail as possible.

This is the process whereby plants utilise sunlight (heat energy), water (H2O), carbon dioxide (CO2) and chlorophyll to make plant sugars (C6 H12 O6) and breathable oxygen (O2).



The process.

Plants contain a pigment called Chlorophyll 'A' which is contained in the chloroplasts and drives the process of photosynthesis. Plants absorb water through the roots and carbon dioxide through the leaves and these 6 CO2 and 6 H2O, in combination with energy from the sun and the catylistic influence of the chlorophyll, produce a plant starch (C6 H12 O6) and a by-product of 6 O2's (part of breathable air). Air is utilised by mammals, and other animals, and CO2 is produced by animals and bacteria.

© Lee Gutteridge – 2 December 2005

GRASSES

Here is a short list of some of the grasses from the Northern part of South Africa. The latin names (and meaning if possible), ecological status, pioneer/ sub-climax / climax status, whether it is good for grazing or not, and any other interesting facts have been included where available.

Natal red top
Melenis repens
Melenis=with the colour of new honey repens=creeping
This commonly seen red grass will fade to white with age, and is found next to roads and on other disturbed sites. It flowers from September to June. It is not too tall a species, but sometimes reaches a metre in height. It is a tasty grass but does not produce too much leaf. This is a pioneer increaser 2 species, which is also found in Australia and the USA.

© Lee Gutteridge – 2 December 2005

Broad leaf turpentine grass
Cymbopogon excavatus
Kymbe=Greek for boat
Pogon=beard
Excavatus=hollowed out
It flowers from November to May. It is very common, but rarely abundant. With its untidy jumble of inflorescences, and great height it is easily identified. When crushed it smells of turpentine. It contains an essential oil with 18 different ingredients, of which carvone, trans-carveole and d-limonene are the most important. It also contains Prussic acid, which can kill an animal if the plant is eaten when wilted. This toxin is also referred to as a hydrocyanic toxin (which is also synthesized in the bodies of sub-family Acrea butterflies). It is however palatable as a young plant, but is only used if there is nothing else to eat. It is found on sandy and disturbed soils, often next to the road. Increaser 1, climax species. It is used in Africa to line grain baskets, as not even rodents enjoy eating this species of grass.

Common finger grass
Digitaria eriantha
Digitus=finger
It flowers from January to April. It is from 0,5 to 2 metres tall with a characteristic finger shaped inflorescence. It almost appears hand-like. It is a very common species and is highly palatable, its presence in large numbers indicated good veld condition. It is edible until late in the winter. It helps to stabilize disturbed areas, and is used in farming as a standing hay. It is a decreaser climax species, which only occurs naturally in Southern Africa.

© Lee Gutteridge – 2 December 2005

Silky autumn grass
Schizachryum jefferysii
It flowers from February to June, and grows in sandy areas and vlei. It has a good leaf production but is not highly palatable. It grows up to a metre in height, has reddish colour in the autumn and has silky hair on the inflorescence. It is used to thatch huts. This increaser 1 climax species occurs in the Democratic Republic of the Congo and Southern Africa.

Herringbone grass
Pogonarthria squarrosa
Pogon=a beard
Arthurian=a joint
Squarrosa=parts spread at the ends
This distinctive grass species is in flower from November to May, and has an easily identifiable fish-bone shape. They grow up to 1,2 metres in height in disturbed and sandy soils. It is a poor grazing plant and is seldom utilized. These grasses are sometimes tied into bunches and used as a hand broom. This sub-climax increaser 2c is found throughout sub-tropical Africa.

© Lee Gutteridge – 2 December 2005

Guinea grass
Panicum maximum
Panicum=Latin for millet
Maximum=Latin for biggest, referring to the size of the plant.
It flowers from September to March and is, as the name implies, a very large grass, have up to 2 metres tall. The inflorescence is large and spreading with purple spikelets. It is a good grazing species and has high leaf production levels. Birds eat seeds. This is a shade loving decreaser which can be a sub-climax to climax species.

Yellow thatching grass
Hyperthelia dissoluta
Hyper=over
Thelia=nipple or teat
Dissoluta=Latin for dissolve
This tall grass reaches 3 metres in height, and flowers from December to June. It has a greenish yellow erect stem. This grass is of average grazing value when young, but becomes useless as it ages and hardens. It is found in almost all soil types but shows a marked preference for sandy or disturbed soils. It needs a lot of water per annum, in excess of 600 mm, and for this reason is found on the edges of roads where it can utilize excess run off water. This is the only Hyperthelia species found in Southern Africa. It also occurs in Madagascar. It can be a pioneer, sub-climax or climax species and is an increaser 1.

© Lee Gutteridge – 2 December 2005

Common Reed
Phragmites australis
Phragma=Greek for hedge
Australis=Latin for south
This is a very large grass, up to 4 metres tall, and grows along waterways. It flowers from December to June, with a large white, feather like plume. It helps to stabilizes soils and protect them from flooding. It grows in very dense stands. It has a low grazing value but helps to filter water and is a popular and safe nesting site for birds. The sharp leaves are a deterrent to most predators. It is used by man as a building material, to make mats, for baskets and even arrow shafts. It is also used in paper making industries. Man can eat the young shoots. This decreaser plant is probably the most widely distributed plant in the world.


Common signal grass
Brachiaria brizantha
Brachium=arm like
Briza=Greek for grain
This grass flowers from December to April. It is typical of signal grasses in shape and reaches as much as 1,8 metres in height. It is usually not this tall though, around 70 cm on average. It is a climax species with a large leaf production and average palatability. It becomes hard and less palatable later in the season. It grows in sand next to streams and in disturbed areas. It is seldom abundant in natural veld, and is grown as pasture for cattle. It can be used as grain, and occurs throughout sub-tropical Africa.

© Lee Gutteridge – 2 December 2005

Couch grass
Cynadon dactylon
Kyon=Greek for dog
Odon=toothed
Dactylos=Greek for finger
It flowers from September to May, and has a short culm of about 40 centimetres ending in a digitate inflorescence with 3 to 7 fingers. Roots go down about one metre. They are eaten by warthogs. It can cause prussic acid poisoning in livestock if eaten when the grass is wilting. The creeping stems make this a mat forming grass. It will grow in all types of soil, but mostly sandy or fertile soils. It is found on disturbed areas and damp areas, and is grazed down to a lawn like appearance by rhino and antelope. It has an average to high grazing level, and remains green until late in the winter. Often found in association with termite mounds. It has stolons and rhizomes and helps to stabilize the soil. The leaves are high in vitamin c and are used by humans in the preparation of food and drink. It is also used medicinally to treat various ailments such as heartburn, indigestion and wounds.
This is a pioneer increaser 2c which occurs in all moderate parts of the world.

© Lee Gutteridge – 2 December 2005

Giant spear grass
Trachypogon spicatus
Trachy=Greek for rough
Pogon=a beard
Spicatus=pointed
This grass flowers from December to May and stands up to 1,5 metres tall. The inflorescence is a tangled affair with wire like awns which curve outwards and present an untidy appearance. It grows in open grasslands in undisturbed soils, of a gravely or sandy nature. It also occurs near vleis. It is an unpalatable species, which may be grazed when young. If there is an abundance of spear grass it is a sign of under utilization by grazers. Thick stands of these grasses can protect the soil in areas of high rainfall. It is an increaser 1 and is spread by the awns attaching themselves to animal's fur. It is found in Central, Southern and East Africa, and has been introduced to South America.

Cat's tail
Perotis patens
No information available on name derivative.
It flowers from November to April. It occurs on disturbed areas, usually in poor, sandy soils. Often found in dry bare patches in grasslands. It is an indicator of poor veld condition in natural veld. It is considered a weed in some disturbed areas. This increaser 2c has a very low grazing value. It is however an attractive looking species and is used in flower arrangements.

© Lee Gutteridge – 2 December 2005

FLOWERS

This is a list of a few common flowers and some facts about each.

Becium angustifolium – Becium means colts foot. Found on the rocky ridges of the lower escarpments of the Waterberg.

Boophae disticha – Bushmans poison bulb, tumble weed. This plant is used by the pedi in conjunction with traditional beer for convening with dead ancestors.
Found in most of the low altitude grasslands. Has a red flower in october.

Callilepis leptophylla – Ox-eye daisy. Callilepis means beautiful scale. Leptophylla means thin leaf. This is a large white daisy with a white flower. Common in kloofs and on plateau's.

Carissa bispinosa – Num num, or Y thorn. Carissa is the indian name for this genus. Bi-spinosa means two spined. Carissin is a poisonous glucoside from the bark of this plant. Has paired thorns on the same branchlet in a Y shape. Bush sized shrub, with red edible berries. It has a milky latex. Grows in thickets with other plants. Flowers are white.

Chironia paulustris – Bitterwortel. Chiron was a mythical centaur, the father of medicine and botany. pink bitterwortel type. Palaustris means marsh loving.

Cleome maculata – Wild cleome. Cleome from cleoma, a strong tasting plant from the middle ages. Maculata means spotted. Yellow markings are presented up untill the plant is pollinated, then they droop to encourage the pollination of as yet un-pollinated flowers. Very small and delicate and often missed. They often grow in disturbed sandy soils, ie next to roads.

Clerodendrum triphyllum – No common name found. (small blue flower with white stripes). Kleros means chance, dendron means tree. Triphyllum means three leaves. Common in the kloofs and on upper grasslands of the plateau's.

Commalina africana sub-species *barberae* and *krebsiana* –Wandering jew. Commelina after the dutch botanist Johan Commelin(1629-1692). Africana means from africa. Leaves can be boiled with ground nuts to make a type of spinach. Delicate yellow flower, also known as mouse ears. No fluid in the leaf sheath. Can be affected by red mites on the leaves.The large flower type is *Barbarae* and the smaller commalina is sub-species *Krebsiana.*

Commalina benghalensis – Benghal wandering jew. Benghalensis after benghal in india. Also known as Venus' bath, as if you squeeze the leaf sheath at the base of the flower a drop of tasteless, but very slightly sticky sap will come out from between the leaves. This plants leaves can also be prepared as a meal. Used to reduce fever, treat swollen glands and cure gonnorhoea.

Cotyledon orbiculata – Pigs ear. (round green succulent leaf with red rim). Kotyle means cavity or small cup, referring to the leaf shape, orbiculata means disc shaped. Found in rocky areas, a short succulent plant. It contains several cardiac glycosides such as orbicuside A of the bufadienolide group. Used to treat worms, warts and toothache amongst others.

© Lee Gutteridge – 2 December 2005

Crossandra greenstockii –Rooiblom. (bright red flower). Krossoi is a fringe, andros is a man. Canon W. Greenstock collected this plant from the Pilgrims Rest area of Mpumalanga.

Gladiolus eliotii – Gladiolus. (purple with yellow). Gladiolus means small sword. Eliottii, refers to Scott Eliott who identified this flower in 1890 at steenkool spruit near Bethal.

© Lee Gutteridge – 2 December 2005

A TREE LIST OF SOME OF THE COMMON NORTHERN SOUTH AFRICAN SPECIES.

1. African white sugar bush *Protea gaguedi*
2. Ankle thorn acacia *Acacia robusta*
3. Baboon grape *Rhiocissus digitata*
4. Bell spike thorn *Gymnosporia tenuaspina*
5. Bitter forest grape *Rhoicissus revoilii*
6. Black monkey orange *Strychnos madagascarensis*
7. Black monkey thorn *Acacia burkei*
8. Bladder nut *Diospyros whyteana*
9. Blue bush *Diospyros lycoides*
10. Blue guarry *Euclea crispa*
11. Blue honey bells *Freylinia tropica*
12. Brandy bush *Grewia flava*
13. Broom cluster fig *Ficus sur*
14. Buffalo thorn *Ziziphus mucronata*
15. Bushveld grape *Rhoicissus revoilii*
16. Bushveld ironwood *Olea capensis*
17. Candelabra euphorbia *Euphorbia cooperi*
18. Cape gardenia *Rothmannia capensis*
19. Cape holly *Ilex mitis*
20. Cape myrtle *Myrsine africana*
21. Cheesewood *Pittosporum viridiflorum*
22. Cluster head protea *Protea welwitschii*
23. Coffee pear *Pleurostylia capensis*
24. Common brides bush *Pavetta gardenifolia*
25. Common bush Cherry *Maerua cafra*
26. Common cabbage tree *Cussonia spicata*
27. Common currant *Rhus pyroides*
28. Common guarry *Euclea undulata*
29. Common hook thorn *Acacia caffra*
30. Common karee *Rhus lancea*
31. Common resin tree *Ozoroa paniculosa*
32. Common spike thorn *Gymnosporria buxafolia*
33. Common tree euphorbia *Euphorbia ingens*
34. Common wild elder *Nuxia congesta*
35. Common wild fig *Ficus thoningii*
36. Common wild pear *Dombeya rotundifolia*
37. Coral tree *Erythrina lycistemon*
38. Cork bush *Mundalea sericia*
39. Corky bark monkey orange *Strychnos cocculoides*
40. Cross berry raisin *Grewia occidentalis*
41. Current resin tree *Ozoroa sphaeroides*
42. Dwarf mabola plum *Parinari curatellifolia*
43. Elands bean *Elephantoriza elephantina*
44. Flame creeper *Combretum paniculatum*
45. Flame thorn acacia *Acacia ataxacantha*
46. Flat flowered aloe *Aloe marlothii*
47. Forest bush willow *Combretum kraussii*

© Lee Gutteridge – 2 December 2005

48. Glossy currant *Rhus lucida*
49. Governors plum *Flacourtia indica*
50. Grassland tree fern *Cyathea dregei*
51. Green cluster leaf *Terminalia brachystemma*
52. Green monkey orange *Strychnos pungens*
53. Hard pear *Olinia ventosa*
54. Healing leaf tree *Solanum giganteum*
55. Highveld cabbage tree *Cussonia paniculata*
56. Horn pod tree *Diplorynchus condylocarpon*
57. Iron wood *Olea capensis*
58. Jackal berry *Diospyros mespiliformes*
59. Jacket plum *Pappea capensis*
60. Kai finger leaf *Vitex obovata*
61. Kei apple *Dovyalis caffra*
62. Koko tree *Maytenus undata*
63. Kooboo berry *Mystroxylon aethiopica*
64. Kraal spike thorn *Maytenus polycantha*
65. Krantz aloe *Aloe arborescens*
66. Kudu berry *Pseudolachnostylis maprouneifolia*
67. Lance leaved guarry *Euclea linearis*
68. Large fruited bush willow *Combretum zeyheri*
69. Large myrtle *Myrsine pillansi*
70. Lavender fever berry *Croton gratissimus*
71. Lavender tree *Heteropyxis natalensis*
72. Leadwood *Combretum imberbe*
73. Live long *Lannea discolor*
74. Lowveld silver oak *Brachylaena huillensis*
75. Marula *Sclerocarya birrea*
76. Monkey thorn *Acacia galpinii*
77. Mountain cabbage tree *Cussonia paniculata*
78. Mountain fig *Ficus glumosa*
79. Mountain karee R*hus leptodicta*
80. Mountain medlar *Tapiphylum parvifolium*
81. Mountain seringa *Kirkia wilmsii*
82. Mountain silver oak *Brachylaena rotundata*
83. Nana berry *Rhus dentata*
84. Narrow leaved false brides bush *Tarenna supra-axillaris*
85. Natal box *Buxus natalensis*
86. Natal guarry *Euclea natalensis*
87. Natal mahogany *Trichilia emetica*
88. Natal plane *Ochna nataletia*
89. Ouhout *Leuosidia sericia*
90. Paperbark acacia *Acacia sieberiana*
91. Paperbark albizia *Albizia tanganyicensis*
92. Parsley tree *Heteromorpha trifoliata*
93. Peeling plane *Ochna pulchra*
94. Pipe stem *Vitex rhemanii*
95. Puzzle bush *Ehretia rigida*
96. Quar *Psydrax obovata*
97. Real yellow wood *Podocarpus latifolius*

© Lee Gutteridge – 2 December 2005

98. Red bush willow *Combretum apiculatum*
99. Red leafed rock fig *Ficus ingens*
100. Red thorn acaia *Acacia gerrardii*
101. Resin bush *Ozaroa paniculosa*
102. River bush willow *Combretum erythrophylum*
103. Rock alder *Canthium mundianum*
104. Rock bush willow *Combretum moggii*
105. Rock stinging nettle *Obetia tenax*
106. Round leaf teak *Pterocarpus rotundifolia*
107. Round leafed rock fig *Ficus abutiflora*
108. Rubber head euphorbia *Euphorbia tirucalli*
109. Russet bush willow *Combretum hereroensis*
110. Sand paper raisin *Grewia flavescens*
111. Scented thorn acacia *Acacia nilotica*
112. Sickle bush *Dichrostachys cineria*
113. Silky bark *Maytenus acuminata*
114. Silver cabbage tree *Cussonia tranvaalensis*
115. Silver cluster leaf *Terminalia sericia*
116. Silver protea *Protea rupelliae*
117. Silver raisin *Grewia monticola*
118. Slender karee *Rhus keetii*
119. Small knobwood *Zanthoxylum capense*
120. Smelly berry vitex *Vitex mombassae*
121. Sour plum *Ximenia caffra*
122. Spiny leaved monkey orange *Strychnos pungens*
123. Spiny monkey orange *Strychnos spinosa*
124. Stunted ochna *Ochna inermis*
125. Sugar bush protea *Protea caffra*
126. Sumach bean *Elephantoriza burkei*
127. Sweet thorn acacia *Acacia karroo*
128. Tamboti *Spirostachys africana*
129. Thorn pear *Scolopia zeyheri*
130. Thorny elm *Chaetacme christata*
131. Tinder wood *Clerodendrum glabrum*
132. Transvaal beech wood *Fauria seligna*
133. Transvaal candelabra tree *Euphorbia cooperi*
134. Transvaal gardenia *Gardenia volkensii*
135. Transvaal milk plum *Englarophytum megalismontanum*
136. Transvaal red milk wood *Mimusops zeyheri*
137. Transvaal saffron *Cassine transvaalensis*
138. Transvaal sumach *Osyris lanceolata*
139. Tree wisteria *Bolusanthus speciosus*
140. Velvet bush willow *Combretm molle*
141. Velvet rock alder *Canthium gilfilanii*
142. Violet tree *Securidarka longipedunculata*
143. Water berry *Syzigium cordatum*
144. Water pear *syzigium guineneense*
145. Waterberg bush willow *Combretum nelsonii*
146. Waterberg cycad *Encephalartos eugene-maraisii*
147. Waterberg poora-berry *Vitex pooara*

© Lee Gutteridge – 2 December 2005

148. Weeping wattle *Peltophorum africanum*
149. White iron wood *Vepris lanceolata*
150. White olive *Halleria lucida*
151. White pear *Apodytes dimidiata*
152. White silky bark *Robsonodendron eucleiformis*
153. White stink wood *Celtis africanus*
154. Wild apricot *Dovyalis zeyheri*
155. Wild custard apple *Anona senegalensis*
156. Wild grape *Lannea edulis*
157. Wild jasmine *Schrebera alata*
158. Wild olive *Olea europea*
159. Wild seringa *Burkea africana*
160. Wolkberg dragon tree *Draceana transvaalensis*

© Lee Gutteridge – 2 December 2005

A LIST OF SOME MEDICINAL TREES AND THEIR USES

ACACIA CAFFRA *COMMON HOOK THORN*

BARK	FRESH BARK CHEWED	EMETIC (CAUSES VOMITING)
LEAVES	CHEWED	STOMACH ACHE

ACACIA KAROO SWEET THORN

BARK & LEAVES	POWDERED, EATEN WITH FOOD	DIARRHOEA DYSENTRY
GUM	EATEN	CONJUNCTIVITIS HAEMORRHAGE ORAL THRUSH
	INHALATION	COLDS
ROOT	EATEN WITH FOOD	INFANTS WITH COLIC

COMBRETUM HEREROENSE RUSSET BUSH WILLOW

ROOT	ENEMA	STOMACH COMPLAINTS
BARK	INFUSION	HEART DISEASE HEART BURN

COMBRETUM ZEYHERI LARGE FRUITED BUSH WILLOW

BARK	INFUSION ASH	GALLSTONES EYE LOTION
LEAVES	OINTMENT MIXED WITH OIL ENEMA	BACK PAIN HAEMORRHOIDS

© Lee Gutteridge – 2 December 2005

CROTON GRATISSMUSS LAVENDER FEVER BERRY

BARK	INFUSION	PURGATIVE DROPSY UTERINE DISORDERS
	ASH	BLEEDING GUMS
LEAVES	INHALATION	INSOMNIA COUGH CHEST PAINS FEVER
	POULTIS	RHEUMATISM

DICHROSTACHYS CINEREA SICKLE BUSH

LEAVES	INFUSION CHEWED POULTIS	DIARRHOEA TOOTH ACHE PAIN RELIEF STINGS AND BITES
	INHALATION OINTMENTS	TUBERCULOSIS EAR-ACHE

ERYTHRINA LYSISTEMON COMMON CORAL TREE

LEAVES	OINTMENT POULTIS	EARACHE ANTI-SEPTIC
BARK	POULTIS	RHEUMATISM ARTHRITIS
	BURNT POULTIS	DISSINFECTANT

EUPHORBIA INGENS COMMON TREE EUPHORBIA

KEY - CACTUS LIKE IN APPEARANCE. DRIPS WHITE LATEX WHEN PIERCED.

LATEX	INFUSION IN SMALL DOSES	PURGATIVE DIPSOMNIA CANCER

© Lee Gutteridge – 2 December 2005

FICUS THONNINGII COMMON WILD FIG

ALL PARTS	INFUSION	EASY PREGNANCY
ROOTS	INFUSION	BLOOD CLEANSER
LEAF	POULTIS	WOUNDS BOILS WARTS

PTEROCARPUS ROTUNDIFOLIUS ROUND LEAF TEAK

KEY - DISTINCTIVE ROUND LEAVES WHICH, WHEN RUBBED BECOME VERY SHINY.

LEAF	TINCTURE	SORE EYES

SCLEROCARYA BIRREA (SP. CAFFRA) MARULA

ALL PARTS	INFUSION	HEART DIARRHOEA DIABETES FEVER MALARIA

TERMINALIA SERICEA SILVER CLUSTER LEAF

KEY - SILVER, HAIRY LEAVES IN A CLUSTER TOGETHER.

ROOTS	INFUSION	COLIC MENSTRUAL CRAMPS DIARRHOEA
	OILS	EYE INFECTION
	INHALATION	PNEUMONIA
	CHEWED	ANASTHETIC

© Lee Gutteridge – 2 December 2005

XIMENIA CAFFRA SOUR PLUM

ALL PARTS	INFUSION	INFERTILITY VENERIAL DISEASE STOMACH PAIN CRAMPS DIARRHOEA FEVER
	POULTIS	WOUNDS RHEUMATISM
ROOT	POWDERED IN BEER	APHRODISIAC NAUSEA
LEAVES	OILS	EYE LOTION
FRUIT	LINIMENTS	SEPTIC SORES CHICKEN POX

ZANTHOXYLUM CAPENSE SMALL KNOB WOOD

ALL PARTS	CHEWED	ALL ROUND DENTAL CARE
LEAVES	INFUSION	COLIC STOMACH PAIN FEVER EPILEPSY PARALYSIS PARASITES SNAKE BITE
	INHALATION	FLU COUGH

ZIZIPHUS MUCRONATA

LEAVES	POULTIS	BOILS SORES PAIN RELIEF
	CHEWED	APHRODISIAC
ROOTS	CHEWED	DYSANTRY LUMBAGO

© Lee Gutteridge – 2 December 2005

PRACTICAL USES OF SOME COMMON TREE SPECIES. THESE INCLUDE USE OF TREES FOR FOOD, WATER AND BUILDING MATERIALS AND TOOLS ETC.

SILVER CLUSTER LEAF
MEKORO POLES IN THE OKAVANGO, AND FENCE POLES.

LIVE LONG LANNEA
FENCE POLES

RUSSET BUSH WILLOW
KNOB KIERRIES

RED BUSH WILLOW
LEAVES AND SAMARAS USED TO MAKE TEA

MARULA
USED TO OBTAIN WATER

COMMON WILD FIG
STICKY WHITE SAP USED ON GRASSES TO TRAP GUINEAFOWL.

SOUR PLUM
FRUITS ARE EATEN

TRANSVAAL MILKPLUM
FRUITS ARE EATEN

JACKET PLUM
A GUN OIL CAN BE SQUEEZED FROM PIPS

COMMON TREE EUPHORBIA
SAP USED AS A FISH POISON

COMMON CORAL TREE
SEEDS ARE USED DECORATIVELY

SWEET THORN ACACIA
GUM IS EATEN

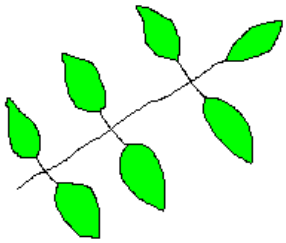
© Lee Gutteridge – 2 December 2005

LEAF STRUCTURES

The following are different leaf types along with an example of each.

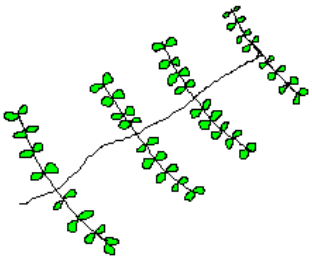
Pinnately compound

Marula



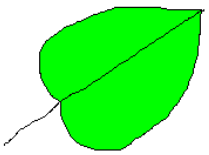
Bi-pinnately compound

Sweet thorn acacia



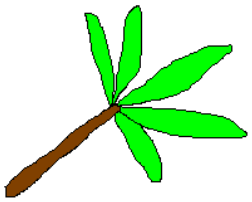
Simple leaves

Custard apple



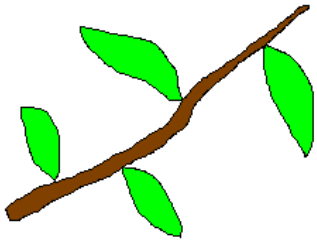
Palmately compound

Baobab

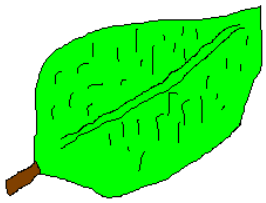


© Lee Gutteridge – 2 December 2005

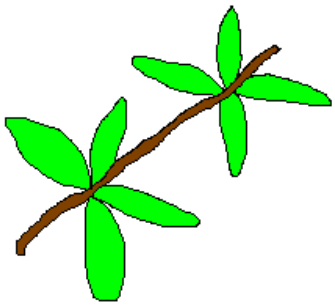
Alternate leaves
Buffalo thorn



Hairy leaves
Velvet bush willow



Whorled leaves



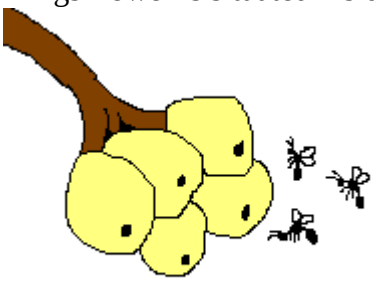
GENERAL BOTANICAL INFORMATION

How do plants protect themselves from being browsed?

Plants protect themselves from browsing in many ways, such as :
- bitter tastes – *Terminalia*
- thorns - *Acacia*
- poisons - Tambotie
- growth shape - *Acacia*
- height - Jackalberry
- leathery leaves - Guarry

© Lee Gutteridge – 2 December 2005

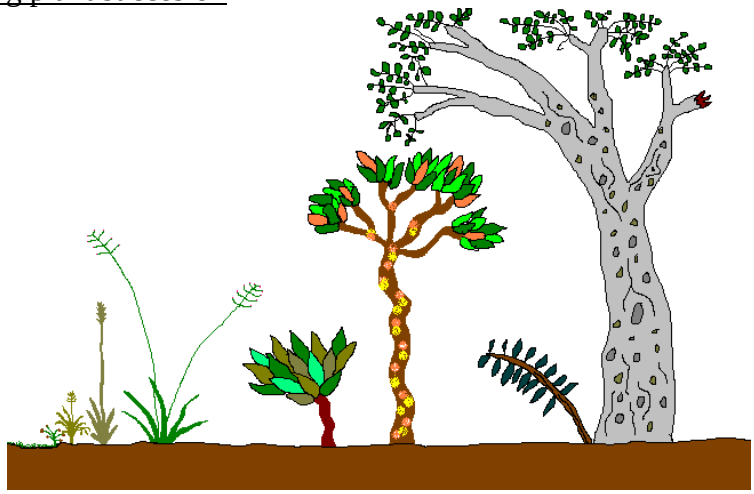
Where are a figs flowers situated?
A figs flower is situated inside the fruit.



Wasps pollenating flowers.

What is ring barking?
Ring barking is when a trees bark is removed all around the trunk, stopping the flow of food and water, causing the death of the tree.

A diagram explaining plant succesion



What are thallo-bionta and embryo-bionta?
Thallo bionta are plants with no roots, leaves, stems or flowers such as lichen. Embryo-bionta are regular plants such as trees and grasses and flowers which have normal plant parts such as leaves and roots.

What is the difference between sweet veld and sourveld?
Effectively sweet veld refers to the fact that there is good grazing during the dry cold winter months, and in sour veld very poor grazing in the winter. High rainfall, high altitude, cold winters are condusive to sourveld developing.

© Lee Gutteridge – 2 December 2005

HABITATS

Some habitats found in South Africa.

MONTANE SOURVELD

This habitat has open grasslands, including previously cultivated areas, with predominantly poor grasses. This lowers the carrying capacities considerably. Plants include *Dichapetalum, Fadogia, Krotaleria, Asclepias* and many others. Many of these plants, or forbs, are poisonous. Large mammals include species such as Buffalo, Elephant, Zebra, Leopard, Blesbok, Eland and Kudu. Trees include species such as Tvl Beech, Sugarbush Protea and Waterberg Bush Willow.

WATERBERG VALLEY COMMUNITY

This includes rocky water courses and stream beds, with sandstone boulders and seasonal pools. These areas are forest-like in vegetation composition and the canopy is often closed. These areas are inhabited by Hyrax, Leopard, Klipspringer, Mountain Reedbuck and Kudu. Plants include *Kalanchoe, Cotyledon, Solanum, Ansellia and Pteridium.* Tree life includes Yellowwoods, Cycads, Protea, Waterberry, Waterpear, White Stink Wood, Flame Creeper Combretum and Showy Ochna.

BUSHVELD, MIXED (SWEET AND SOUR).

This habitat is below the escarpment, at 1200 to 1300 metres, and has a great diversity of trees. Predominant species however include Wild Seringa, Silver and Green Cluster Leaves, Spiny Leaved Monkey Orange, Blue Bush, Marula and Peeling Bark Ochna. Climax community is seldom closed canopy in sour areas, but the sweet grass areas dominated by Sweet Thorn Acacias is often a closed canopy community. Mammals include Lion, Rhinoceros, Impala, Wildebeest, Kudu, Caracal and Giraffe.

Forbs such as *Dichapetalum, Boophae, Verbena, Ipomoia and Lippia* are common.

CLIFF BASE OR SCARP SLOPES.

This specialised habitat is a jumble of loose boulders, and rocks, with many streams and small periodical rivers. Vegetation is spread between rocks and gravel and includes trees such as the Rock Nettle, Lavender Tree, Lavender Fever Berry, Silver and Rough leaf Raisin, Resin Bush and Common Wild Pear. Forbs such as *Senicio, Ctyledon, Pteridium, Kalanchoe and Aloe* can be found.

Mammals such as Bushpig, Porcupine, Hyrax, Lion, Jamesons Red Rock Rabbit, Klipspringer and Leopard utilise this habitat.

RIPARIAN BUSH.

Thicket forming plants such as Blue Bush, Common Wild Currant, Kooboo Berry, Buffalo Thorn, Ankle Thorn and Sweet Thorn occupy this niche along the Waterbergs river beds. *Cyperus, Lippia, Typhus, Kylinga, Phragmites and Monopsis* form part of the grass and shrub level. Mammals include Bushbuck, Caracal, Hippopotamus, Common Reedbuck, African Wild Cat, Marsh Mongoose and Water Buck.

© Lee Gutteridge – 2 December 2005

GENERAL PLANT AND ECOLOGICAL INFORMATION

Why do we do controlled burns in grassland areas?

Controlled burns are neccesary to simulate the natural fires which would have burned through parts of South Africa every year. These fires play an important ecological role in removing moribund and dead vegetation, and also assisting with the propagation of certain species such as protea. We can not however burn an entire reserve at a single go, as we need to have food available for the grazing species that live there, so we would burn small specific sections under controlled and ideal circumstances.

Name some poisonous plants from your area of operation, and say what poison it is and how it will affect a human being.

Datura stramonium – thorn apple. Datura is the Indian name for this plant. Also known as malpitte. A thorny green fruit, which dries to brown and splits open, bears small blackish brown seeds. These seeds when eaten can cause hallucinations in high dosages, and depressant action when in low dosages. The narcotic effect is caused by its ability to block the action of acetylcholine at post-ganglionic nerve endings. More often than not however, the seeds cause serious stomach problems and poisoning resulting in the hospitalisation of the victim and even death. The alkaloids atropine, hyoschyamine and hyoscine (scopolamine) are found in this plant. These chemicals are used to reduce withdrawal symptoms in people recovering from morphine addictions. The antidote for these tropane alkaloids is called neostigmine. This counteracts atropine. Used medicinally to treat asthma and bronchial infections, boils, ulcers, burns, sinusitis and even dandruff to name but a few. These plants are used by Shona N'yanga's (witch doctors) when divining. Roots of thorn apple are chewed, and he spits on the bones before divining. The heart of a vulture and a buzzard are kept near by, or eaten as both of these birds are renown for their eye sight and will help him to see the future. Sometimes powdered roots and leaves are inhaled as snuff too. Portions of legs and head of these birds are placed nearby to intensify the visions.

Dichapetalum cymosum – poison leaf. Highly toxic to livestock. It has a very deep root of up to 20 metres in length. It sprouts early in spring before most of the other plants and is therefore very appetising. The toxic principle present is a heart toxin, which is very soluble in water. The younger the leaves the more dangerous they are. A handful is sufficient to kill an ox. Due to solubility in water the animals often die suddenly after having drunk at a trough or dam. Death occurs from a few hours up to 24 hours after eating.

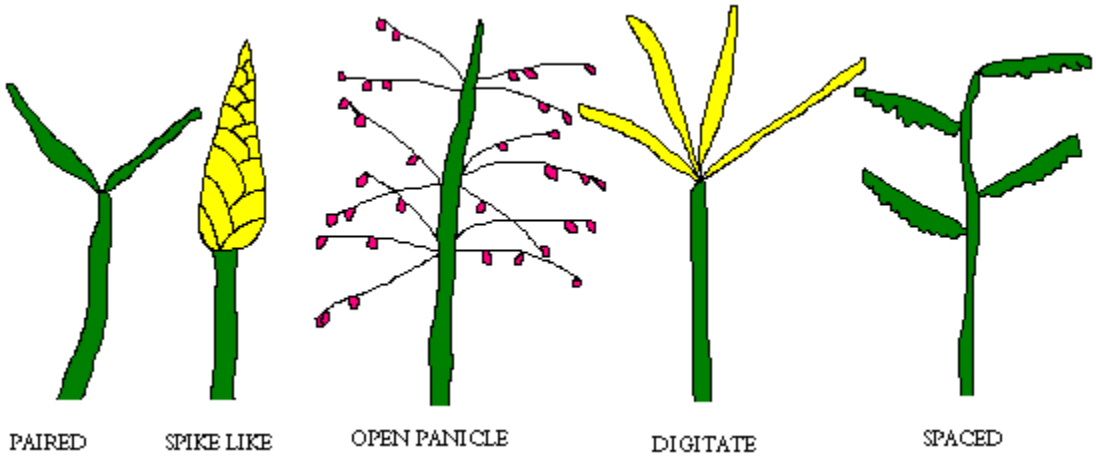
Euphorbia vandermerweii – (between rocks, ground growing). Euphorbus was the physician to king Juba 2 of Mauretania (24 BC). Four sided with sharp thorns along each corner of the plant. Typical milky latex present. Highly poisonous cytotoxic Phorbol Esthers which can cause tissue damage to skin and eyes.

Solanum panduriforme – poison apple. Also called deadly night shade. Solanum actually means woody nightshade. Panduriforme means fiddle shaped. Purple flower with prominent yellow centre. Fruit which is green and white, untill yellow and ripe contains solanacious gluco-alkaloids (solasonine is believed to be one of them) which cause ocular paralasis,gastro-enteritis, coma and death. These toxins, also known as solanine, occur in potatoes too. Used to cure toothache, haemorrhoids, rheumatism and ringworm in livestock.

© Lee Gutteridge – 2 December 2005

GRASS INFLORESCENCES

Name and draw some common grass inflorescence types.



ALIEN PLANTS

Some alien species found across South Africa

Argemone ochreoleuca – white mexican poppy. Often found in sandy soil and dry stream beds. An Anglo-boer war import brought in with horse fodder from south America.Usually found in watercourses in loose sand.

Asclepias fruticosa – milkweed. Named after Asklepias, the Greek god of medicine. Toxic, containing chrystalline glucocides (C27-H44-O7), or cardenolydes (cardiac glycocides such as 15B-hydroxygomphoside [afroside] and 19-deoxyuscharin), which can cause heart failure. 40 grams of leaf and stem are fatal to a rabbit. Larval food of the Danaus butterflies. These butterflies retain the toxins and are therefore toxic to eat. Milkweed locusts also use this plant. It was introduced from Australia. Fruticosa means shrubby. Used medicinally to treat coughs, diarrhoea, sexual diseases, stomach problems and warts. Milkweed has hairy pods which contain a cotton like substance when opened.
Milkweed locusts feed on a milkweed.

Bidens pilosa – black jack. Bidens means two teeth. Pilosa means with long weak hairs. Common in south africa and well known for the seeds sticking to clothing. From south America. Used medicinally for colic, diarrhoea, constipation, dysintary, ear-ache, snake bite and many other uses. Leaves are eaten and there has been a link established between this and occurrence of osophageal cancer.

Lopholiana corrifolia – fluff bush. An import from New Zealand, brught in by sheep farmers as fodder.

Opuntia ficus-indica – prickly pear. A south American import with an edible fruit.

Tagetes minuta – khaki bos. Imported during the Boer war. It gets a yellow flower and often grows in association with black jacks.

© Lee Gutteridge – 2 December 2005

KINGDOMS

Plants fall into the kingdom Plantae. Lichen are algae which are symbiants with fungus which falls into the kingdom Fungi, so lichen is effectively not wholly within either kingdom. Other Kingdoms are Monera, Protista and Animalia.

GRASS ECOLOGICAL STATUS'

Ecological status' of grasses.

Decreasers

Decreaser grasses are grasses which will be common in areas of good veld, but will decrease in areas which are over or under grazed (remember some grasses need to be stimulated by grazing to thrive). These are often very good grasses palatability wise like guinea grass and red grass.

Increaser 1

These grasses increase in undergrazed veld, species like yellow thatching grass are examples of this. This grass can only be utilized properly when young so undergrazed areas will become dense with underutilized adult plants.

Increaser 2

These grasses increase when an area is overgrazed. These are mainly pioneer species such as herringbone and natal red top.

(Not all grasses fit into the above categories. Some species are affected by more than grazing pressure. There are also increaser 1a and b, increaser 2 a, b and c and invaders).

SCIENTIFIC NAMES OF SOME COMMON GRASS SPECIES

(ECOLOGICAL STATUS D = decreaser, I1 = increaser 1, I2 = increaser 2, I2c = increaser 2 c)

1. **Brachiaria nigropedata D**
2. **Panicum maximum D**
3. **Panicum schinzii D**
4. **Setaria sphacelata var sphacelata D**
5. **Setaria sphacelata var sericia D**
1. **Themeda triandra D**
7. **Phragmites australis D**
8. **Brachiaria brizantha I 1**
9. **Cymbopogon excavatus I 1**
10. **Hyparrhenia hirta I 1**
11. **Hyperthelia dissoluta I 1**
12. **Loudetia simplex I 1**
13. **Melenis nerviglumis I 1**
14. **Schizachrium jeffreysii I 1**
15. **Trachypogon spicatus I 1**
16. **Tristachya leucothrix I 1**
17. **Urelytrum agropyroides I 1**

© Lee Gutteridge – 2 December 2005

18. Cyndon nlemfuensis I 1

19. Aristada meridionalis I 2

20. Cynadon dactylon I 2

21. Eragrostis chloromelas I 2

22. Eragrostis curvula I 2

23. Eragrostis lehmanniana I 2

24. Eragrostis rigidor I 2

25. Eragrostis superba I 2

26. Heteropogon contortus I 2

27. Andropogon eucomus I 2c

28. Andropogon huillensis I 2c

29. Aristada adscensionis I 2c

30. Aristada canescens I 2c

31. Aristada congesta var congesta I 2c

32. Aristada congesta var barbicollis I 2c

33. Aristada diffusa I 2c

34. Aristada junciformis I 2c

35. Aristada stipitata var stipitata I 2c

36. Aristada stipitata var graciliflora I 2c

37. Eragrostis gummiflua I 2c

38. Melenis repens I 2c

39. Perotis patens I 2c

40. Pogonarthria squarrosa I 2c

41. Sporobolus africanus I 2c

© Lee Gutteridge – 2 December 2005

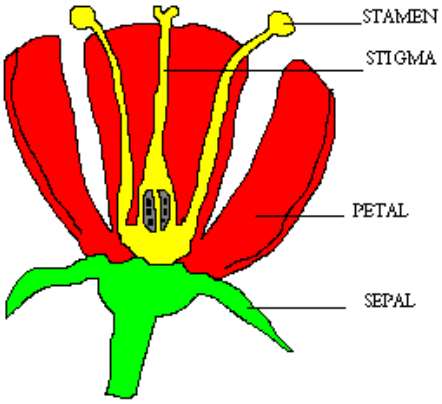
COMMON NAMES OF SOME COMMON GRASS SPECIES

These numbers correspond with the Latin names on the previous pages.

1. **Black footed signal grass**
2. **Guinea grass**
3. **Sweet guinea grass**
4. **Common bristle grass**
5. **Golden bristle grass**
6. **Red grass**
7. **Common reed**
8. **Common signal grass**
9. **Broad leafed turpentine grass**
10. **Common thatching grass**
11. **Yellow thatching grass**
12. **Common russet grass**
13. **Bristle leafed red top**
14. **Silky autumn grass**
15. **Giant spear grass**
16. **Hairy trident grass**
17. **Quinine grass**
18. **Star grass**
19. **Giant three awn**
20. **Couch grass**
21. **Curly leaf**
22. **Weeping love grass**
23. **Lehmanns love grass**
24. **Broad leafed curly leaf**
25. **Saw toothed love grass**
26. **Spear grass**
27. **Snowflake grass**
28. **Large silver andropogon**
29. **Annual three awn**
30. **Pale three awn**
31. **Tassel three awn**
32. **Spreading three awn**
33. **Iron grass**
34. **Ngongoni three awn**
35. **Long awned three awn**
36. **Long awn three awn**
37. **Gum grass**
38. **Natal red top**
39. **Cats tail**
40. **Herringbone grass**
41. **Rats tail dropseed**

© Lee Gutteridge – 2 December 2005

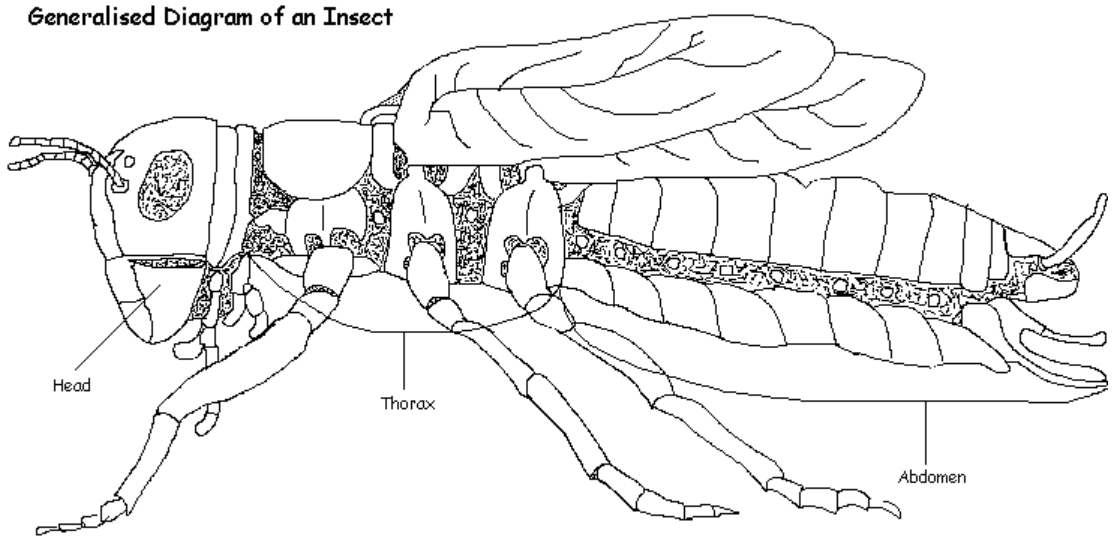
PARTS OF A FLOWER



© Lee Gutteridge – 2 December 2005

INSECTS AND ARACHNIDS AND THEIR RELATIVES

INSECT BODY PARTS AND LIFE CYCLES



1. Thorax: The thorax is concerned with locomotion and always consists of 3 segments, known as the prothorax, mesothorax and metathorax; each carries a pair of legs and the last two may also have wings. The mesothorax and the metathorax are collectively known as the pterothorax. Each segment consists of a notum (dorsal plates) dorsally, two pleura on the sides and a sternum ventrally.

2. Abdomen: The abdomen is equipped with the reproductive apparatus. The abdomen consists of 11 segments, but usually only 10 are visible; in come insects there appear to be fewer because of a fusion of the segments. Each segment consists of an upper "tergum" and lower " sternum" plate; there may be a lateral plate on either side (the "pleura") the genitalia are usually to be found at the tip of the abdomen, and the females of some insects have a specialised ovipositor (egg laying organ) formed by structures on the 8th and 9th segment. The sexes are separate, and reproductive systems comprising ovaries and associated structures are found in females, and testes and associated structures are found in males.

3. Book Lung: has to do with respiration in spiders. The booklung occurs in spiders and consists of 10 – 80 hollow leaves hanging in blood sinus. They are separated by hard columns and are open to the outside through slits.

4. Antenna: The sensory apparatus of insects is complex. The antennae are the organs of smell. Antennae, the most obvious of the sense organs are present in most insects, except the primitive soil living Protura. Insects have 2 antennae situate on the head near the compound eyes. They are concerned with the sense of smell and allow the insect to pick up scent. Antennae come in many shapes and sizes consisting of a variable number of segments and a system of muscles, so that movement is possible. Antennae structure is often linked to sex; it is usually the males which have the most developed and richly ornamented antennae. Sometimes the antennae are not just concerned with the senses. In some Springtails of the sub-order Symphypleona the male antennae

© Lee Gutteridge – 2 December 2005

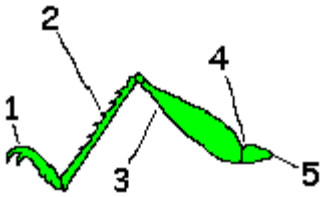
have a kind of pincer which the insect anchors itself to the antennae of the female which then carries it.

5. Tibia: this is the 4th segment of the leg and is the larger of the 2 bigger bones. It is usually long and slender but is very robust. It lies between the Femur and the tarsus. (See diagram below)

6. Femur: this is the 3rd segment and is the sturdiest segment of the leg. It has a strong muscular system and would be the thigh bone in humans. (See diagram below).

7. Coxa: This is the 1st segment of the leg. It articulates with the body. (See diagram below)

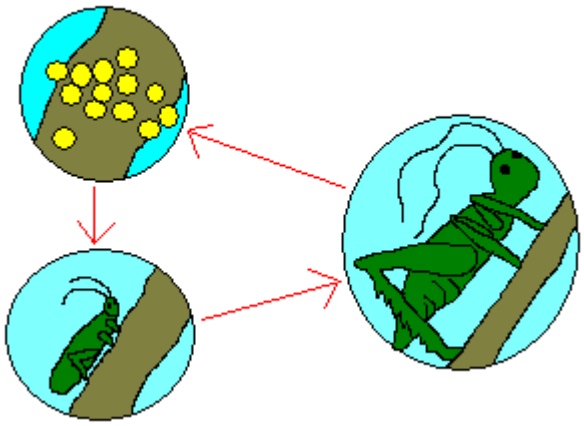
8. Tarsus: this is the 5th segment of the leg – it is the ankle / foot region and is made up of a variable number of joints. It often ends in a pair of hooked appendages this is the foot. (See diagram below).



1. Tarsus
2. Tibia
3. Femur
4. Trochanter
5. Coxa

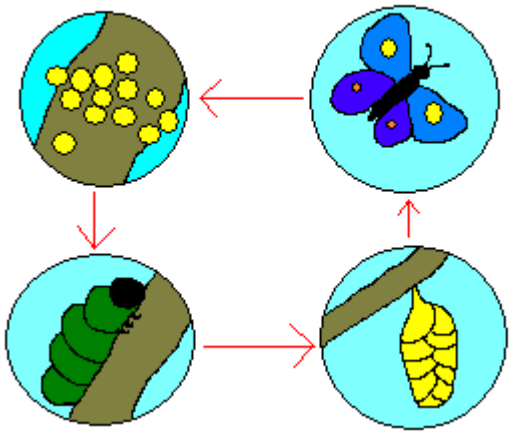
© Lee Gutteridge – 2 December 2005

9) Hemimetabolic: Undergoes incomplete metamorphosis. Egg – Nymph – Adult
The immature resemble and gradually develop into the adult body form. Wing pads are present in older nymphs. In this method of reproduction after the eggs have hatched into nymphs, the nymphs moult their exoskeleton as they grow. Each moult is called an "instar" the major changes are the development of wings or the change from an aquatic lifestyle to a terrestrial lifestyle eg: dragonflies, aphids and mayflies.



Hemimetabola.

10) Holometabolic: Undergoes complete metamorphosis. Egg – Larva – Pupae – Adult
Eggs hatch into larvae. The larval stage can last for up to 17 years eg. Cicada – the larvae then change into a pupa which is usually a dormant stage. Most pupae are protected by a cocoon of some sort. During the pupae stage the body changes structure completely and comes out as an adult. This usually occurs in the springtime.



Holometabola.

© Lee Gutteridge – 2 December 2005

SPIDER AND INSECT COMPARISONS

Spiders	Insects
1) Un-segmented abdomen	1) Segmented abdomen
2) 2 major body parts:	2) 3 Major body parts:
a) Cephalothorax – head and thorax	a) Head
Combined	b) Thorax
b) Abdomen	c) Abdomen
3) Eight legs	3) Six legs
4) Pinchers / chelicerae are modified	4) Unmodified antennae
Antennae – hence no antennae	
5) Organs for smell and touch are situated	5) Organs of sense are situated on the
on the legs.	Antennae
6) External digestion	6) Internal digestion
7) Wings – always absent	7) Wings – most often present
8) Poison – present in all but 1 family	8) Absent in most
9) Food – always live prey	9) Food – Live prey but many are herbivorous
10) Breathing – Booklungs (2 sometimes 4) & often tracheae	10) Tracheae
11) Silk – always present & used for many purposes	11) Silk – sometimes present in stages of metamorphosis & used for cocoon
12) Development – spiderlings resemble adults from birth & grow by ecdysis	12)Development - young generally do not resemble adults, metamorphosing from larva to pupa to adult
13) Normally 8 eyes, but sometimes 6or even 2, & always simple	13) Normally 4, with a combination of compound & simple eyes

INSECT RELATIVES

1) Araneae – Spiders: body divided into a fused head and thorax (cephalothorax) and a generally unsegmented abdomen, the two separated by a narrow constriction. There are no antennae, usually 8 eyes, a pair of chelicerae (fangs), a pair of pedipalps and 4 pairs of legs. The abdomen ends in a group of silk producing spinnerets, but has no other appendages.

Spider

© Lee Gutteridge – 2 December 2005

2) Scorpiones – Scorpions: easily identified by the greatly enlarged, pincer like pedipalps and elongate jointed abdomen which ends in a swollen sting. Antennae are absent and the mouthparts are formed by small pincer-like chelicerae (fangs). There is a central pair of dorsal eyes and 2 – 5 smaller lateral pairs of eyes. There are 4 pairs of walking legs.

Scorpion

3) Acari – Ticks and Mites: a highly diverse group once placed in single order Acari, but now divided among 7 others. The group is best recognised by the apparent lack of body divisions. Antennae are absent, there are 4 pairs of walking legs and the fangs and pedipalps are usually inconspicuous.

Tick

4) Amblypygi – Whipscorpions: a specialised group of strange, flattened spider like creatures with no antennae, long slender legs and enormously enlarged spiny pedipalps which they hold flexed in front of the body. The first of the 4 pairs of walking legs are modified into elongate whip-like feelers.

Whipscorpion

5) Solipugida – Solifuge / Sun Spiders: easily recognised by enormous fangs, projecting from the front of the body as a pair of vertically articulating pincers. Antennae are absent and there are 4 pairs of walking legs. The elongate sensory pedipalps resemble a 5th pair of legs, but are not used for walking.

Sunspider

© Lee Gutteridge – 2 December 2005

6) Myriapoda – Centipedes and Millipedes: recognised by an elongated body form, no thorax and abdomen and the presence of walking legs on each body segment (except the 1st and the last 1 or 2) centipedes are usually flattened and have 1 pair of legs per segment, those of the 1st segment being modified into poison fangs. Millipedes are cylindrical and made up of "diplosegments" each representing 2 fused body segments and hence bearing 2 pairs of legs.

Millipede

7) Isopoda – Woodlice: they have seven pairs of walking legs. They generally live in damp environments. They eat dead plant and animal material. The eggs are brooded in a marsupium or pouch under the body of the female, where they hatch into smaller versions of the adults.

Woodlice

© Lee Gutteridge – 2 December 2005

ANTENNA TYPES

10 Different Antennae types:

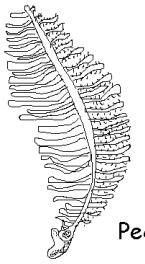
Filiform

Serrate

Moniliform

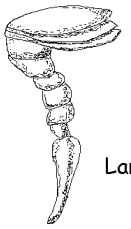
Setaceous

Stylate



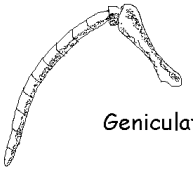
Pectinate

Aristate



Lamellate

Clavate



Geniculate

© Lee Gutteridge – 2 December 2005

GENERAL ORDER INFORMATION

This is some information on common orders, and some families, genus' and species within these groups.

Beetles

ORDER *COLEOPTERA*

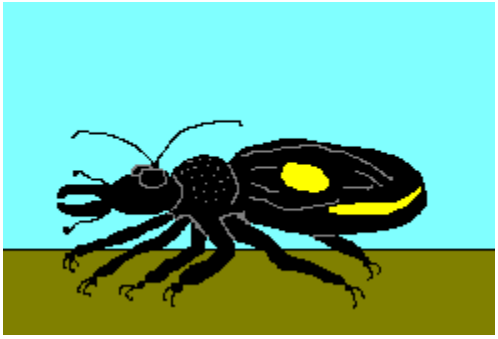
Most beetles have hard sclerotized bodies, with longer hind wings which fold behind the modified fore wings, which are usually hard and are known as elytra. The elytra fit together snugly, and in flightless species they may be fused. All beetles have chewing mouth parts. Some are predators, some feed on plants and some are parasites. Larvae vary too, but all have biting mouth parts and have a well sclerotized head for protection.

Beetles have 3 pairs of thoracic legs. *Coleoptera* is the largest order in the animal kingdom with 370 000 species identified. In the region there are 18 000 identified species.

Family *Carabidae*

Ground beetles are mostly ground dwelling flightless predators. However there are some arboreal species which can fly, and live in birds nests. Most are nocturnal. The antennae have a keen sense of touch and smell. They are opportunistic and can detect stationary prey such as insect eggs. Some however have become omnivorous and even herbivorous. Some species are well camouflaged and others are brightly coloured in warning. This is called APOSEMATIC colouration. There are in several species special PYGIDIAL GLANDS in the 9th segment of the abdomen (usually however only 6 to 8 segments are visible). In these glands organic ACIDS or QUINONES are formed, and can be squirted out in a strong jet for up to 30 cm. Anthia species spray FORMIC ACID. This can cause blindness in small mammals and birds. Bombardier species catalize HYDRO-QUINONES which cause burns and stains on vertebrate skin. These jets can be directed towards a predator. These beetles can live for up to 4 years, and some are territorial.

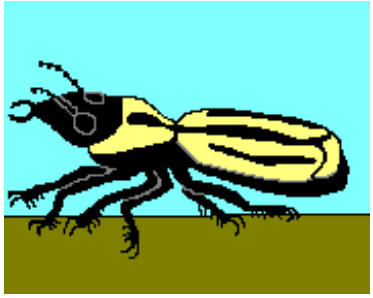
Larvae are active free-living predators.



Ground beetle

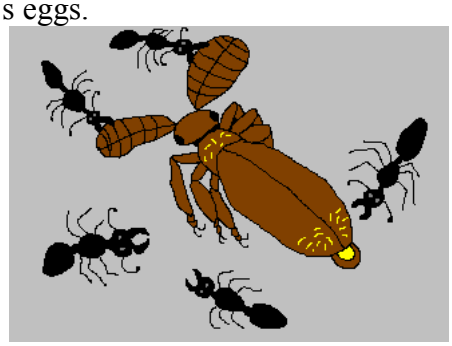
© Lee Gutteridge – 2 December 2005

Family *Cicindelidae*
Tiger beetles are often brightly coloured and are active predators. The large mandibles of some species are used to hold the female in place while mating. They can be quite large. They utilize bare sandy habitats. When they are disturbed they take flight but usually settle again rapidly. These are very fast agile beetles, but the larvae wait in burrows for prey. They have a special hook on the 5th segment to hold themselves in the burrow and have long bristles and well developed eyes to warn them of approaching prey. The hard head and proto-thorax block the entrance of the burrow.



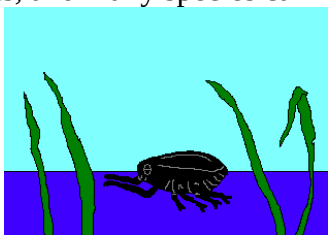
Tiger beetle

Family *Paussidae*
Ant's guest beetles are specialized guests in ant nests. They are referred to as MYRMECOPHILOUS, which means ant loving.
They are fed by ants through TROPHALLAXIS (mouth to mouth feeding), and also exude a volatile substance which the ant lap up greedily, this helps to appease the aggressive ants. These beetles have special antennae designed to be used by the ants to drag the beetle around. The larvae are soft bodied predators of ant's eggs.



Ant's guest beetle with ants

Family *Gyrinidae*
Whirligig beetles are AQUATIC BEETLES with elongated front legs for catching prey. Front legs of males are more flattened than females. The two hind pairs of legs are short and adapted for paddling. They also have specialized compound eyes, divided into one pair for air vision and one pair for water vision. Larvae have respiratory filaments which make the larvae independent of surface for breathing purposes. They crawl along submerged vegetation and prey upon invertebrates. When alarmed adults submerge, using an air supply trapped under the elytra for breathing. Most adults feed on insects, and many species can fly.



Whirligig beetle

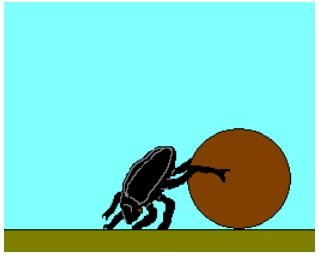
© Lee Gutteridge – 2 December 2005

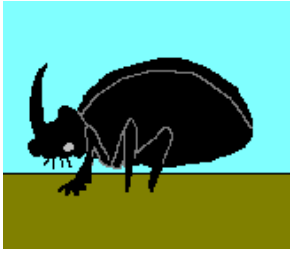
Family *Scarabaeidae*

Dung beetles and fruit chafers are the most frequently encountered groups of this family. These beetles feed on dung, carrion, fungi and fresh and decaying fruit matter. These beetles are active diurnally, nocturnally and crepuscularly. They also have a wide range of habitats from true desert to tropics. Dung feeders (COPROPHAGES) use dung in several different ways. Larvas also use dung, having an immature life cycle of 30 days to 2 years. The classification of these beetles is based on the method of utilization, such as ENDOCOPRIDS, which utilize the dung where it lays, and do not excavate, but lay the egg inside a ball of dung inside the dung heap. No external sign of activity is usually visible. PARACOPRIDS dig tunnels to connect the nesting chamber to the dung supply.

TELECOPRIDS are the third type of dung beetle. These make a nest (nest making is referred to as NIDIFICATION) away from the dung supply, and knead a round ball of dung which they will roll using the hind and middle pair of legs. These balls of dung are deposited in the nest and here mating takes place between adults. This dung detached from the pad can be used by either the adult or the larva, and some species will stay with the eggs until they hatch and emerge with the new generation of adults.

Fruit chafers feed on flowers, nectar and plant sap diurnally. At night they sometimes sleep communally in trees. They do not lift their elytra like dung beetles, but have a hollow on the sides of the elytra where the wings can fold out. Some species attack bee hives for honey and others attack wasp nests.

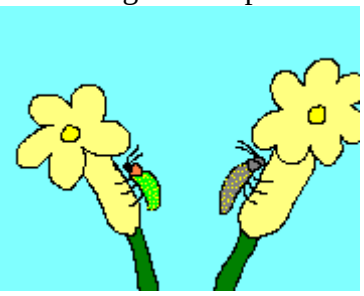




Scarab beetles

Family *Buprestidae*

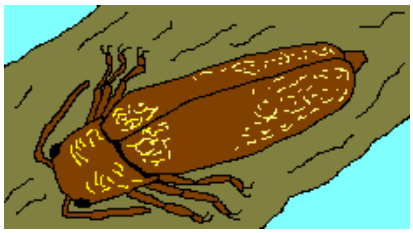
Jewel beetles are usually brightly coloured, often metallic. They are very alert, and are diurnal. Adults eat nectar, pollen and foliage. Eggs are laid in bark, and immature beetles can live for 35 years during their larval stage. This is the longest life span of any insect.



Jewel bugs

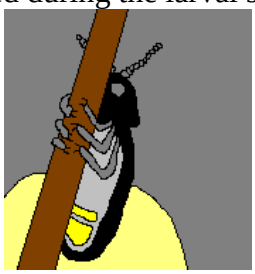
© Lee Gutteridge – 2 December 2005

Family *Elateridae*
Click beetles have a distinctive characteristic, in that the hind corners of the PRONOTUM are elongate forming distinct processes. There is also in some species a click apparatus, which is a projection of the PROSTERNUM which fits into a corresponding groove in the MESOSTERNUM. This enables the animal to click into the air when on its back.



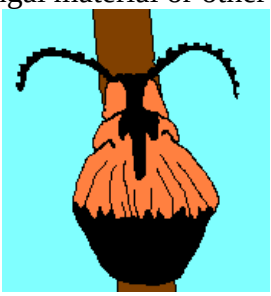
Giant click beetle

Family *Lampyridae*
Glow worms and fire flies are also strangely enough beetle types. These adults have light producing organs. In females this is usually on the penultimate segment, and in males the last two segments. Male and female fireflies fly with the male being more active. Only male glow worms fly. Larvae feed on slugs which are digested externally. Adults do not feed. These beetles flash light from light organs under a transparent cuticle. This light is produced by a luminous substance called LUCIFERIN which is OXYDIZED in the presence of water and an ENZYME called LUCIFERASE. These fluids are diffused during the larval stages in the PLASMA.



Glow worm beetle

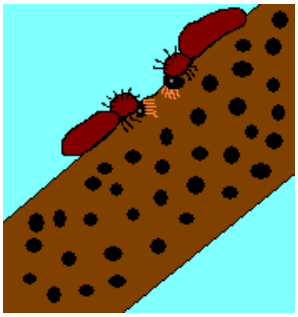
Family Lycidae
Net winged beetles are usually a distinctive orange colour with a black DISTAL SECTION of the elytra. The elytra are usually soft. This bright aposematic colouration is an indicator of danger. These beetles do in fact contain CANTHARADIN, a blistering agent. The adults are diurnal, and are often mimicked. Larvae feed on fungal material or other larvae.



Net winged beetle

© Lee Gutteridge – 2 December 2005

Family *Bostrichidae*
Auger or shot hole borers bore into living wood. Larvae feed in dry wood, vegetable or animal materials. The head is HYPOGNATHUS. The PRONUTUM has spines or horns in males. These beetles are often attracted to light.



Shot hole borers

Family *Coccinellidae*
Lady birds are amongst the most well known of beetles. Most species can fly. Adults and larva are carnivorous eating small insects and mites, but some species eat leaves. In winter many species will aggregate on the HIGHEST POINT ON THEIR HORIZON and when the spring comes they will mate and disperse. When disturbed adults will drop to ground and discharge drops of yellow blood. This blood is toxic to vertebrates, and is an effective defensive behaviour. There are 30 species in South Africa.

Lady birds

Family *Tenebrionidae*
Darkling beetles or toktokkies are also a group well known in South Africa. These beetles are known for their tapping behaviour, and many species have a down-curved pointed abdomen to facilitate this. This tapping is to attract the opposite sex. Most are flightless and TERRESTRIAL.

Striped toktokkie

© Lee Gutteridge – 2 December 2005

Family *Meloidae*
Blister beetles are aptly named as they produce CANTHARADIN. These toxins are secreted from the leg joints. CMR beetles derive their name from the Cape Mounted Rifles, whose uniform is the same colours (see picture below). Some larvae are ground dwelling, feeding on grasshoppers, and these go through several different INSTARS. Others lay eggs on flowers, where the larva attach themselves to the leg and body hairs of bees. These then travel to the hives where they feed on bee eggs, honey and pollen. Certain species swarm around acacia trees, which initiates breeding. Dead MELOIDEA attract males of the ANTHICID genus. There is thus some type of chemical recognition between these two groups.

CMR beetle

Family *Cerambycidae*
Longhorn beetles have characteristically long antennae, sometimes longer than the beetle.
The eyes are kidney shaped. Males often have longer antennae and larger mandibles. The head can be PROGNATHUS or HYPOGNATHUS. The head is recessed into the prothorax, and in some species it can be moved up and down vigorously to cause a squeaking sound which it does when alarmed. Larvae feed on wood, and some carry bacteria which secrete CELLULASE, which will help to break down CELLULOSE.
Some of the adults do not feed, but others eat bark, twigs, stems, fruit and sap. The adult life span is at least 7 months if the individual pupates at the end of summer. If however the individual pupates in the spring it may not live longer than 6 weeks. Males emerge first, and usually die before the females too. Some species have shortened ELYTRA, and mimic HYMENOPTERA species.

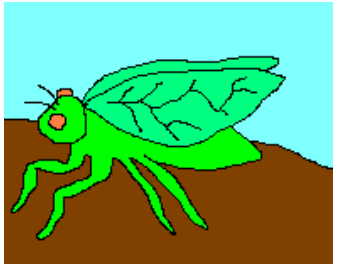
Long horn beetle

© Lee Gutteridge – 2 December 2005

Family *Circulionidae*
The Weevil and snout beetle family is the largest family of animals in the world with about 50 000 known species. Most have extended mouth parts called a ROSTRUM for feeding on deep plant tissue or for digging holes in wood for OVIPOSITION. Some weevils run to escape danger, others hide on the opposite side of a leaf or twig, some STRIDULATE to startle a predator and yet others perform THANATOSIS. Camouflage is the main form of defence for most species. Most are diurnal, with some nocturnal species which hide under rocks and bark by day. Some circulionids eat plant material and others may feed on fungus. There are also MYRMECOPHILUS species, but no dung feeding types in Southern Africa.


Snouted weevil

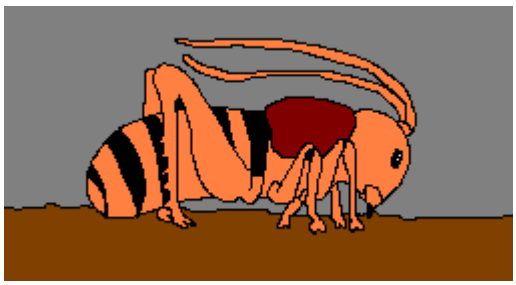
ORDER *HEMIPTERA*
Bugs and cicadas
All bugs have piercing and sucking mouth-parts. These long mouth-parts lay back along the body between the legs. They also have two pairs of wings. In some species both sexes are wingless, or APTEROUS, and in others it may only be the female. Bugs do not have a pupal stage. These insects have a HEMIMETABOLUS life cycle. Some bugs can secrete foul smelling liquids from REPUGNATORIAL GLANDS.



A Millipede assassin and a Green wing Cicada.

© Lee Gutteridge – 2 December 2005

ORDER *ORTHOPTERA*
Grass hoppers, crickets and locusts
This is the sixth largest order of insects with nearly 20 000 species worldwide. The well known group is known to most people as they are extremely conspicuous, with large hind legs. The first pair of wings is leathery or hardened and covers the fanlike hind wings. These protective wings are called the tegmina. There are two major divisions in Orthoptera. The first is the short horned grass hoppers and locusts with sound producing organs on the hind legs. Then there are the long horned katydids with 'ears' on the fore legs and sound producing organs on the wings. The short horned Orthopterans lay their eggs in a pod in the ground, whereas the long horned lay theirs singly on vegetation.

Family *Anostostomatidae*
These include parktown prawns and king crickets. They stridulate by rubbing the hind legs against the abdomen. The eggs take up to 18 months to hatch, nymphs take up to three years to mature and the adult lives for a year. The males sometimes have harems of females.



A Parktown Prawn

Family *Tettigonidae*
Katydids, bush crickets and longhorn grass hoppers. The males STRIDULATE by rubbing a toothed file on one forewing against an oval disk on the other.

Family *Gryllotalpidae*
This includes the mole cricket, which STRIDULATES by means of a file on each of the tegmina which it rubs together.

Family *Pyrgomorphidae*
Foam grasshoppers such as the common and green milkweed locusts are in this family. The nymphs are black and yellow and take two years to mature. When molested the wings are raised in threat and a foul smelling foam exudes from the thoracic joints.

Family *Acrididae*
This family includes the short horned grasshoppers and locusts. Most of our common species fall into this group.

© Lee Gutteridge – 2 December 2005

ORDER *LEPIDOPTERA*
Moths and butterflies
This is a very large order, with more than 150 000 species worldwide. About 12 000 occur in South Africa. The name lepidoptera literally means scaly wing, and refers to the small scales on these animals wings. Some of these scales give colour through either PIGMENTATION, or REFRACTION. Some females are wingless. Others are like hairs in shape, and produce attractive scents on the males to assist with being found by a potential mate. These are called ANDROCONIA. A characteristic of the order is the curled PROBOSCIS, or sucking tube. In some species the adult does not feed and the mouthparts may be rudimentary or totally absent. The difference between butterflies and moths is not very distinct. All butterflies have clubbed antennae, whereas moths may have filliform, dentate, lamellate and an array of different shaped antennae. Some moths also have clubbed antennae. Moths and butterflies both have species which fly by day, and by night and there are species of each which land open winged as well as species of each which land closed winged. Some moths have beautiful colouration like butterflies, eg. False tiger moths. These insects have a holometabolic life cycle. Danaus or milkweed butterflies, as they are commonly known, are poisonous. The larvae ingest toxins known as cardiac glycosides (CARDENOLIDE) which remain in the body through larval, pupal and adult stages. These toxins, which come from *Asclepidaceae* plants, cause nausea, followed by a heart attack. A second group of butterflies called Acreas are also poisonous, but these butterflies synthesize their own HYDROCYANIC TOXINS. Some species are highly territorial, and will actively defend their area from invaders. Hill topping and mud puddling are also common activities. Most feed on plant nectar, but some feed on liquid from animal dung, and yet others do not feed at all in their adult phase. The ORGANS OF JOHNSON, based in the PEDICEL, are the organs of smell.

A Dancing Acrea, an African Monarch and a Broad Bordered Grass Yellow

ORDER *DIPTERA*
Flies comprise a large order including important species such as mosquitoes and tsetse flies. There are about 16 000 species known from Africa. Some feed on live mammals, some on crops, and others on blood or even pollen. Adult flies are important pollinators.

Family *Culicidae*
Mosquitoes are well known members of the fly order, as they carry the Malaria parasite. Only females eat blood, males eat nectar and plant sap. Males have bushy antennae to detect the sound of females in flight. There are more than 100 species in the region.

A mosquito

© Lee Gutteridge – 2 December 2005

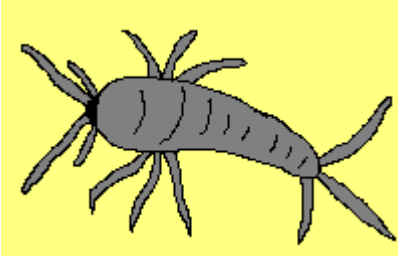
Family *Cecidomyiidae*
Gall midges cause the swellings of tree twigs and branchlets such as the silver cluster leaves galls. See below.

Gall caused by a gall midge

Family *Tabanidae*
Horse, Hippo and Deer flies. Females of this group transmit Ngana in cattle and Loa loa parasites in the eyes of humans.

Hippo fly

ORDER *THYSANURA*
Silver fish are primitive wingless insects. They are usually metallic in colour. They are mainly nocturnal. They use their sensory appendages to find and feel their way around. They have a simple Ametabolic life cycle, and the young resemble small adults. The young do not drink water, but absorb it from the atmosphere around them.

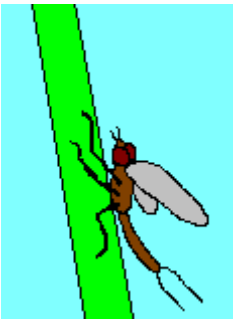


A Silverfish.

© Lee Gutteridge – 2 December 2005

ORDER *EPHEMEROPTERA*

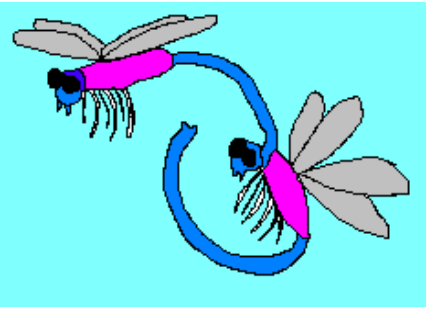
Mayflies usually live near water. Nymphs are aquatic. Adults only live for a few hours, and are not able to feed. Adults moult a second time after emerging with their wings from the nymphal state. The first winged form is called a dunn, and the second is called a spinner.



A Mayfly

ORDER *ODONATA*

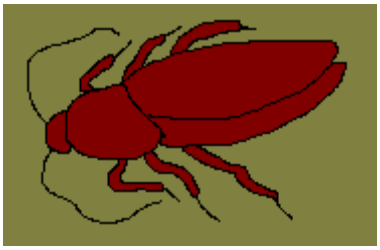
Dragonflies and Damselflies have bristle covered legs which are used as a basket to catch insects in flight. Nymphs of both live in water, but Dragonflies use internal rectal gills to breathe, whereas Damselflies use tracheal gills on the end of the abdomen. Nymphs have labial masks which shoot out to grab prey. Mating is quite unique, and adults can be seen flying around in tandem, with the male clasping the females head with the tip of his abdomen. Eggs are scattered on water, or tail tapping occurs, where the tail tip touches water and the egg is pulled from the ovipositor by the water meniscus.



Dragonflies in a tandem wheel formation.

ORDER *BLATTODEA*

Cockroaches are nocturnal and feed mainly on vegetable matter. They have 2 cerci on the abdomen. Some species are capable of flight. They are hemimetabolic. The eggs are deposited in an ootheca, or egg case.



A Cockroach

© Lee Gutteridge – 2 December 2005

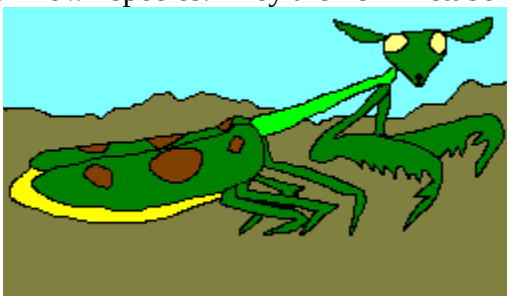
ORDER *ISOPTERA*

Termites are on of the best known groups of insects due to the type of large nesting structures they build. Termite mounds are commonly seen throughout Africa in different shapes, sizes and forms. Winged Alates of termites are eaten by birds, animals and humans. They live in a complex 4 caste system with sterile workers, soldiers and minor soldiers, primary reproductives (kings and queens) and secondary reproductives. Workers have unmodified heads, and are usually blind. Soldiers have large modified sclerotized heads. Primary reproductives are large and have vestiges of wings. They are darkly pigmented. Secondary reproductives have wing buds and are less darkly pigmented.

A termite queen, some winged alates, a soldier and some workers.

ORDER *MANTODEA*

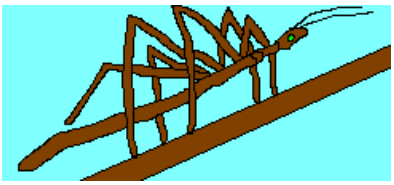
The Mantis is a large predatory insect, with a pair of large front legs, often armed with spines and held in a characteristic praying position. They catch and eat insects. The eggs are laid in an ootheca. There are about 1800 known species. They are hemimetabolic.



A Praying Mantis

ORDER *PHASMATODEA*

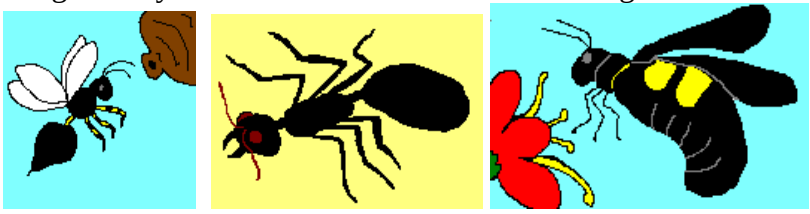
These well known slow moving insects are well camouflaged, and look like twigs or sticks. Hence the common name of stick insects. They cannot jump, but walk slowly or fly. Males have usually got stronger wings than females. All are nocturnal herbivores. Parthenogenesis occurs, and in some species only females have ever been found. They are hemimetabolic and the nymphs look like adults. Eggs look like seeds.



A Stick Insect

© Lee Gutteridge – 2 December 2005

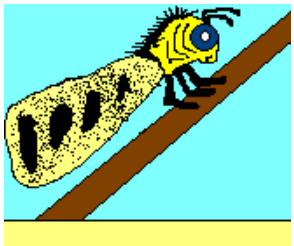
ORDER *HYMENOPTERA*
Bees, Wasps and Ants are the members of this group. All have biting mouthparts, with some modified for chewing or sucking. The ovipositors are modified in some for sawing, boring, stinging and piercing. Some are carnivores and others eat pollen or nectar. The wings of flying species are coupled together by hooks on the front of the back wing.



A Mud-dauber potter wasp, an Ant and a Carpenter Bee.

ORDER *NEUROPTERA*
Ant lions and lacewings
These insects are slow flying dragon fly like creatures. When at rest the wings are held in a roof like position over the body. Wings usually are conspicuously veined. Adults are predacious and have chewing mouthparts. Larvae are also predacious and range from dry habitats to arboreal habitats to aquatic habitats. Mandibles in larva are adapted for piercing and sucking. Digestive enzymes are injected into prey animals.

Myrmeleontidae or ant lions are an insect which is very common in our environment. Eggs are laid singly in loose sand. Some species simply ambush prey from below the surface and in other species the larva are responsible for the building of funnel shaped ant traps in loose sand. Larval life span is up to three years. Pupation takes place in a silken cocoon below the sand. The adult has long thin wings, a thin body, and often clubbed antennae. These insects sometimes swarm in shaded areas. They are poor fliers.



An Ant lion

GENERAL INSECT AND ARACHNID INFORMATION

1) What does *Lepidoptera* mean?
Lepidoptera means “Scaly winged”

2) A common aquatic beetle found throughout South Africa.
The Whirligig Beetle. This belongs to the family *Gyrinidae*.

3) A beetle with an unusual kidney shaped eye.
Long horn beetles have a kidney shaped eye. They belong to the family *Cerambycidae*.

© Lee Gutteridge – 2 December 2005

4) <u>The 2 butterfly groups that are poisonous in South Africa are:</u>
a) The *Danaines* - they are a small sub-family with only 19 African species, eg the African Monarch. They are highly unpalatable because of the toxins contained in their tough bodies. The toxicity of *Danaines* is due mainly to cardenolides present in the toxic milkweeds (*Asclepiadaceae*) on which the larvae feed. The larva concentrates these toxins and they are passed on to the pupae and the adult. Cardenolides are heart poisons which if ingested by a bird for example will cause vomiting at low doses and acute heart failure at high doses. Male *Danaines* are also known to suck fluids from certain plants containing toxins known as pyrollizidine alkaloids. Although these alkaloids may further increase the toxicity of the butterfly it is known that these compounds are used by the male to produce pheromones.

An African Monarch

b) The *Acreas* – both the adult and the early stages are toxic. The adults when injured secrete a clear yellow fluid that contains hydrocyanic acid. *Acreaines* are apparently able to self-synthesise this hydrocyanic acid.

A Dancing Acrea

5) Milkweed locusts secrete foam from their legs as a defence mechanism. The foam is poisonous. They also have bright colourations as a warning signs that they are poisonous.

Milkweed locusts on a Milkweed plant

© Lee Gutteridge – 2 December 2005

6) Temperature regulation in termite mounds is one of the most ancient forms of air conditioning. Activity by the termites causes a heat by product as result of energy expenditure. This accumulated heat rises up through the chimneys of the mound resulting in a slightly lower air pressure inside the mound. Then cooler heavier air begins to sink down to stabilise the pressure below and thereby cool down the inside of the mound.
When the termites are collecting plant material to line their fungus gardens below, they inadvertently prepare a food supply for the future. These plant parts which are taken below will compost in the moist warm subterranean environment created by the termites and begin to enrich the soil. This is a nutrient hotspot. Many of the seeds collected will have a chance to grow in this composted and warm environment and many tree species are associated with termite mounds. Sometimes a dozen or more species can be found on one mound. These trees will drop seeds, leaves and fruit, thereby ensuring a future food supply for the colony. Animals will utilize these mounds too. Nile monitors lay their eggs in the mounds and mongooses use the larger cavities as permanent homes. Many snakes use the mounds and their tunnels too. Rodents, scorpions, lizards, geckoes and shrews all use termite mounds for refuge.

7) Termites are on of the best known groups of insects due to the type of large nesting structures they build. Termite mounds are commonly seen throughout Africa in different shapes, sizes and forms. Fungus growing termites are a well known group. Winged Alates of termites are eaten by birds, animals and humans. They live in a complex 4 caste system with sterile workers, soldiers and minor soldiers, primary reproductives (kings and queens) and secondary reproductives. Workers have unmodified heads, and are usually blind. Soldiers have large modified sclerotized heads. Primary reproductives are large and have vestiges of wings. They are darkly pigmented. Secondary reproductives have wing buds and are less darkly pigmented. Food stuffs in vegetable form is chewed and partially digested, and deposited deep underground in chambers in a comb form. Fungus which can break down the cellulose and lignin of plant cells then grows on these combs of chewed vegetable matter and produces a liquid by product which is eaten by the termites.

8) <u>Stridulation in insects.</u>
Crickets and some weevils stridulate, amongst others. Stridulation is when sounds are produced by rubbing together parts of the body.

9) <u>Scorpion mating:</u>
a) Courtship: this is usually initiated by the male who often wander around actively in the warmer months looking for females. Evidence suggests that the female gives off a pheromone that the male recognises and responds to. Females remain near or in their shelters – a burrow crevice or under a rock, depending on the species. During this time males often inhabit temporary shelters not normally associated with the species. When a male locates a female he communicates his intentions through vibrations. He may judder his entire body, tap his pincers or wag his tail. These actions produce vibrations that travel through the substrate. Only after the male is sure that he has made his intentions known, and the female makes a positive response, will he approach her.

b) Securing the female: Males of most genera have modified pincers on their pedipalps, which are used to grasp the female. The male may grasp the female by her pincers, or in some cases, males and females lock mouth parts. Once the male has a firm grip on the female, he manoeuvres her to a place where he can deposit his spermatophore. He fans out his pectines to feel the substrate while looking for a smooth hard place such as a rock, stone or branch to attach his spermatophore. Thos part of courtship may last from 5 minutes to half an hour during which time the male may drive the female as much as 25m or more.

© Lee Gutteridge – 2 December 2005

c) Positioning the female: once the male has attached his spermatophore to a suitable object, he has to position the female so that the hooks on top of the spermatophore catch her genital opening. After the male has deposited his spermatophore and he manoeuvres the female into position over it, she may arch her body over the spermatophore, or the male may lift her up and then drop her down. At this time the female spreads the genital opercula which normally cover her genital opening, and the end of the spermatophore enters her. The weight of the female bends the spermatophore and triggers the release of sperm. She may remain motionless for a just a few seconds, or even for a few minutes. After sperm uptake both male and female break away from each other often violently. Either one may club the other with its tail or probe the other with its sting. The female may even try to eat the smaller male at this point. After mating, the spermatophore may be eaten by the male or the female. Males can mate more than once during mating season and can produce another spermatophore in as little as 6 days.

10) Sac Spider

Sac Spiders are small to medium sized spiders. Body length 4mm-10mm. They are a pale straw or yellow to greenish colour. The abdomen is longer than the cephalothorax & the legs are slender & long. The first pair of legs is usually longer than the rest. The most recognisable feature of this spider is its black head.

Life Cycle: The life cycle lasts about a year. The adults appear with the onset of the rains around December and towards the end of the rainy season. The female lays her eggs in a cocoon in a silk "nest". She guards the eggs for a short time & then dies.

Feeding Behaviour: They are nocturnal, fast moving & aggressive hunters. They catch their prey with speed & agility. The front legs are held forward, enabling them to grasp whatever comes into their path. Being nocturnal & common in houses they pose a potential threat to people while they are asleep. They bite at the slightest provocation & their large fangs easily penetrate the pyjamas of a sleeping human.

11) Rain Spider:

The body is golden to light brown in colour & the abdomen is decorated on the upper surface with a darker leaf-like pattern. These spiders are bold and when disturbed they raise the first two pairs of legs in warning. This displays bands of brown, fawn and rust on the legs as well as a white moustache at the base of the fangs.

Life Cycle: eggs are laid in a heart shaped cocoon. About 100 spiderlings nearly 3mm long hatch out and live in and around the cocoon. After another two weeks the spiderlings moult and move off to live on their own.

Feeding Behaviour: They do not make a web to catch prey but wander around looking for food. They often come indoors to hunt on the walls and ceilings for insects & geckos attracted to the lights at night.

Mating Behaviour: They mate at the start of the rainy season & by Dec/Jan the female lays her eggs. She lies head down on the cocoon & guards it from predators. This structure is about 80mm by 100mm in size & is made of layers of dry leaves bound together by thick sheets of silk. The cocoon is hidden in a shrub & is tied by strong radiating threads to branches about a metre above the ground. During this entire period of 4-6 weeks the female does not eat – but gets thinner & thinner & eventually dies.

© Lee Gutteridge – 2 December 2005

12) Some differences between spiders and scorpions.

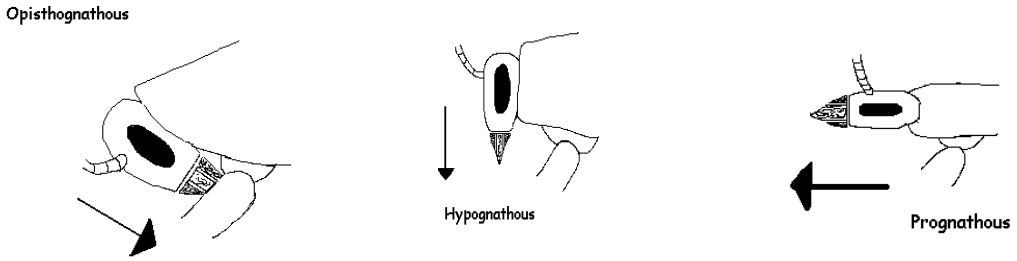
Spiders	Scorpions
1) Have 2 – 8 simple eyes which consist of groups, main or direct eyes & secondary eyes	1) On their carapace they have a pair of median eyes & a cluster of small lateral eyes on each side
2) Have no sting	2) Have a sting
3) Does not have pectines	3) Has pectines (comb like structures on the underside of the scorpion that are used for sensing temperature & humidity levels & for feeling the substrate)
4) Has fangs	4) Does not have fangs
5) The chelicerae are used to capture prey	5) Chelicerae are used for feeding & the enlarged pedipalps are used to capture prey

13) What easily identifiable marking do button spiders have? A Button spider has an hour glass shape on the underside of its abdomen.

14) Are ticks insects? No ticks are not insects, they are part of the arachnid family.

15) What is Parthenogenesis? This is when a female can produce young without the help of a male of the species. eg: Stick insects.

16) The three major head positions of beetles.

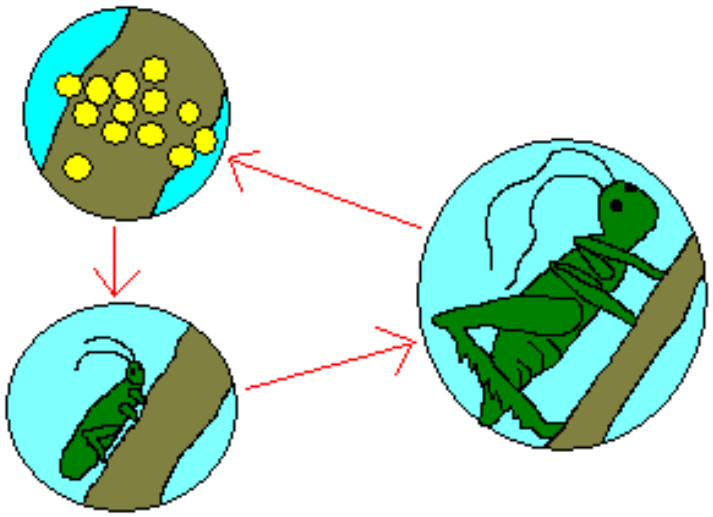


17) Describe the relationship between figs & wasps

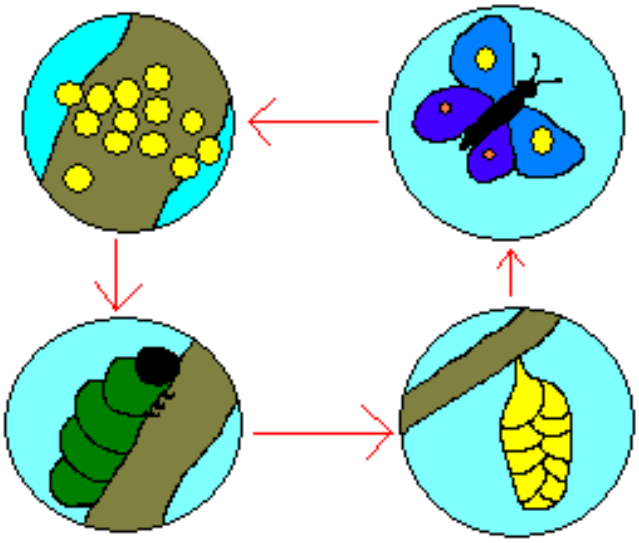
Bees & butterflies cannot pollinate the fruit of the wild fig tree as they cannot access the fruit. The figs are pollinated by tiny wasps called fig insects that belong to the family *Agaonidae*. The females are black & have 4 wings & are much more active than their wingless mates which never leave the figs in which they are born & bred. The female fig insect is fertilised inside the fig soon after she emerges from the pupa. Then she creeps out of the small opening at the top of the fig & in doing so, passes over the male flowers in the fig & becomes well dusted with pollen. She subsequently flies to younger, smaller figs in the same or on neighbouring tress & creeps into them, thus pollinating the young figs. The female wasps lay their eggs in the ovaries of the female flowers & the larvae develop inside them to produce the next generation.

© Lee Gutteridge – 2 December 2005

18) Hemimetabolic Life Cycle – Dragonfly



19) Holometabolic Life Cycle - Butterfly



20) How many body parts & legs do spiders & insects have respectively?

Spiders	Insects
1) 8 Legs	1) 6 Legs
2) 2 Body parts – cephalothorax & abdomen	2) 3 Body parts – head, thorax & abdomen

© Lee Gutteridge – 2 December 2005

21) There are 4 major scorpion groups/families:

a) Bothuridae
b) Buthidae
c) Ischnuridae
d) Scorpioidae

a) Bothuridae:

These species of scorpion are endemic to northern & central Namibia. Both species have thick tails & robust pedipalps. They are rarely seen because of their small size & limited distribution. No envenomations are recorded. Because of their size & the small amount of venom they produce, their sting is unlikely to be of medical importance. The sting is painful but not toxic. There is 1 genus group - *Lisposoma*

b) Buthidae

There are 7 genuses in this group of scorpions:

i) *Afroisometrus* – 1 species: *Minshullae* - a very small scorpion up to 30mm venom not toxic

ii) *Hottentotta* – 3 species: a) *H.arenaceus* , *H.conspersus, H. trilineatus* medium sized, robust scorpions with stout appendages. Males are slightly smaller & more slender than the females & have more bulbous pincers. All species are characterized by lyre-shaped markings on the carapace & 3 distinct longitudinal keels on the tergites. This genus is considered medically important as all its members can inflict a very painful sting. Does not stridulate.

iii) *Karasbergia* - 1 species: *K.muthueni* – endemic to Southern Africa. Very small distribution & very small in size – therefore unlikely to be encountered. Venom is probably potent in small amounts & hence unlikely to be life threatening. No recorded envenomations.

iv) *Lychas* – only 1 species has been collected in Southern Africa : *L.burdoi* –up to 40mm in length, characterised by yellow & black markings. Males are smaller than females. Venom is strong but not life threatening under normal circumstances. Has a very large tubercle.

v) *Parabuthos* – there are 20 species distributed throughout southern Africa. These large scorpions (70mm – 180mm in length) are the most venomous in southern Africa. All except *P.distridor* have rough areas on the upper surface of the first segment of the extremely thick, strong & keeled tail. In many species, the second tail segment is also characterised by a rough area on the upper surface. Pincers are smooth & weak.

vi) *Pseudolychas* – 3 species but only 1 is likely to be encountered: *P.pegleri* these species are found in vegetated areas under surface debris where humidity is higher. Sting is very painful but not of medical importance.

© Lee Gutteridge – 2 December 2005

vii) *Uroplectes* – contains 50 species, distributed throughout southern & eastern Africa. There are 19 species in southern Africa. Small to medium sized (on average 50mm long) with a fiery disposition & a painful sting. These brightly coloured scorpions range from yellow to brown to red or green, with areas of pigmentation, bands of colouration & other markings. The venom vesicle of the sting is distinctively shaped. Distinguishing male from female depends greatly on the species, in some species the first pectinal tooth is modified, in others the shape of the pedipalps is important. Males in this genus are smaller & more slender than the females.

c) Ischnuridae: there are 3 Genera in this group:
i) *Opistacanthus* – all are very docile. Males have a bump on the inside margin of the pedipalps. None stridulate.

ii) *Chleoctonus* – contains 5 species of medium sized scorpions, males are more slender than the females & have a prominent tooth on the moveable pedipalp finger., which is absent or reduced in females. Generally docile & not medically important.

iii) *Hadogenes* – 17 large to very large species worldwide. This genus contains the longest scorpions in the world. They are easily identified by their large pedipalps, thin tail, small venom vesicle, very flat appearance & elongated appendages. Their range is restricted to mountain ranges or discrete rocky outcrops. Both sexes possess large powerful pincers& the female could easily crush the male during courtship. The last sternite is wider in females

d) Scorpionidae – one genus – *Opistophthalmus* – endemic to Southern Africa with over 59 recognised species.

This genus contains some of the worlds most beautifully coloured scorpions, medium to large (up to 180mm to 210mm in length) with large robust pincers & a relatively thin tail. The sting is long & slender. Many have an obvious keel on the pincers. Because their venom is mild they tend to crush prey with their pincers. They produce a hissing sound by rubbing the stiff bristles on the mouth parts against the underside of the carapace. Species with a deep V-shaped groove on the carapace produce a louder sound than those with a shallow V, & in some species even second instar individuals can stridulate loudly. This genus can deliver a painful sting but envenomation is not life threatening in normal circumstances.

22) Insect respiration: insects breathe in a very different way from vertebrates. The blood of insects is many different colours but almost never red. This is because they do not have red, oxygen fixing haemoglobin pigments. The spiracles or stigmata lead to tracheae, which are tiny tubes along which air flows, and these tracheae branch out into the body of the insect. Each trachea ends in a special cell. They then divide into tracheoles which take air directly into the tissues where it will be used for cellular respiration. This explains why there is no need for pigmented transport cells for the oxygen, as the oxygen is transported directly to the tissue where it will be used in the tracheoles. This makes for much quicker gas exchange, useful for insects which hover in the air for prolonged periods of time, like dragonflies. In an organism where the air reaches the cells by blood the process would take too long to facilitate muscular and cellular respiration.

© Lee Gutteridge – 2 December 2005

23) The differences between ants & termites

Ants	Termites
1) Hymenoptera order, related to bees and wasps.	1) Isoptera order
2) Have a conspicuous demarcation between head & abdomen	2) No demarcation between head & abdomen
3) Ant societies are essentially matriarchal, the male role is confined to reproduction since the workers are all sterile females	3) Termite males play an important active part in the work of the community in that some belong to the sterile castes, while the fertile individuals stay near the female which has to be fertilised several times during her life
4) Ants live in the open much more than termites	4) Termites rarely live in the open
5) Ants undergo full metamorphosis	5) Termites only undergo partial metamorphosis & do not pass through the larva pupa stages.
6) Young hymenoptera are totally dependant on adult care	6) Young termites are ready to work without being a burden on the community
7) Ants are predatory.	7) Termites are herbivores.

24) <u>The life cycle of a Two Host Tick</u> – eg: Red legged tick: the eggs of this tick hatch within 2 months into larvae that can survive for several months without feeding. When an animal comes along the larvae attach themselves to the animals ears or flank & gorge themselves. They then moult into nymphs, gorge themselves again & drop off the animal about 15 days later. When on the ground they then moult into adults – this takes about 25 days. They then look for another host. When a suitable animal comes along they attach themselves under the tail & gorge themselves until they find a suitable mate. They then copulate & fall off the animal so that they can lay their eggs on the ground. Once the eggs are laid the female dies.

<u>The life cycle of a Three Host Tick</u> – eg: Brown ear tick: the eggs of this tick hatch within three weeks into larvae & start to look for a host. The larva feeds on the host & then drops off. Once on the ground it moults into a nymph. The nymph then looks for another host & attaches itself, gorges, drops to the ground & moults into an adult on the ground. The adult then attaches itself to a third host where it completes the life cycle.

25) <u>What is a stabililmentum?</u>
Various theories have been put forward as to the real function of the stabilimenta made by some species of the orb-web spiders. The most accepted of these are that this structure serves as a strengthening mechanism, a warning to large flying insects or birds that may destroy the web if they hit it & a place to weave in debris & prey remains among which the spider can conceal itself.

© Lee Gutteridge – 2 December 2005

26) Describe how you would identify the following spiders, and what venom they have

i) Sac Spiders – Cytotoxic poison, within 24 hours the bite becomes inflamed & swollen, it ulcerates after a few days. The wound is slow in healing & often becomes subject to secondary infection. A fever may occur & often a severe headache.
Sac spiders are a straw yellow colour with a black face, they are often found close to their "nest" which is a white papery substance in a circular shape. It is often found on walls & in the creases of clothes & curtains.

ii) Violin Spider – Cytotoxic poison, a nasty ulcerating wound is caused often involving severe secondary infection. The resulting tissue damage leaves disfiguring scars which may require plastic surgery.
Violin spiders look deceptively similar to the Daddy long legs. Their colour varies from brick-brown to a rich red brown with darker markings on the abdomen. They have a characteristic dark brown to black violin-shaped marking on the carapace.
iii) Black Button Spider – Neurotoxic poison. This spider is one of the most dangerous in Southern Africa. Its poison affects both the heart & the respiratory function. The bite is painful & produces symptoms within half an hour which include anxiety, severe chest & abdominal pains, headache, rapid changes in body temperature & coldness of the skin. At the bite a red inflammatory swelling occurs & often a rash appears.
It is a black, medium sized spider (4-10mm). Most of the spiders have an orange-red marking on the underside of the abdomen.

iv) Brown Button Spider –
This spider varies in colour from light yellowish-brown, to pitch black. It has a characteristic hourglass shape on the underside of the abdomen.

© Lee Gutteridge – 2 December 2005

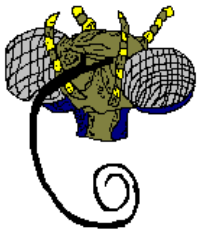
27) <u>Some drawings of mouth parts of common insects.</u>

Extending, grabbing mouth parts of the dragonfly nymph.

Biting mouthparts of the Katydid.



The sucking mouthparts of a Butterfly.

The chewing, cutting mouthparts of a wasp.



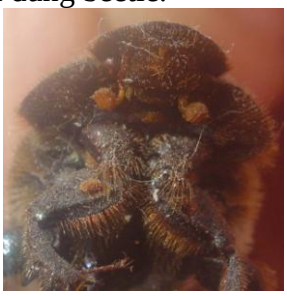
The pinching, chewing mouthparts of an ant lion nymph.

The mouthparts of a Lycid (net wing) beetle.

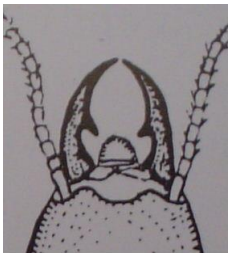
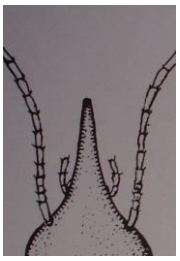
© Lee Gutteridge – 2 December 2005

The mouthparts of a stick insect.


The mouth parts of a dung beetle.

The mouth parts of a termite.

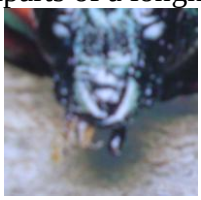
The mouth parts of a fruit fly.

The mouthparts of a house fly.

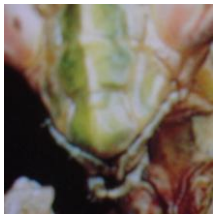
© Lee Gutteridge – 2 December 2005

The mouthparts of a weevil.

The mouthparts of a longhorn beetle.



The mouthparts of a mantis.



The mouthparts of a milkweed locust.

The mouth parts of an ant.

© Lee Gutteridge – 2 December 2005

28) Ametabolic life cycle – in this method of reproduction there is little difference between young & adult in appearance, except size & sexual development eg. Fishmoth = Egg-young-adult.

29) The Horned Baboon Spider is very large & hairy with heavy legs that retain the basal diameter throughout the entire length of the leg. They have large hairy pedipalps that look like an extra pair of legs. This specific spider has a horn in the centre of its carapace, behind the clypeus. Baboon spiders can inflict a painful wound but the venom is only mildly toxic to man. Horned Baboon Spiders live underground, in open-ended silk lined burrows. The burrow entrance of this specific baboon spider is different from the others as it lies flush with the surrounding substrate. The spider emerges at night to hunt & never moves very far from its burrow – unless it is a male looking for a mate.

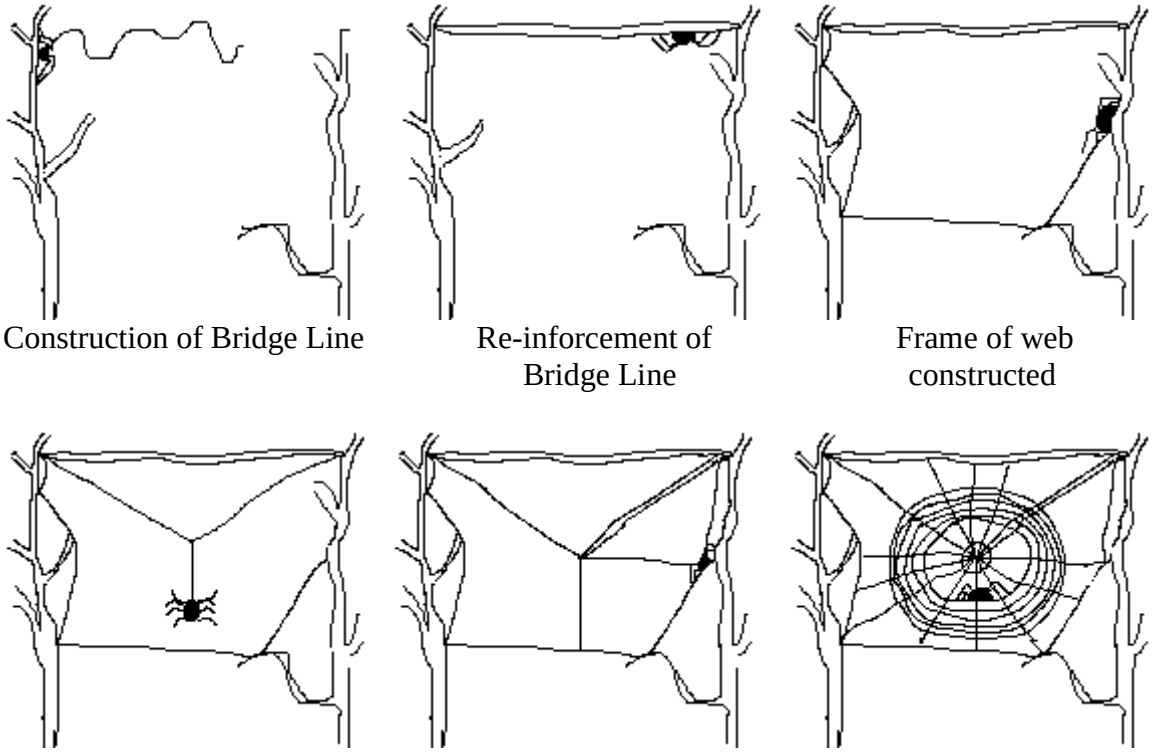
30) Both the Bark Spider & the Golden Orb Spider are web bound spiders. They are also Orb web spiders. These spiders build their unique structural masterpieces in open spaces between trees, branches of trees or man made objects such as fences. The webs may vary in size from a few centimetres to a few metres across. The spider sets up home either in the web, usually at the hub, or up & away in a retreat which is connected to the hub by means of a signal line.

Bark Spider: at dusk after establishing a long & sturdy bridge line bark spiders produce a very large orb web which can span 1 – 1.5 metres in diameter. They bridge line may measure up to 2 metres between attachment points. At dawn the spider dismantles the web leaving only the bridge line intact & disappears onto the nearest tree.

Golden Orb Spider: this spider hangs upside down in the hub of its web. The web can sometimes be recognised by the debris of old prey strung out in a line from the top to the bottom of the web & resembling a stabilimentum. Juveniles, both male & female spin a complete orb but as adults only the females spin the webs of strong, thick, golden silk. The adults do not spin the top section of the web, but because of all the attending threads it is difficult to notice that there is a section missing. The whole construction is linked to branches & twigs with irregular tough strands which also serve as knockdown lines.

© Lee Gutteridge – 2 December 2005

The Construction of an Orb Web



BOT FLIES

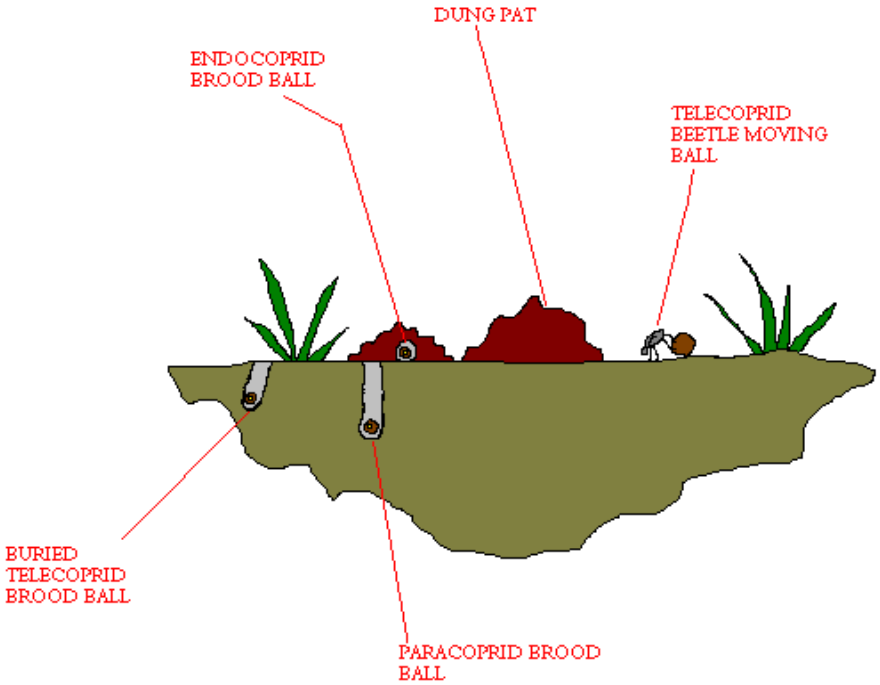
The Nasal Botfly of the family *Oestridae* has developed a clever method of avoiding cold winter weather by utilizing various mammals as hosts for the larva. The larva is white and barrel shaped with a black head. The larval development can take up to 9 months. The eggs are laid in the nose of most hosts, and when the larva hatches it attaches itself to the sinus membranes and feeds on mucous. The adults do not live long and rarely are seen. Other botflies will travel into basal horn pulp.

PUTSI FLIES

Mango and Putsi fly are colloquial names given to these flies, which are well known in Zambia, Zimbabwe and Northern South Africa. These flies are significant as they lay eggs on damp clothing, and unless the clothing is ironed thoroughly to kill the eggs the hatching maggots will make their way into the skin of the wearer of the clothes and cause sores. These insects also affect dogs, sheep and wild animals. They are probably of the family *Oestridae* (botflies).

© Lee Gutteridge – 2 December 2005

DUNG BEETLES



Dung beetles are classified into three main groups, by their methods of dung utilization.

Paracoprids

These beetles dig a tunnel directly down from the dung pat, as a feeding or brood chamber.

Endocoprids

These beetles form a dung ball in the dung heap itself.

Telecoprids

These beetles are the classic rollers of dung balls which most people associate with the dung beetle group.

CENTIPEDES AS COMPARED TO MILLIPEDES

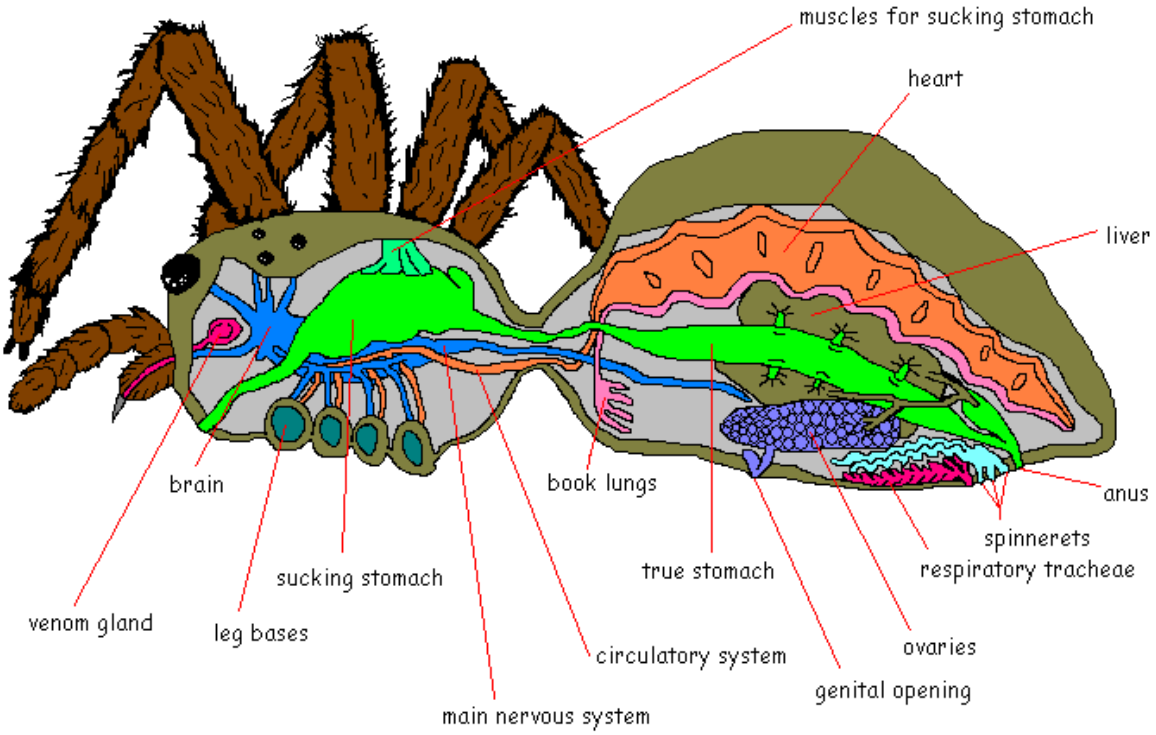
Myriapoda – Centipedes and Millipedes: recognised by an elongated body form, no thorax and abdomen and the presence of walking legs on each body segment (except the 1st and the last 1 or 2) centipedes are usually flattened and have 1 pair of legs per segment, those of the 1st segment being modified into poison fangs. Millipedes are cylindrical and made up of "diplosegments" each representing 2 fused body segments and hence bearing 2 pairs of legs.

MYGALOMORPHS AND ARANEAMORPHS

Mygalomorphs are primitive downward biting spiders. (E.g. Baboon spiders)
Araneamorphs are more specialized sideward biting spiders. (E.g. Orb-web spiders)

© Lee Gutteridge – 2 December 2005

A DIAGRAMMATICAL REPRESENTATION OF A SPIDER SHOWING INTERNAL ORGANS



© Lee Gutteridge – 2 December 2005

GEOLOGY AND CLIMATOLOGY

GLOSSARY OF TERMS

Define the following terms as they pertain to geology and climatology.

1. alluvial – water formed.
2. anabatic wind – warm upward blowing wind found in association with hillsides.
3. atmosphere – a gaseous layer around the earth.
4. atmospheric pressure – the weight of a coulumn of air.
5. biological weathering – weathering through non-mechanical means.
6. castle weathering – weathering of rock into blocks. i.e. Matopos hills in Zimbabwe.
7. catina – seepline, crest and dambo system.
8. chemical weathering – weathering by chemical means.
9. clay – dense, small grained, non-porous soil type.
10. cold front - cold air wedges under warmer unstable air causing vertical cloud formation, of the cumulonimbus type. Causes rainfall and decreased temperature.
11. composite rock – rock composed of different materials.
12. conglomerate – sedimentary rock formed by fragments of pre-existing rocks.
13. continental drift – the movement of continental plates away from one another.
14. crust – the outer 35 km of the earth, underlying the continental plates. Situated above the mantle.
15. crystal- a structure of a specific mineral. These mineral structures are constant to the type of mineral.
16. crystalize- the accumulation of a mineral in solution into crysteline form.
17. deposit- layers of material put in place by wind or water etc.
18. dew point- the temperature and humidity where the air becomes saturated with water and condensation starts to take place.
19. down warping- the downward movement of joins between tectonic plates.
20. erosion- the removal of material from a site by means of water, wind, chemical and mechanica means.
21. fault- a crack in the earths crust.
22. fold- areas where the line and plates of rock below the earths surface are bent by movement against each other.
23. gondwanaland- the super continent which was in existance until about 140 MYA which was composed of the modern day Africa, Antarctica, South America, India, Madegascar, Australia and New Zealand.
24. igneous rock- rocks formed by volcanic means.
25. in situ- on the spot.
26. inner core- The centre of the earth. A solid mass. Up to 5000 degrees centigrade.
27. katabatic wind- downward winds formed due to cooling of hillsides and slopes.
28. larva- molten rock above the earths surface.
29. leaching- water movement through soil, which will take away minerals and nutrients.
30. loam- soil rich in organic material, and clay, sand and silt.
31. magma- molten rock below the earths surface.
32. mantle- the layer of the earth between the core and crust of the earth, plastic by nature (thick liquid). 1600 degrees celcius.
33. mechanical weathering- weathering by means of physical processes.
34. metamorphic rock- when a parent rock changes form by means of heat and/or pressure.
40. mineral- the building block of a rock, consisting of one or a compound of elements.

© Lee Gutteridge – 2 December 2005

41. onionskin exfoliation-the exfoliation of layers in a rounded hollow shape due to oxidation of layers of rock.
42. outer core – the outer liquid core of the earth.
43. oxidation- reaction of oxygen and various minerals such as iron, resulting in colour chane and weakening of the mineral.
44. plateau- a fairly level area of land high above the area around it.
45. precipitation- rain.
46. rift valley- a valley formed along a major fault line. This requires two parralell faults to enable the land in between to sink and form the vally.
47. rock division- the groups of rock to which all rocks belong. Ie. Metamorphic, igneous or sedimentary.
48. sedimentary rock- layered rock form, deposited by wind or water and solidified by means of sheer mass.
49. sedimentation- the layering of sediments.
50. seep line- an area in a catina system where bed rock and surface soil are close together, causing water to seep through the soil.
51. sial- silica aluminium rich magma.

1. sima- silica magnesium rich magma.
2. soil- the pedological sphere, brocken fine layers of parent material on the surface, often mixed with organic material.
3. tectonic plate- rocky plates of earth crust wich have land masses above them.
4. thunder- produced by the expansion of air by the tremendous heat of lightning flashes.
5. uplift-when plates collide and one wedges in underneath the other.

© Lee Gutteridge – 2 December 2005

ROCK TYPES

Explain the three major rock types, how they are formed, three examples of each,the differences between your examples of each rock type, and the minerals you would expect to find in each.

Igneous Rock

Formed by cooling of volcanically superheated rock (magma).
Basalt, Granite, Andesite, Dolerite, Diorite, Gabbro and Rhyolite are examples of this rock division.
Minerals such as olivine, orthoclase, plagioclase, biotite, horneblende and pyroxine are found in these rocks.

Metamorphic Rock

Formed when other rock types are altered by heat and pressure (but not melting).
Quartzite, Slate, Schist, Gneiss, Marble and Hornfels are examples of this rock type.
The minerals would depend upon the parent rock type.

Sedimentary Rock

Layers of sediment which solidify through sheer mass and pressure form sedimentary rock.
Mudstone, Shale, Conglomerate, Breccia and Sandstone are examples of this rock type.
Minerals such as silica and quartz are common but the parent material would determine the mineral composition.

IGNEOUS DIVISIONS

In the case of igneous rocks there are intrusively cooled and extrusively cooled varieties. Explain the differences, and what you can use visually to determine one from the other.

Intrusively cooled igneous rocks are cooled under the surface, so loose heat slowly. This gives minerals present in the rock time to accumulate into large enough groups to form large crystals. These large crystals are a visual characteristic of intrusive igneous rocks.

Extrusively cooled rocks cool quicky on or near the surface. The crystals formed by the various minerals are therefore much smaller.

© Lee Gutteridge – 2 December 2005

MINERALS

Name four minerals in your area and describe what they would look like in a piece of rock. Collect examples and be prepared to practically identify them.

Orthoclase feldspar

A white mineral.

Plagioclase feldspar

A pink mineral.

Mica

A reflective mineral, layered in platelets.

Biotite

A soft black mineral.

Calcite

A fine white powdery mineral.

© Lee Gutteridge – 2 December 2005

WATERBERG GEOLOGY

Describe in detail the geology of the waterberg, and specifically entabeni. Mention the two faults involved, major rock types and how they were formed. Describe the general depression and then upliftment of the area. Also mention the role of erosion in the formation of the features of the area. In the area of entabeni five main formations have been identified with specific rock types, what are the formations names, and what do the specific rock types look like. Try to collect examples of some of them.

The sediments of the Waterberg were laid down between **2000 million years ago** (2 billion) and 1700 million years ago (1.7 billion). This era takes its name from an ancient river which flowed at this time, the **Mokolian**, which in turn falls within the **Proterozoic Epoch**, a time before the Pre-Cambrian when multicellular animals began to appear on the earth . This would explain why there are no animal fossils to be found in the **Waterberg supergroup** as the **Phanerozoic epoch** (including the Pre-Cambrian and Cambrian epochs) where these fossils may occur only took place much later, so basically the waterberg was formed before animal and plant life as we know it was around.

During the early Mokolian era, the inland area between Ellisras, Thabazimbi, Warmbaths and Potgietersrus was affected by seismic activity along the **Murchison** and **Melinda** fault zones. The Murchison in the south (running from Thabazimbi eastwards between Potgietersrus and Naboomspruit) and the Melinda in the north (running through Ellisras) caused movement in the earths crust, and **a basin was formed with a diameter of approximately 200 km**. It is due to these fault zones that we have the hot springs near Warmbaths, Nylstroom and Naboomspruit. Deep water deposits along the faults come into contact with volcanically superheated rock material. Water at Warmbaths for example, comes out of the earth at 52 degrees celcius, and is very rich with sulphur.

Rivers and streams flowed into the basin forming a series of **inland lakes, seas, fan deltas, alluvial dunefields and braided rivers**. With the arrival of all this water depositions of water borne (alluvial) materials took place, and were deposited at depths of up to **5 km thick**. Surely if there was this thick a **deposit** it would have **filled up the shallow lakes and rivers and seas** very quickly. The answer to this puzzle is that as sediments were deposited the earths **crust was sinking**, accomodating this increased deposition, so the **height remained constant**. It is interesting to note that by this time the earths atmosphere had aquired enough oxygen to cause the deep red colour of these sediments, allowing iron to be **oxidised** to the red, yellow, orange and brown colours of its various minerals. This would imply the **presence of photosynthetic organisms at the time of deposition.**

Then for about a 1500 million years the **erosion processes** have removed these depositions and in many of the older basins the ancient chrystalline foundations of our subcontinent have been exposed, along with the old schist belts. In effect, most of what was deposited has been washed away. **It is therefore not accurate to say that the tops of mount Entabeni and Hanglip were the old lake beds**, as the **actual lake bed** may have been several kilometres above the current height of these two modern day giants, and have been **washed away**.

There were many **stages of deposition** in the formation of the Waterberg. The deepest and oldest strata is known as the Swaershoek formation, followed in ascending order by the Alma, Sterkrivier, Schilpadkop, Makgabeng and Mogalakwena sedimentary strata.

© Lee Gutteridge – 2 December 2005

Geological formations on the lower areas of Entabeni Game Reserve, Limpopo, which lies below an elevation of 1330m in the Eastern Waterberg.

1. There are sandstones containing mica and feldspars, which belong to the **Alma** sedimentary strata, as well as mud stone and siltstone. These would have been deposits from fan delta's or possibly shallow lakes.(Louwskraal and Klipspruit).
(stones to look out for- sandstones with shiny mica{quite a soft flaky mineral}and either white or pink feldspars{plagioclase or orthoclase}/ soft dark stones with definate strata which are extremely fine grained)
2. There is also evidence of the **Sterkrevier** formation, in the presence of extrusive igneous rocks such as diabase/dolerite.(Louwskraal)
(stones to look out for- grey, hard rock with very fine chrystals,white and black in colour)
3. **Schilpadkop** formations such as sandstone, conglomerate and boulder conglomerate which were deposited by a fast flowing braided river just north of the Murchison fault are also found. The Murchison fault flows slightly to the south of the section 1 portion of Entabeni, between Naboomspruit and Potgietersrus. (Louwskraal and Klipspruit)
(stones to look out for- coarse sandstone with lots of pebbles and stones trapped inside{such as quartzite pebbles- metamorphosed sandstone}/ also large boulders filled with sections of large pebbles and rounded, fist sized to small rocks and stones)
4. Fine to medium grain sandstone from the **Makgabeng** formation are also present. These sometimes feldspathic sandstones were born of large and ancient alluvial dunefields.(Louwskraal and Klipspruit) (stones to look out for- fine sandstones, sometimes with pink or white speckles of feldspar, often oxidised to a brown or orange so look at freshly broken pieces)

Geological formations on the top sections of Entabeni Game Reserve above 1550 and below 1793 metres. **It is interesting to note that Hanglip Mountain is not the highest point on Entabeni Game Reserve. It stands at a height of 1767 metres above sea level (5800 feet), wheras the mountain above Earthsong section at the southern end of Longdrive is 1793 metres above sea level (5882 feet).**

1. The main formation on this section covering Charles Hope and Vosdal is the **Mogalakwena** formation. It consists mainly of coarse sandstone, grit, sedimentary conglomerate and boulder conglomerate. Small to large pebbles are common in this formation. It was determined by using measurements of ripple patterns in these rocks that these coarse sediments were deposited by fast flowing braided rivers, which probably flooded during a rapid upliftment of a mountain mass to the north east. The direction of major erosion on Entabeni mountain (north east to south west) substantiates this. Minerals present include zirconium and titanium which are found near the northern boundaries of the reserve.

2. There are diabase/dolerite extrusions which have been exposed near lakeside which may be from the Sterkrivier formation.

3. **Crystal belts and schists** which have been exposed in the Klein Sterk Rivier area which are **pre-Waterberg supergroup** and part of the bushveld complex of igneous origin, about **2600 million years old** (2.6 billion). The northern limb of the bushveld super complex underlies Entabeni and is a mixture of layered and granitic rocks. The layers house several igneous rock types and also chrystal layers as mentioned above.

© Lee Gutteridge – 2 December 2005

Gondwanaland and its break up, and some geological points of interest.

It is interesting to note that as recently as **180 million years ago** Southern Africa was still part of the **supercontinent Gondwanaland**, so all of the above processes took place in a geographically very different world from the one we know now. **Africa, India, Australia, South America, Madagascar and Antarctica were all together as one continent** up untill roughly this time, each on its own continental plate. **Cracks between these plates constantly allow magma to seep to the surface and solidify**, causing a pushing apart of the continental plates. To measure the distances these plates move in a specific time frame, the scientists will measure the magnetic properties of rocks on each side of the crack in the ocean bed, and find correspondingly magnetic rock groups on each side. Magnetic properties help to determine age. Then from the distances these matching pairs move apart over specific time frames the speed of the movement of the lithosphere(rock beneath the sea bed) can be determined. This is a constant process and **every year we find ourselves further away, distantially, from South America** and the Indian subcontinent pushes further into the Asian continent folding the land before it (due to these processes the Himalaya's were formed, including the worlds highest mountain, Mount Everest) . However most of these sea beds which are forced towards the continents themselves are in the end thrust up against the continental shelves and **subduction**, or a **forcing under** of these plates takes place. **The lithosphere is then forced deep under ground and a remelting takes place.** Therefore seabed lithosphere rocks are not nearly as ancient as the rocks of the major continents. There is a constant **recycling** of these sea bed rocks. It is estimated that the approximate **age of the earth is 4600 million years old** (4,6 billion). Amongst the **oldest rocks in South Africa** are the ancient greenstone belts near Barberton, which are surrounded by gneiss' of **3300 million years of age** (3,3 billion). These ancient rocks developed as part of the earths first crust, as prior to this time in the **Archean epoch** the earths surface was mainly molten rock. This greenstone could have been, to all intents and purposes, an island in a sea of lava.

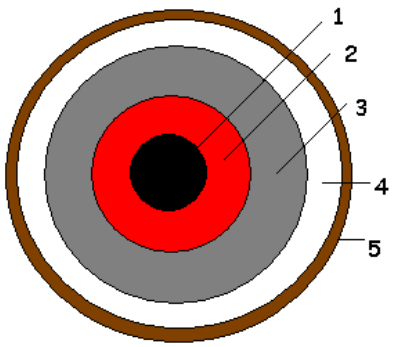
Bibliography

A first introduction to geology of the bushveld complex. H.V.Eales.
Geology of the Waterberg and Entabeni Game Reserve. L.Visser.
Map #2326 Pietersburg. Geological survey Pretoria.

© Lee Gutteridge – 2 December 2005

THE EARTH IN CROSS SECTION

Draw a diagram of the earth in cross section. Label all the layers of the earth.



1. Inner core, 2. Outer core, 3. Inner mantle, 4. Outer mantle, 5. Crust.

GRANITE AND BASALT COMPARISON

Compare granite and basalt as regards mineral composition, chemistry, colour, size of crystals, depth of melting, depth of cooling, resultant soil types, vegetation types on these soils.

	Granite	Basalt
Minerals	Quartz, Orthoclase, Plagioclase, Feldspar and Biotite.	Calcium, Olivine, Plagioclase, Pyroxine and Magnetite.
Ph	Acidic.	Basic/ Alkaline.
Grain	Coarse crystal grain.	Fine crystal grain.
Depth of melting	25km	50km
Cooling depth	20km	Surface.
Soils	Sandy soils.	Fine clay soils.
Vegetation	Broad leaf, sourveld.	Acacia, sweetveld.

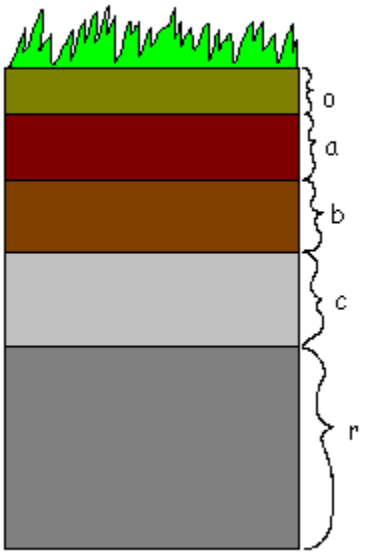
EXAMPLES OF METAMORPHIC ROCKS

Metamorphic rocks develop from other types of rock. Examples are:
Quartzite from Sandstone.
Slate from Shale.
Schist from mudstone.
Gneiss from Granite or Basalt.
Marble from Limestone.

These rocks are metamorphosed by heat and pressure.

© Lee Gutteridge – 2 December 2005

SOIL PROFILES



The diagram above represents a cross section through the soil of an area.
The o horizon is the organic and fine soil layer.
The a horizon is fine soil and parent material.
The b horizon is coarse parent material.
The c horizon is very coarse pieces of stone and parent material.
The r horizon is the parent material, i.e. bedrock.

SOUTH AFRICAN EARTHQUAKES

Where and when was the last major earth quake in South Africa? What was its reading on the Richter scale?
In 1969 there was a major earthquake in Tulbagh in the cape. The measurement on the Richterscale was 6.3.

© Lee Gutteridge – 2 December 2005

GENERAL GEOLOGICAL AND CLIMATALOGICAL PRINCIPLES

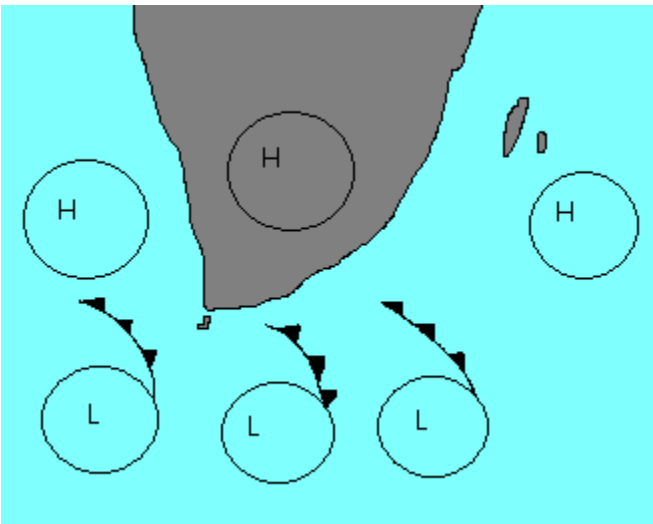
1. What is the difference between weathering and erosion?
Weathering takes place in situ (on the spot) wheras erosion is a process which involves the movement of material from one place to another.

2. When classifying soil several factors are taken into account. What are they and what affect will each have on the properties of the soil itself?
a. Texture – this refers to the soil grain size and will affect the water retentive properties of the soil and penetrating abilities of root systems.
b. Structure – this refers to how the soil is grouped, for example in plates or clods. This affects how easily water will permeate the soil.
c. PH – the acidity or alkalinity of the soil depends largely upon the parent material and therefore the minerals present in the soil. Plant life present can also affect the PH.

d. Colour – this will help determine what the soil parent material was and also things like organic matter content.

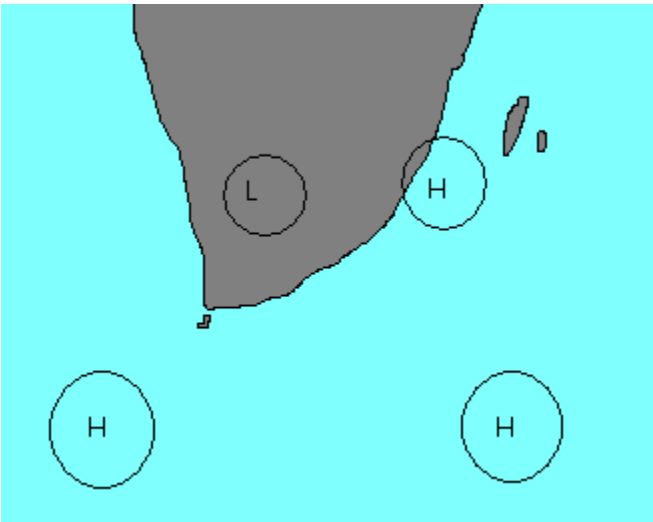
3. What are the names of the ocean currents around South Africa, are they warm or cold and how do they affect the precipitation in adjacent coastal provinces?
Three major currents flow along South Africas coast. The cold Benguela in the west and the warm Mozambique and Agulhas currents in the east. Warm currents will provide the moisture for our summer rains when the low pressure cells occur over them.

4. Draw a typical winter synoptic chart (chart of weather patterns) displaying high and low pressure systems.



© Lee Gutteridge – 2 December 2005

5. Draw a typical summer synoptic chart displaying high and low pressure systems.

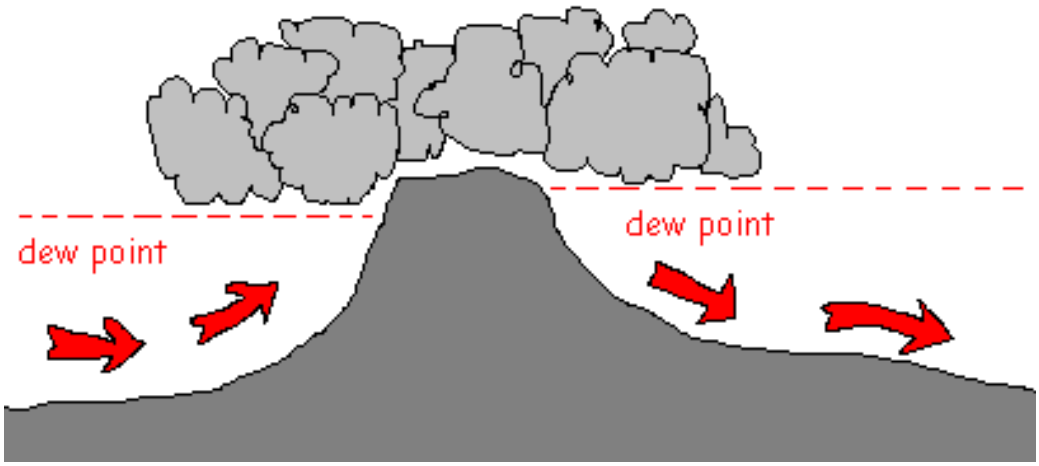


6. Why must a ranger have an understanding of geology and climatology?
The geology of an area will determine soil types and topography of the terrain in which the individual guides, and also therefore detemine mammal and bird species present. The climatiology aspect will help a guide to be prepared for various weather conditions, such as rain or winds.

7. What is an anti-cyclone, or high pressure cell?
High pressure cells are huge wind currents which travel in an anti-clockwise direction and move downwards increasing barometric pressure.

8. What does SO LO CLO stand for?
Southern hemisphere, Low pressure, clockwise motion. This refers to cyclones or low pressure cells.

9. Draw a diagram explaining cloud formation , along a mountain range and give a brief explaination below it.



© Lee Gutteridge – 2 December 2005

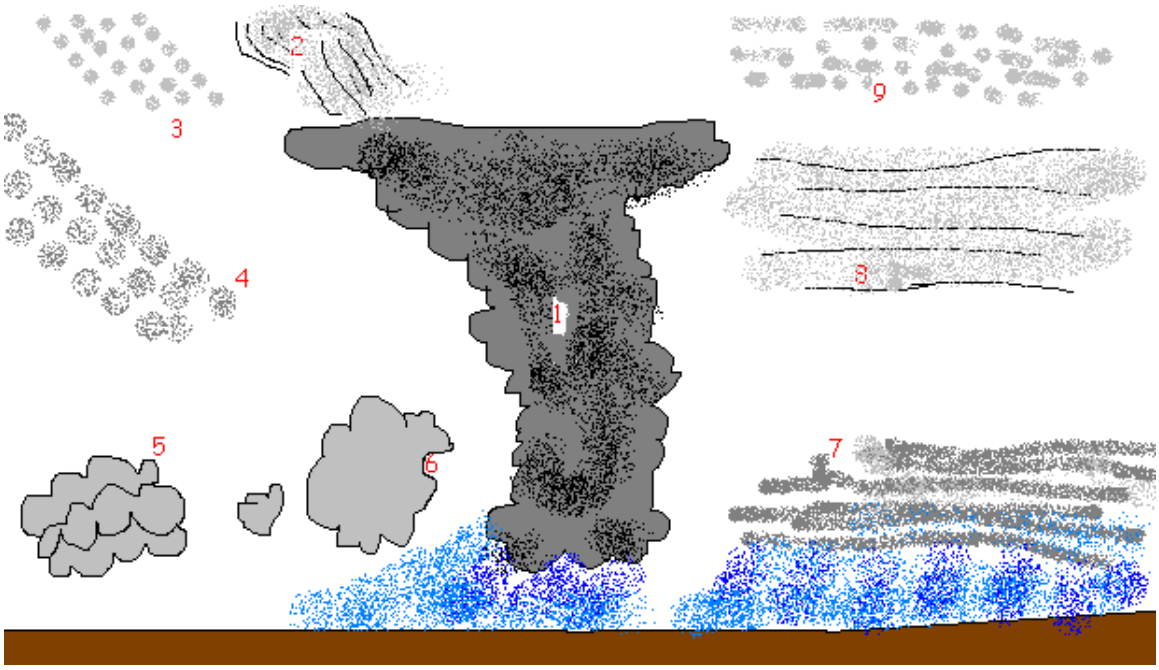
10. Compare gully and sheet erosion.
Gully erosion cuts deep into the surface of the soil in a narrow strip, causing dongas, but sheet erosion takes a surface off a large area, loosing top soil and vagetation over a wider area.

11. What are the three variables which determine cloud type?
Height, form and presence or lack of water for precipitation will influence the type of cloud.

CLOUD AND WEATHER INFORMATION

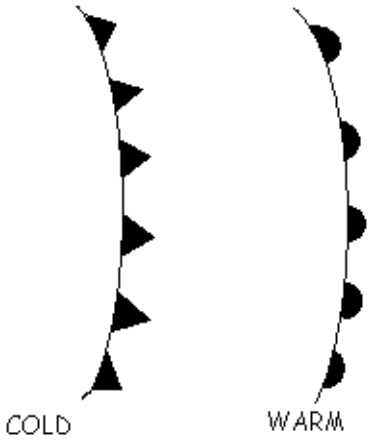
Discuss 3 low, 2 medium height, 3 high and one vertical cloud type, give a brief description as to how they would look (remember the shape) and explain what type of weather you would expect from them.

Name	Description	Picture	Weather	Height
Nimbostratus	Layered	See below #7	Constant rain	Low
Stratocumulus	Fluffy	See below #5	Mild weather	Low
Cumulus	Fluffy	See below #6	Mild weather	Low
Altocumulus	Fluffy	See below #4	Fair conditions	Middle height
Altostratus	Layered	See below #8	Bad weather	Middle height
Cirrostratus	Layered	See below #9	Warm front	High
Cirrus	Small blocks	See below #2	Warm front	High
Cirrocumulus	Fluffy	See below #3	Mild weather	High
Cumulonimbus	Tall, fluffy, dark	See below #1	Thunder storms	Tall vertical development

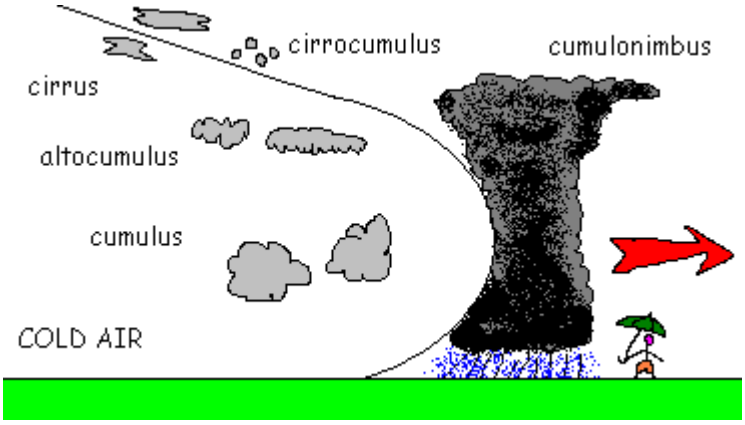


© Lee Gutteridge – 2 December 2005

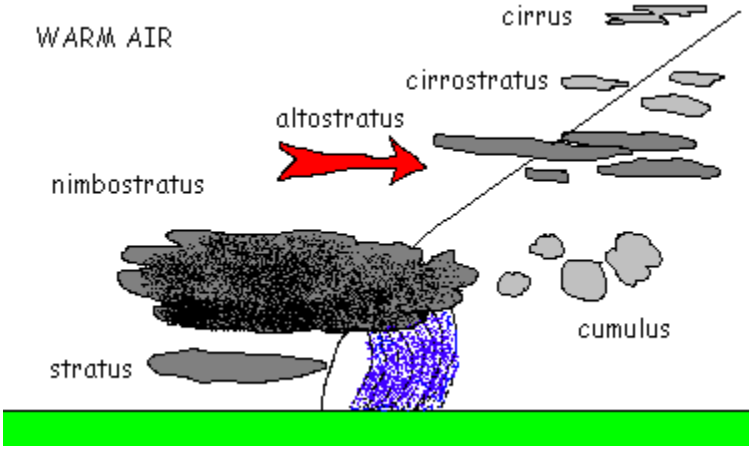
Draw the symbols for cold and warm fronts.



Then draw in the clouds on a separate diagram as you would expect for a cold front,



and for a warm front.



© Lee Gutteridge – 2 December 2005

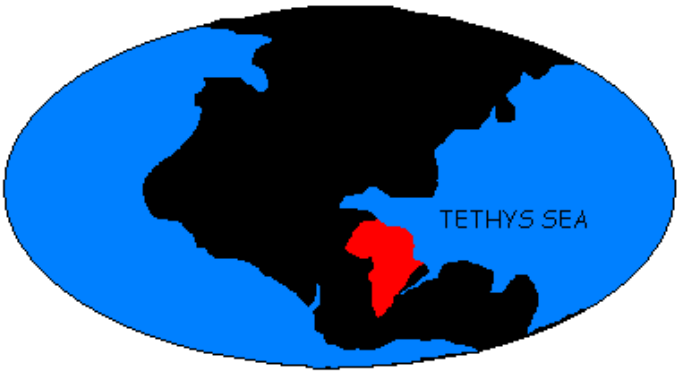
MAJOR BIOMES IN SOUTH AFRICA

BIOME	HIGH OR LOW RAINFALL	SEASON OF RAINFALL
Savannah	High 300-1000mm	Summer
Fynbos	Average to High 200-600mm	Winter
Nama karoo	Low 100-500mm	Summer
Succulent karoo	Low 50-250mm	Winter
Forest	High 500-700mm	All year
Grassland	High 500-2000mm	Summer

THE ANCIENT EARTH

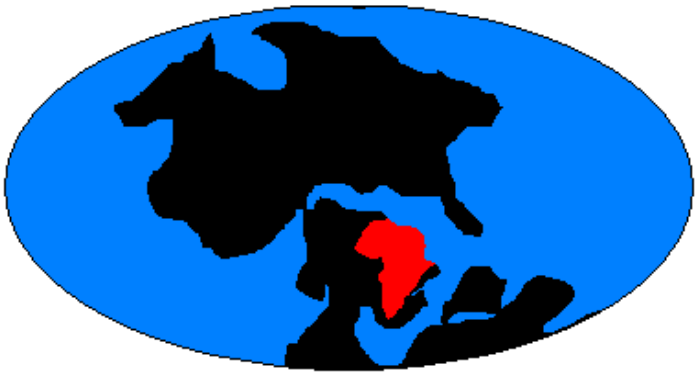
This is what the world looked like about 200 hundred million years ago. The first dinosaurs lived on Pangaea at this time. This was the Triassic epoch.

LAURASIA IN THE NORTH AND PANGAEA
IN THE SOUTH
206 MYA



Then, about 180 million years ago the southern supercontinent Gondwanaland began to break apart. Madagascar and the other Indian ocean islands began to break away from what would become Africa. This is the Jurassic epoch.

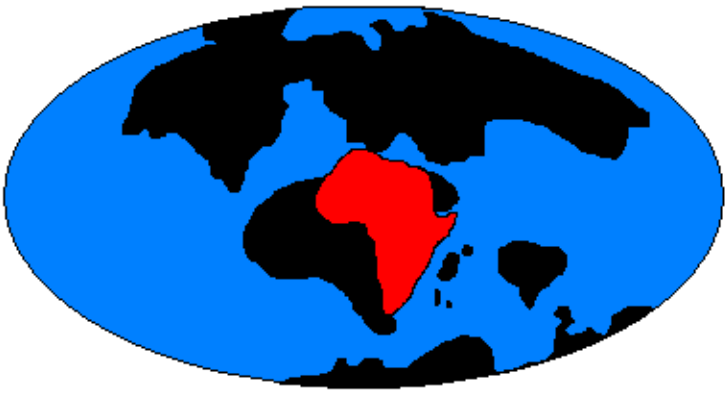
SUPERCONTINENTS LAURASIA (NORTH)
AND GONDWANALAND (SOUTH)
180 MYA



© Lee Gutteridge – 2 December 2005

60 million years ago the two supercontinents have almost finished their drift to the shape of the world we know today. By this time, the Cretacious, there were significant barriers preventing animals from drifting between continents. Mammals arrived during this time. Continents move at a rate of between 1 and 4 centimetres per year.

THE WORLD BEGINS TO LOOK SIMILAR TO
THE WORLD OF TODAY
60 MYA



© Lee Gutteridge – 2 December 2005

FISH

Some fish history.

No-one knows what animal the first fish evolved from as there has been no fossil evidence found as yet. It is however widely speculated that the first fishes arose from an animal similar to sea urchin or starfish larvae (Echinoderms). Fish are the earliest known vertebrate group. However in Carolus Linnaeus' 'Systema Naturae' in 1758 there was no record or classification of any South African indigenous fish species, although two introduced species were classified. In 1822 Burchell described the Smallmouth Yellowfish and the Sharptooth Catfish to science. These were the first of South Africa's rich fish fauna to be described. The fish is widely accepted to be the forebear of land living vertebrates, and a remarkable creature called the Coelacanth has been studied in great detail by science for clues as to how this may have taken place. Fossils of coelacanth from 200 million years ago have been found, in rocky areas of Illinois, with the young fish still attached to a yolk sac (not in an egg like modern fishes). Most coelacanth fossils are small, about 30cm in length. From the fossil evidence it can be seen that it has large fleshy forward fins, supported by bones. This would make an ideal walking platform. The most recent fossils are about 70 million years old, so one can imagine the surprise when a live specimen was captured by a trawler off the coast of Port Elizabeth in 1938. The specimen was taken to Mrs. Courtenay-Latimer, the curator of a small local museum. She was not able to identify it but realised that it was an important find, so she then contacted the greatest authority on South African fish, J.B.L. Smith at the Grahamstown University. He recognized it immediately for what it was. A two metre long living fossil! Leaflets were distributed to see if any more could be found, but there was no luck, and it seemed as though the fish had slipped back into extinction. However, fourteen years later, a specimen of this coelacanth (now named *Latimeria* by Smith) was caught at an island called Anjouan. At this island of the Comoro group, in the Indian Ocean between Madagascar and Tanzania, this *Latimeria* reappeared. And was apparently regularly caught by the local fishermen, who use its rough scales for rubbing down punctured inner tubes that they are repairing! They stated that they did not enjoy catching the fish as it fought hard and the meat was oily….

The coelacanth is not the only fish which scientists have studied for the land-sea link however. There is a more likely candidate called Eusthenopteron, which has a link of the nasal passage which opens into the roof of the mouth like land vertebrates do, and very similar bone structure in its front fins to modern land vertebrates too. Fish like these were succeeded in their quest for terrestriality by amphibians and reptiles.

Some fish characteristics are:

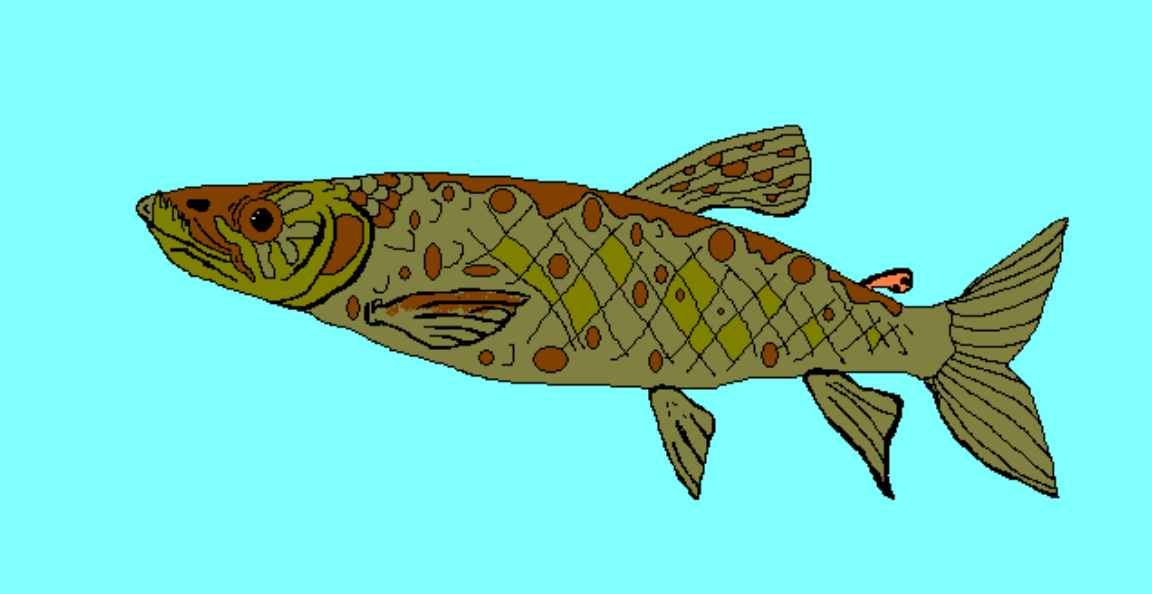
- They are poikilothermic
- They are wholly aquatic
- They are covered with scales
- They have fins
- They breath by means of gills
- They have no external ear openings
- They have no eyelids
- They have a two chambered heart

© Lee Gutteridge – 2 December 2005

Fish body shapes.

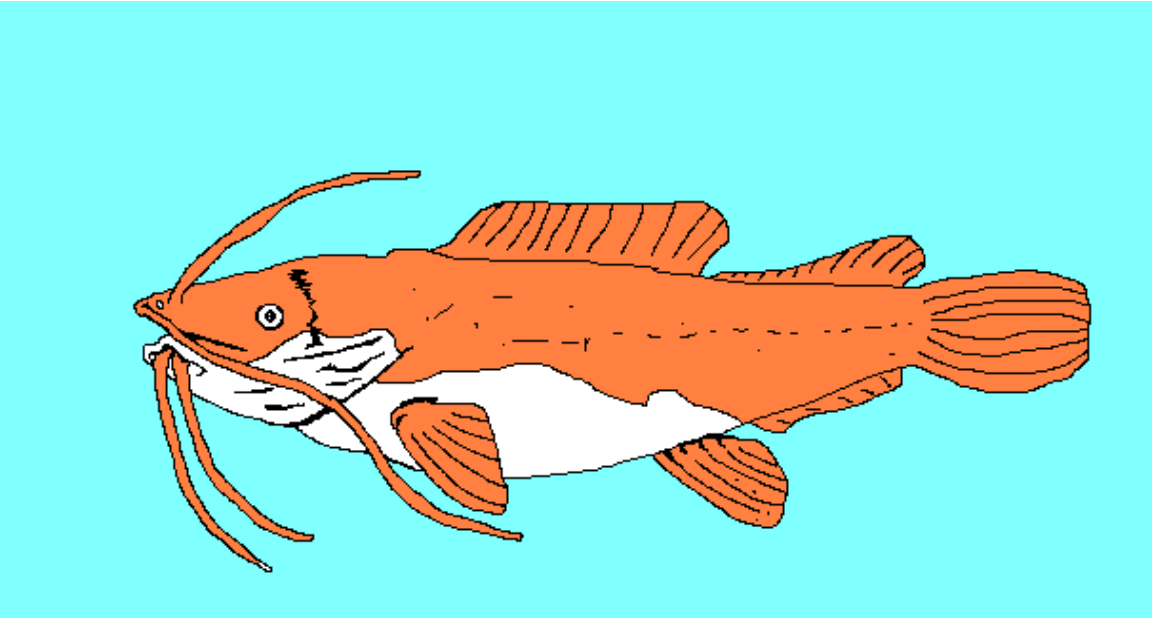
Fusiform.

This body shape is often adopted by predatory fish, as it is streamlined and a powerful fast shape for high speed swimming. They move forward by using wave like thrusts moving from the body to the tail, and the fins play an important role in stabilizing the fish. Fusiform fish which live in fast currents have a deeply forked caudal fin. Below is an image of an African Pike displaying the fusiform shape.



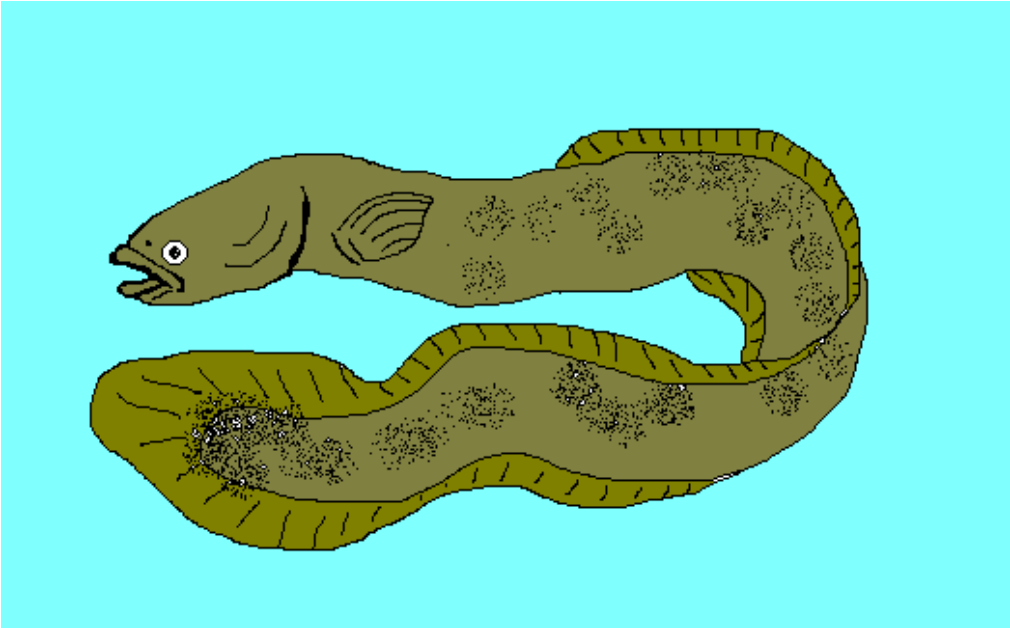
Depressed.

This vertically flattened form is adopted by most of the catfish which are mid-water living, or bottom dwelling detritus feeders. The head is much wider than it is deep, with a broad mouth. Below is a picture of a Vundu which is typical of this depressed form.

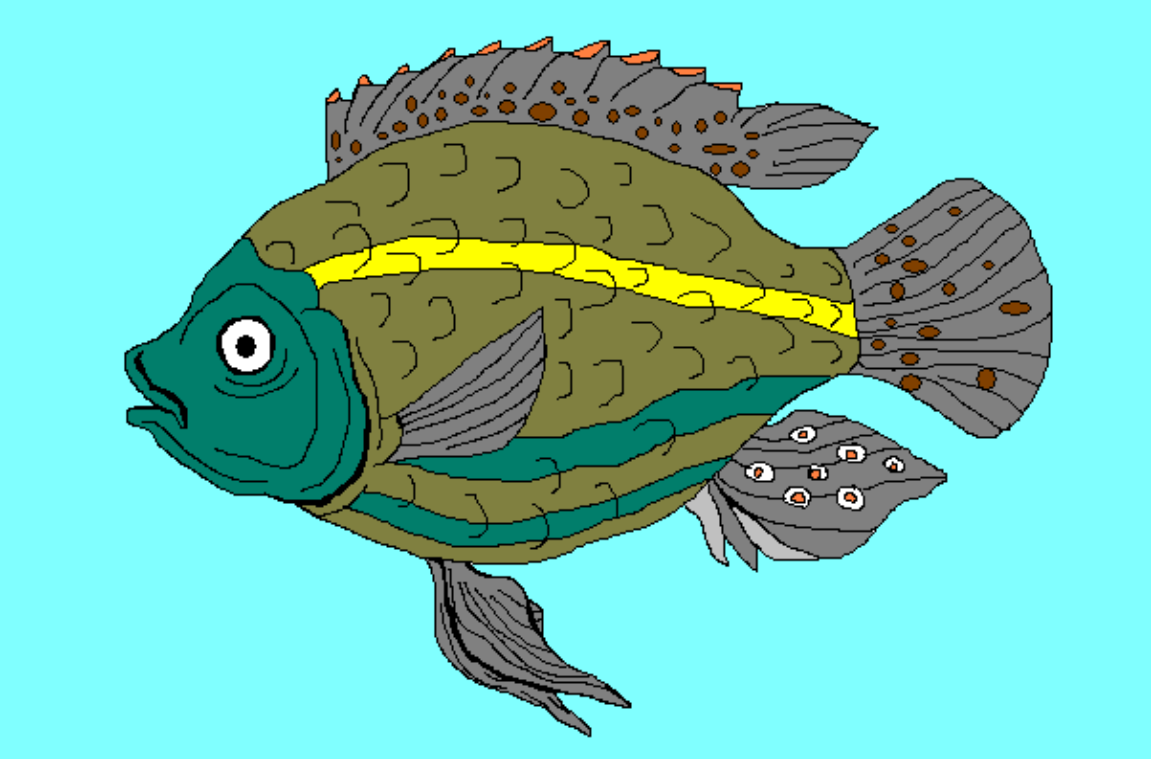


© Lee Gutteridge – 2 December 2005

Elongate.
These long narrow bodied fish are ideally suited to entering confined spaces. Below is an image of a Longfin Eel.

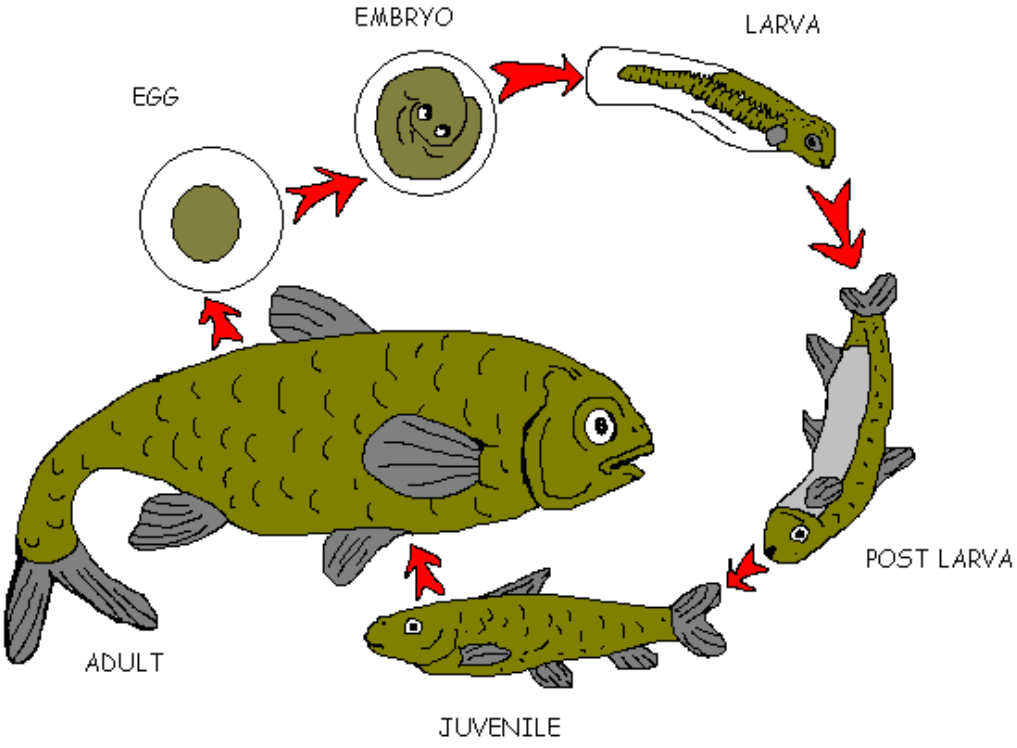


Compressed.
These narrow bodied fish are capable of hovering using the pectoral fins. Below is a picture of a Rainbow bream, showing this typical compressed form.

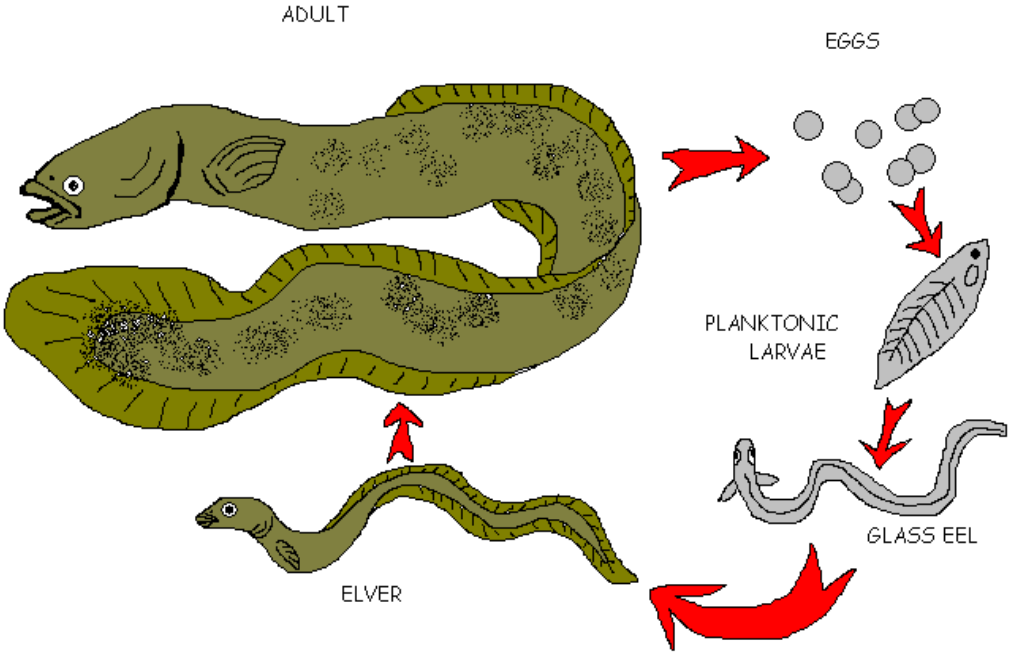


© Lee Gutteridge – 2 December 2005

A diagrammatical representation of the typical fish breeding cycle.

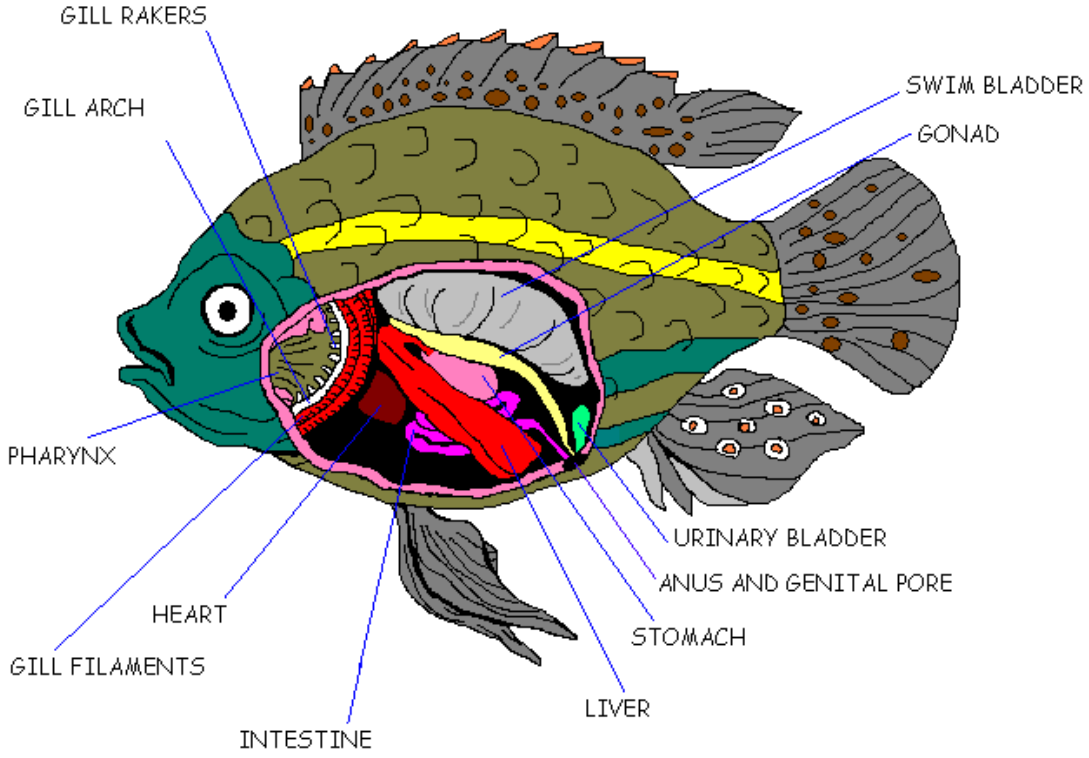


A diagrammatical representation of the life cycle of an Eel.

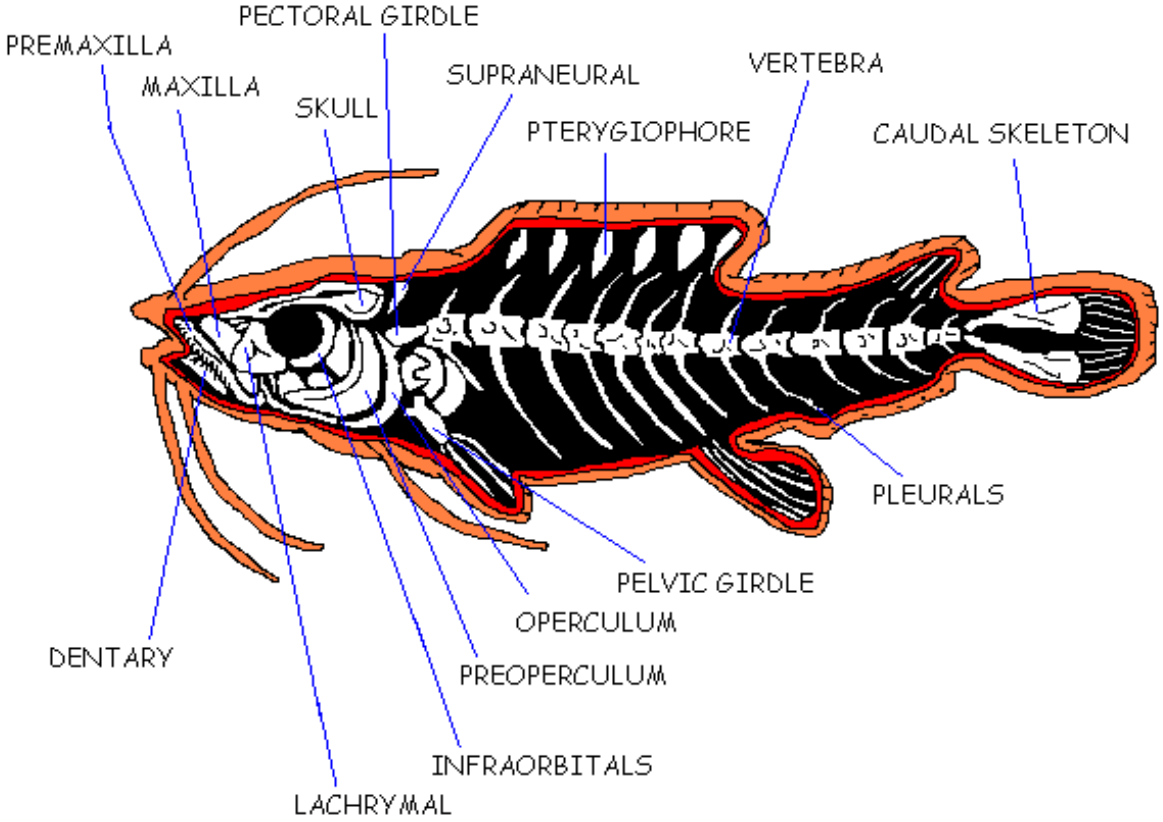


© Lee Gutteridge – 2 December 2005

Diagrammatical representation of the internal organs of a fish.

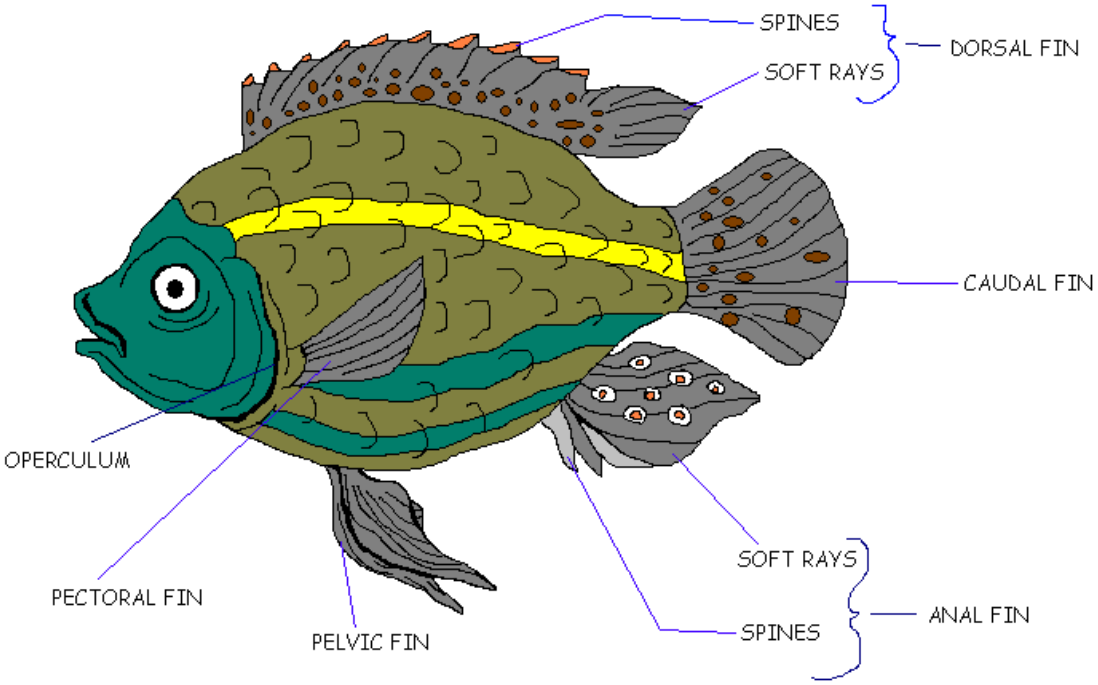


The skeleton of a fish.

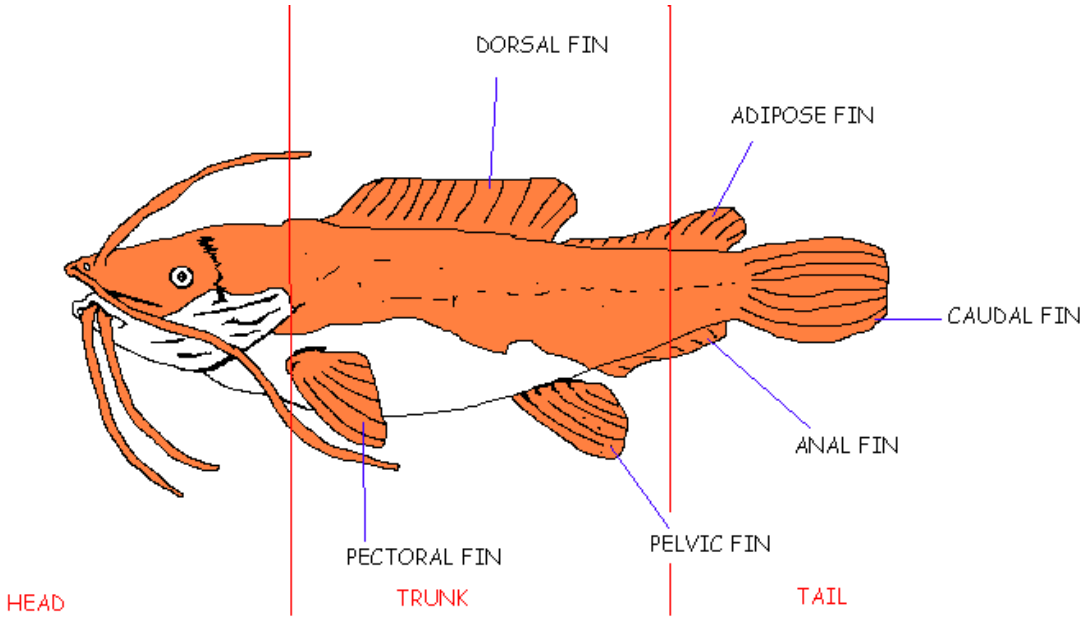


© Lee Gutteridge – 2 December 2005

Diagrammatical representation of the positions and names of the fins of fish.



Other fish forms include some different fins, and body segments such as the following.

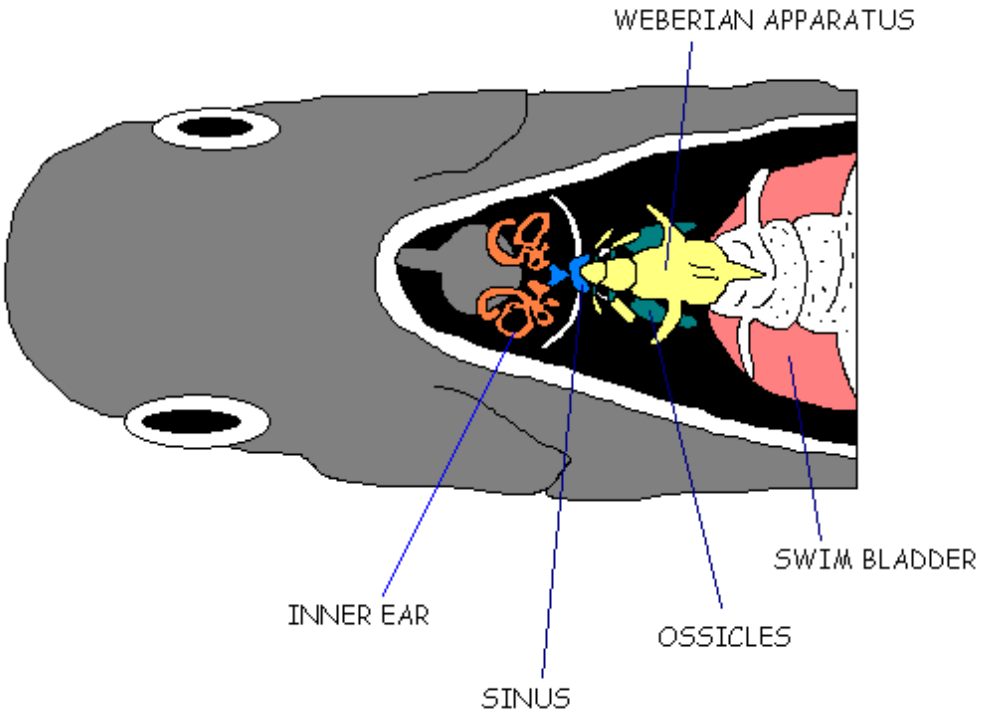


© Lee Gutteridge – 2 December 2005

Functions of some body parts include the following.
The lateral line is a sensory organ used to detect electrical stimuli, current flow, and movement at close range. It is a series of sensory cells contained in mucilage or gel filled tubules.

The swim bladder is used for controlling the buoyancy of a fish. Air is passed into the swim bladder to go up, and pushed out to go down.

The Weberian apparatus are a small group of bones between the bony ear and the swim bladder. These bones carry sound from the ear to the swim bladder where it is amplified to increase the sound volume.



Habitats
Fish are found in various habitats such as streams, rivers, swamps, dams, lakes, ponds, estuaries, deltas and mangrove swamps.

© Lee Gutteridge – 2 December 2005

Survival

Introduction

The definition of survival is to continue to exist – or come out of a situation alive.
There are few places left in South Africa which would necessitate such drastic measures as the definition out-lines but it is still a field of study which evokes much interest. It can be referred to as a 'just in case' subject, but when the time comes to use it you will be very glad to have the knowledge. Survival also gives a good insight into why animals do what they do, how their movement patterns work and why they eat what they eat. Animals are on a permanent survival course. All told, survival boils down to two major components, water and food. No less interesting are aspects such as shelter, movement, improvisation techniques, snares, fire and camp site selection.

Potential dangers in a survival situation are the following:

- Dehydration
- Starvation
- Drowning
- Carnivores
- Heat or cold in excess
- Sickness
- Venomous animals
- Allergies
- Poisoning
- Sickness and disease

Obtaining Water

Natural and unnatural indicators as to the location of water:

- local knowledge
- land form, valleys and depressions
- plant growth
- old wind mills
- animal and bird movement

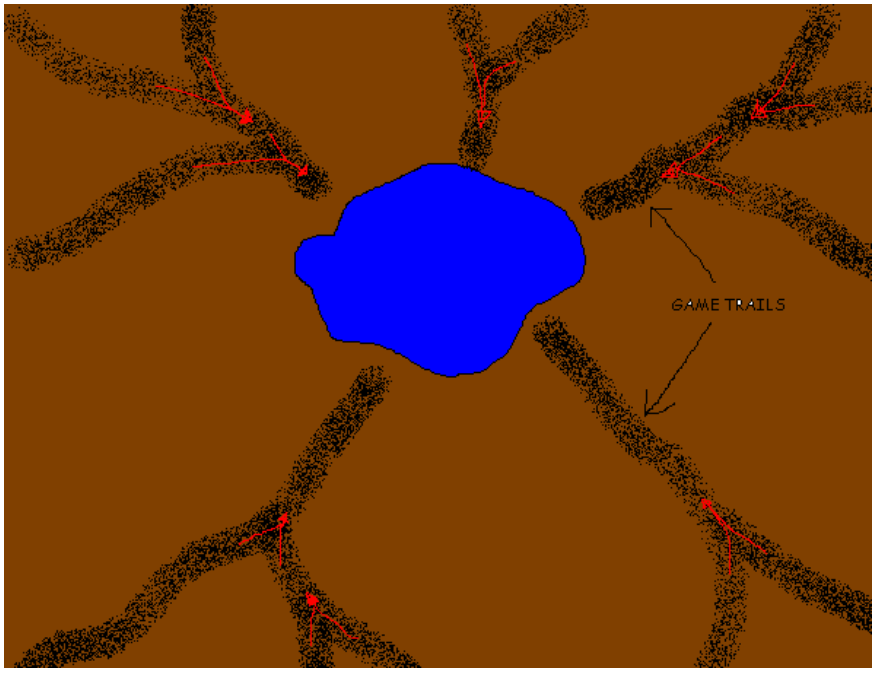
Animal indicators:

Examples of animals which indicate water are.

- Guinea fowl – drink at dusk, listen for their calls.
- Kudu, blesbok - these animals drink daily and usually move to water in the late afternoon.
- White rhino and elephant also drink daily.
- Sable antelope are usually at water in the late morning.
- Predator kills, particularly lion. Track the movement of these animals after a kill, it usually leads to water.
- Swallows and swifts aggregate over water in the late afternoon and at dusk.

© Lee Gutteridge – 2 December 2005

- African snipes drum over water and vleis in the late afternoon and early evening.
- Marsh owls and marsh harriers are usually found in vlei areas.
- Wattled and blacksmith lapwings are always close to water.
- Impala have a feeding range of not more than 2km from water, and zebra up to 8km from water.
- Warthogs and rhino wallow regularly, so if you see an animal with wet mud use its tracks to back track to locate water.
- Doves move to water singly, but due to allelomimetic (group mimicry) behaviour they fly away together simultaneously. Therefore a flock of doves (which is usually a solitary species) when seen is usually flying away from a water source.
- Sand grouse collect water in their breast feathers in hot weather while nesting to cool the eggs and for giving the chicks water once they have hatched.
- Game trails link together on the way to water. Follow the merged trails and you should arrive at water.

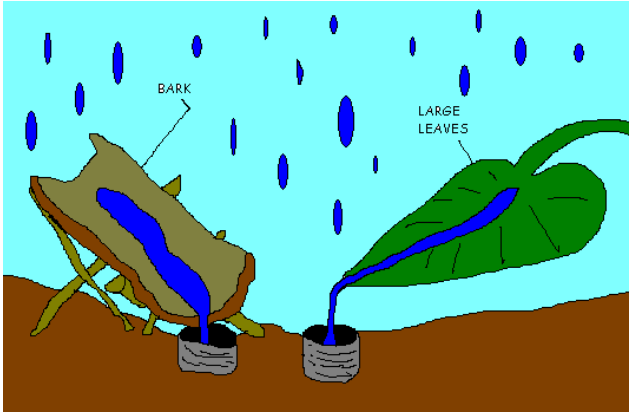


There are many methods of obtaining water, the most obvious of which is open water. Avoid stagnant water if possible. If it is all that is available boil it for a while to kill germs. Also you could us a straw to drink from below the floating scum or foam on the surface. Water Lilly stems act as a filtering straw and can be used as such. Sieving water through a t-shirt can also help to a certain degree, or through a container of sand. It is preferable to use running water from as close to the source as possible. Always check upstream as far as possible for dead animals in the water. Using water from small subsidiary channels which originate near the main stream is also a good idea as you may be able to arrive at the source of origin, often a seep area or a rain water collection area.

© Lee Gutteridge – 2 December 2005

Using the shells of ostrich eggs is a traditional method of storing water, but it will be affected by bacteria. A method of avoiding this is by using 'witbessie' plants to block the hole. Allow the plants to be in contact with the water and the plants natural anti-bacterial properties will prevent the water from becoming undrinkable. 'Witbessie' is known correctly as *Kylinga alba*. See the picture below.

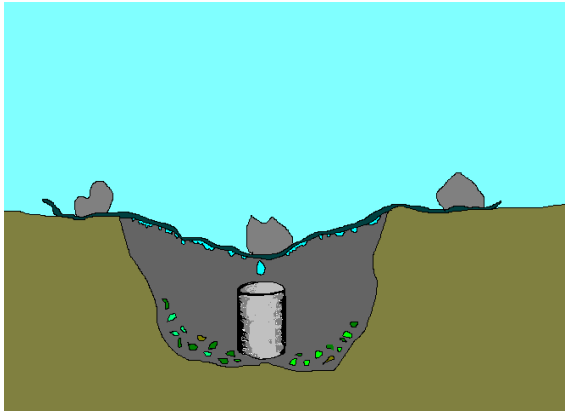
Rain water is also a good option for drinking. The collection of water from rain fall sometimes requires a little imagination though.



Drinking water is essential for survival and even partial dehydration produces a decline in efficiency. To conserve your body water, move in the cool of the day.
Try to rest in the shade between 11h00 - 15h00. Do not talk, keep the mouth closed.
You will find that by putting a small stone under the tongue or chewing a piece of bark will relieve your thirst. If sufficient water is not readily available, clearly you must find it. The most obvious sources as well as the easiest to find are ponds, streams & rivers. Do not be discouraged if you find only sandy river beds or dried up pans. By digging you may be able to reach water flowing beneath the surface. Before digging thrust a sharp stick deep into the sand; if it glistens water is close. The lower levels of sandy river beds and confluences are the likeliest places, also in the outside of sandy river bends. If you have found water by digging you can preserve the hole by lining it with bark and burying a grass bundle with 2 hollow reeds sticking out the top. This will give you a small cistern with drinking straws. Remember that reeds are not hollow all the way through and the divisions must be perforated. By sucking hard you will be able to get water and the bundle of grass acts as a sieve.

© Lee Gutteridge – 2 December 2005

Another way is to build a still:
This will yield up to a pint of water in dry areas. To make, dig a hole approximately three feet in diameter and half as deep. Preferably in a dry river bed or where the soil is damp. At the centre of the hole place a container, put the plastic sheet over the hole. The edges need to be weighed down with sand or a rock to seal the hole. The sheet should not be taut and should be depressed quite steeply towards the container by a fist sized stone placed in the middle of the sheet. The sun will shine through the sheet & the moisture will gather on the underside of the sheet. The water will then run down into the container. To speed up this process spread crushed green leaves or foliage in the hole around the container.



Water from plants
Like all living things, plants need water. Some of them make it available for the survivor. As a rule DO NOT try to get water from a plant with milky or coloured latex.

Transpiration trap
Drop a small stone in a plastic bag and tie around the leafiest branch that you can find making it airtight. As the leaves give off moisture water will pool in the bottom of the bag – the stone is weighing it down. Do not let the leaves lie too long in the water,

Water from plants is a trial and error process as in each area there are many different plants, tubes & trees which can provide water, below are just a couple:

- Baobab tree – tapping of roots. Cut the root close to the tree, then about a metre away from the tree. Lift the root vertical and up to a litre of water can be captured in a vessel below. Inner bark can be stripped and cut into cubes which can be chewed for moisture.
- Marula tree – eating or crushing of fruits, tapping of roots. – dig up roots and cut into 45cm lengths – drain out.

© Lee Gutteridge – 2 December 2005

- Mother-in-laws tongue – chew roots for a source of moisture – do not swallow due to very fibrous nature.
- Wild sisal – bulbs are dug up, skinned and chewed.
- Water lilies – check in dry pans for evidence of dead plants – dig up bulbs, skin & chew.
- Bengal Wandering Jew flowers (a blue flower) – these flowers contain water in their leaf sheath, pick flowers and suck them.

Animals

Certain animals can be used to help find water.

- Doves are crepuscular drinkers. They tend to arrive singularly and leave at the slightest disturbance in groups.
- Guinea fowl drink at dusk and dawn and you can usually hear their calls if you are in the vicinity.
- Kudu are usually in the vicinity of water in the late afternoon.
- Animal paths usually join together in the vicinity of water.
- Animals have a feeding are – impala do not usually graze more that 2km away from water, zebra about 8km.

If you are really thirsty, you will not be too finicky to take water from the stomach of fresh-killed game or to drink its milk or blood.

Open the stomach sac and pull out the fibrous green stuff you find in it. Squeeze out the liquid from the finely chewed contents of the last stomach and strain through cloth into a container made from the animal's hide. To clarify the liquid, let it stand or add small pieces of the liver. DO NOT take water from the stomach from a carnivore.

Making water safe to drink

Filtering

Filtering will take out particle of mud, vegetation and small creatures. You can strain the water through fabric – most articles of clothing will do.

Purifying

The only way to get rid of bacteria is to boil the water for at least 3 minutes, longer if possible.

Carrying Water

Use whatever is available, under extreme conditions you can improvise by using bamboo segments and animal intestines that have been thoroughly cleaned. Condoms are also leak proof. When filled put them in a sock to add protection and support.

The Building of Shelters

Finding a suitable place to sleep or camp in the bush is not as easy as you may think.

Use your common sense and pick a camp site carefully. Without a secure, sheltered place to rest up your chances of long term survival are hugely reduced. Cold & wet will take a physical toll on your system, but fatigue can be equally as damaging. Surviving is all about thinking clearly, and this is all but impossible when you are exhausted.

© Lee Gutteridge – 2 December 2005

Whilst the main job of shelters is to keep the worst of the elements off us, they have another role: to protect us from the ground. Always try to sleep and sit on something other than bare earth or stone – leaves, bracken, whatever comes to hand. This will relax your muscles, slow down heat loss and help you survive longer.

Always get your shelter right during the day. To put it up at night is almost impossible. Spend time on site selection and consider the following points

- Choose an area protected from the wind but avoid valleys, which can be very cold & subject to frost if you have to sleep in the valley make sure that you are above the flood line.
- Don't camp in stream beds or too close to rivers as they can rise very suddenly during rains. There is also an increased chance of being bitten to pieces by mosquitoes, and animals might crash into you on their way to the river to drink.
- Don't camp near termite or ant hills – snakes tend to live in holes in termite mounds.
- Trees are good for shade but check which tree it is as the fruit on fig trees attract small flies and insects in their thousands.
- Avoid camping on an animal path as you will be obstructing it when the animals try to move through. If you must sleep on or near an animal trail urinate on the trail a short distance out of camp on all access points as this will deter most animals from approaching.

Building a suitable shelter

The simplest shelter is better than nothing at all. If you have a tarpaulin or poncho and some cord you can make a shelter. Stretch the cord between two uprights – trees, saplings or branches that you have cut – and drape the cover over it. Weigh down the edges with rocks. If you can't find two uprights secure the cover at one end and peg the other end down.

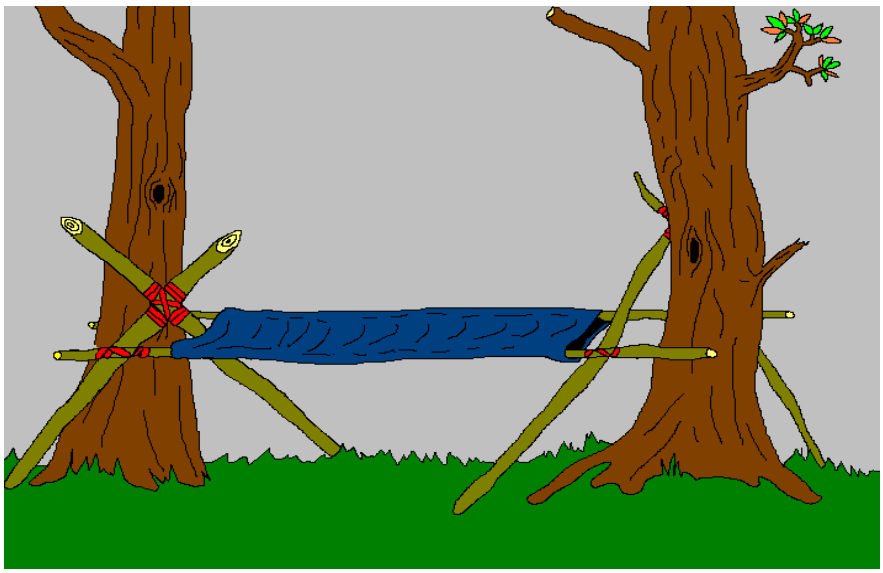
© Lee Gutteridge – 2 December 2005

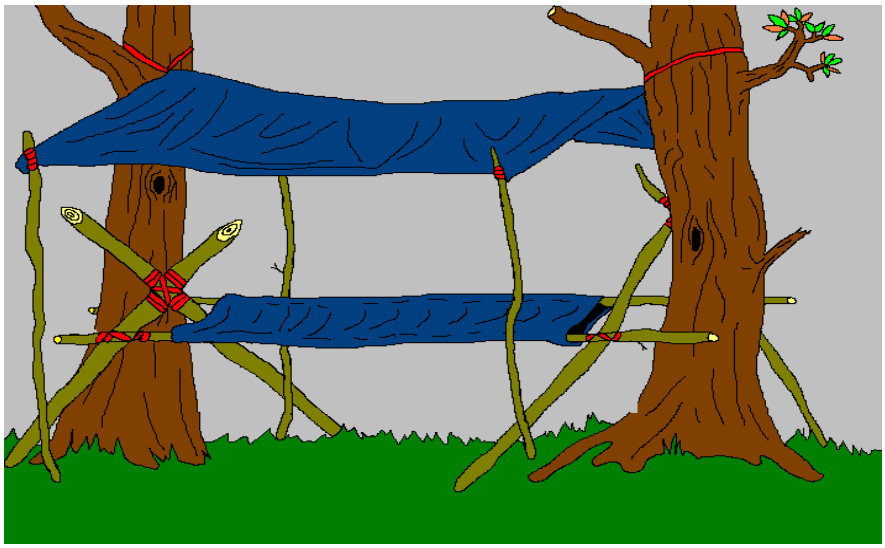
If however you intend to be in the same place for a while, i.e. static survival, while waiting for a search party to find you may wish to prepare a more elaborate shelter. Below are some examples of possible shelters.

<u>The A-Frame Shelter:</u>

Main components: Four main uprights
Roof beam
Four rails

1. Lash the 4 uprights to make 2 upside down 'V's and join them across the top with the roof beam.
2. Lash the rails at the right height for your sleeping platform
3. If you have the right type of poncho you can thread the side rails through the poncho sides to make your bed.
4. Tie cover over the roof or use leaves, branches or other natural materials.

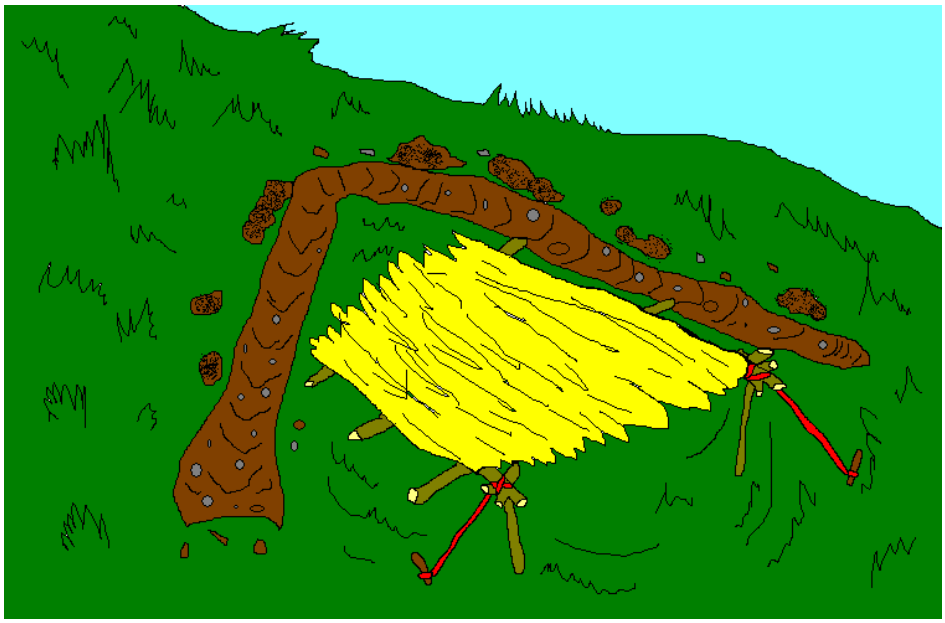




© Lee Gutteridge – 2 December 2005

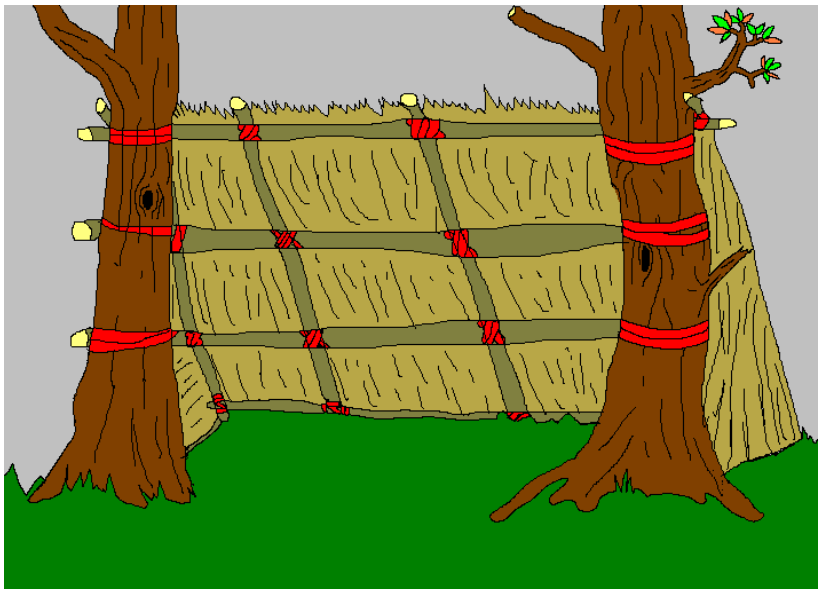
The Dip Shelter

If the shelter is built in a natural dip in the ground dig a small trench around the shelter with a run off leading downhill so that if it rains the water will run away.
Make sure that you make the depression the right size. Lie down to check length & width, then sit up to check height. Make the bed first, if possible from a layer of wood covered in foliage and then build the shelter above it.



The Lean-to

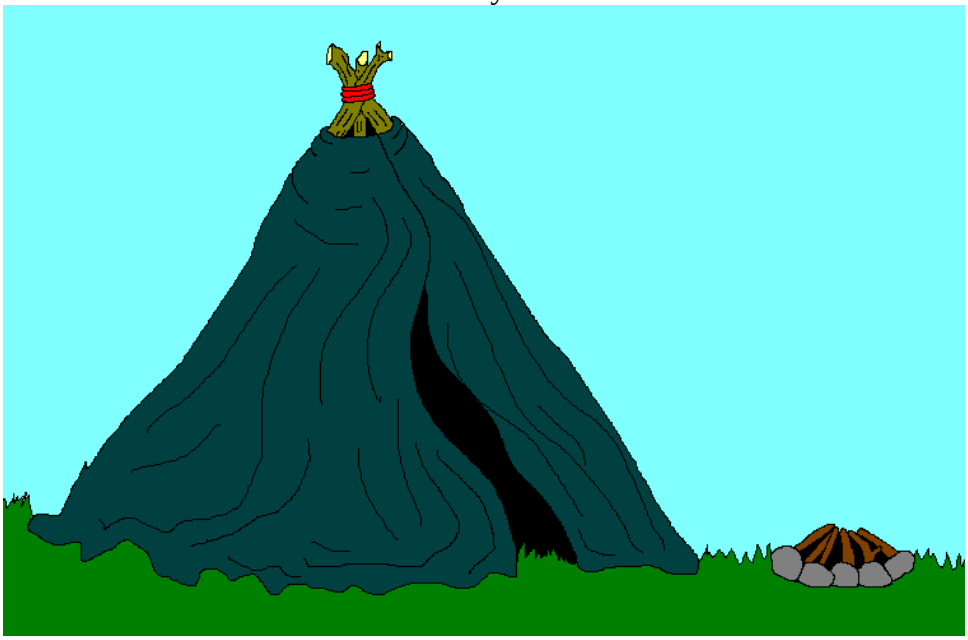
If you have an ample supply of wood this is a very good shelter to make. You can set your cross beam between 2 trees with low branches or make a couple of uprights yourself. Make the roof structure with strong, light twigs or branches, then cover with whatever materials you have – grass, foliage etc. Ensure that the pitch is steep enough for the water to run off.



© Lee Gutteridge – 2 December 2005

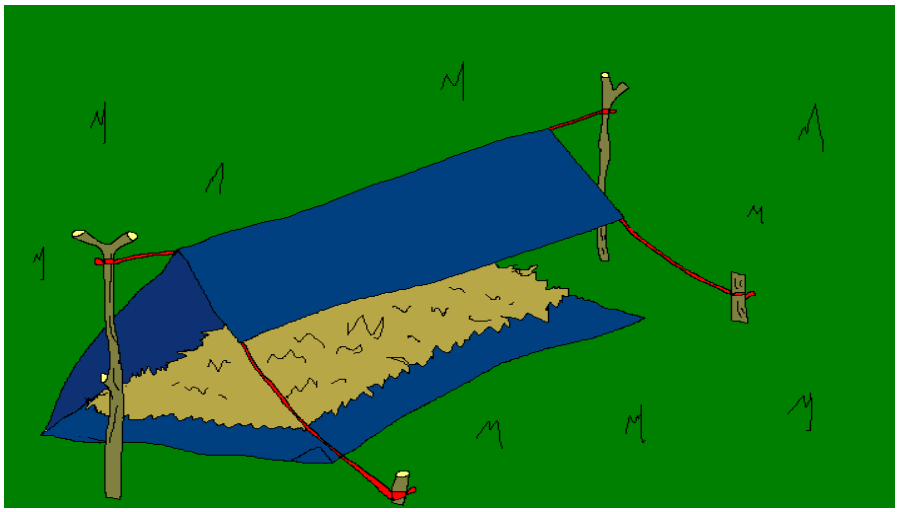
Tepee or Wigwam

Three or more long sticks are tied together at one end, the others are stuck into the earth to form a triangle or circle. Cover it with whatever material you have.



Tarpaulin/ Plastic Sheeting Shelter

A tarp can be a groundsheet and shelter all rolled into one. This simple shelter can keep you dry from above and below.

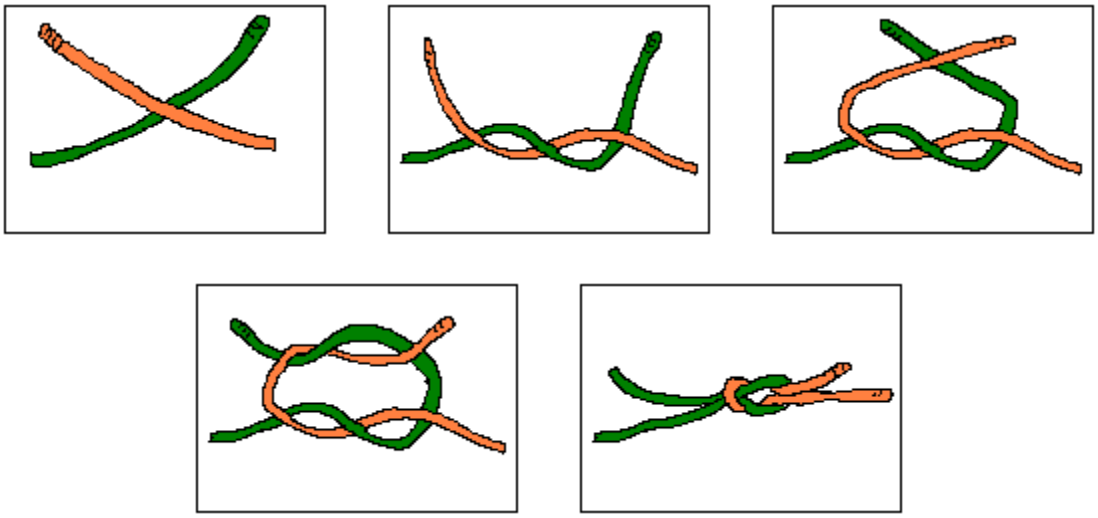


© Lee Gutteridge – 2 December 2005

Knots

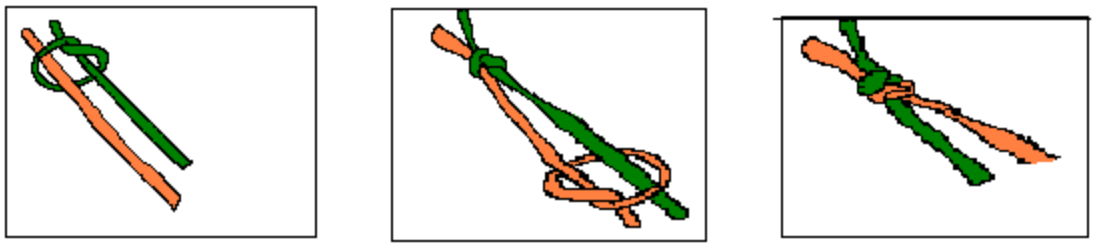
Knowing how to make strong knots will greatly improve your chances of survival. It comes in useful for making weapons and snares, as well as for lashing your lean-to or shelter to its supports.

Reef Knot



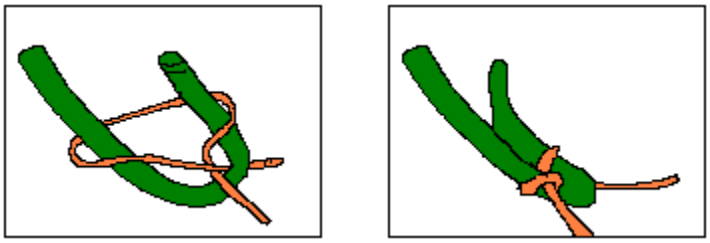
Joining two ropes together.

Fisherman's Knot



Use this knot when the ropes are the same size, slippery or wet.

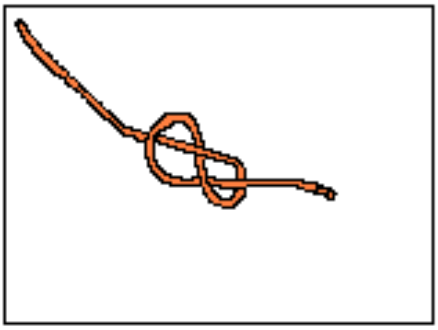
Sheet Bend



It is useful for putting a knot in ropes of different thicknesses.

© Lee Gutteridge – 2 December 2005

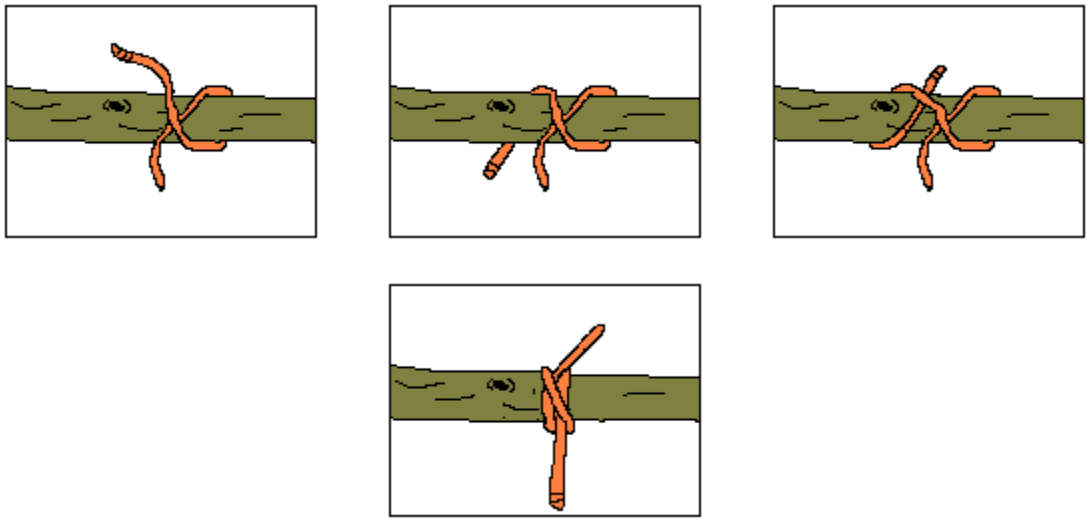
Putting a knot in the end of the rope



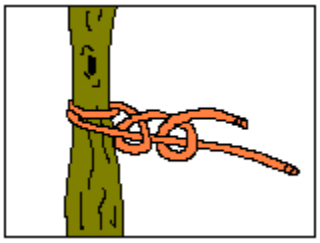
This knot is to be used if the ends are fraying or if you want to stop it going through a loop.

Attaching ropes to sticks & branches

Clove Hitch Knot



Round turn & two half-hitches

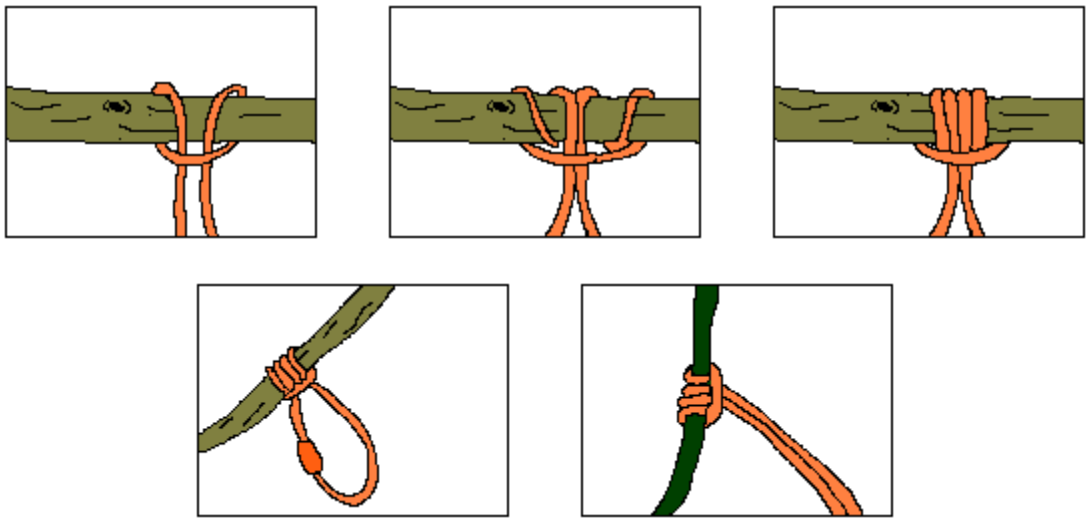


This knot is to be used if whatever you are tying up is pulling in the opposite direction from the tree, e.g.: an animal. This could therefore be used to attach a snare to a whip branch.

© Lee Gutteridge – 2 December 2005

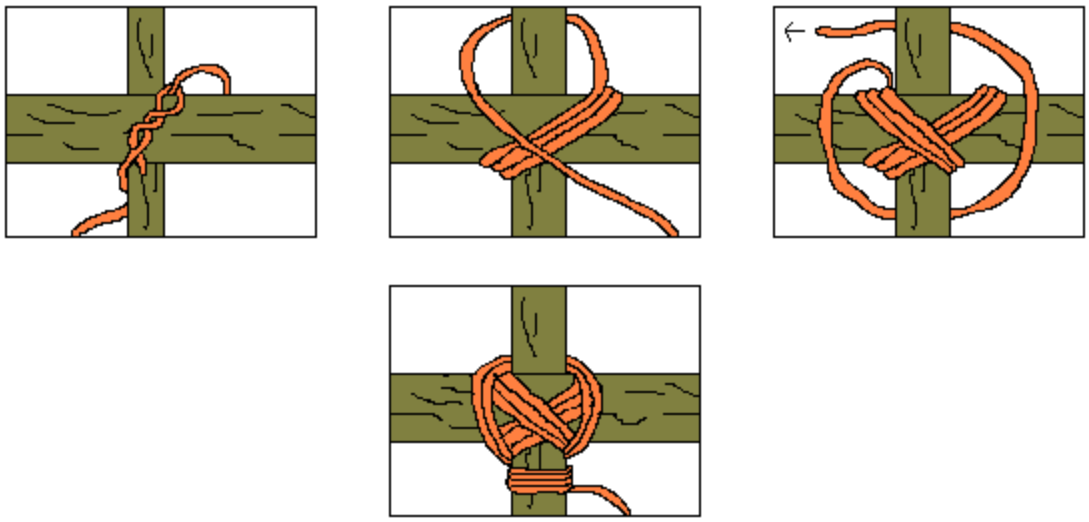
Prusik Knot

This knot is ties which a rope that is already a closed circle. I.e. the loose ends are joined.



The loop that is made by this knot will not slip when under tension. If the knot is fixed to a branch you can use this knot as a moving foot hold. Drape the loop over the main rope and pass it through itself twice.

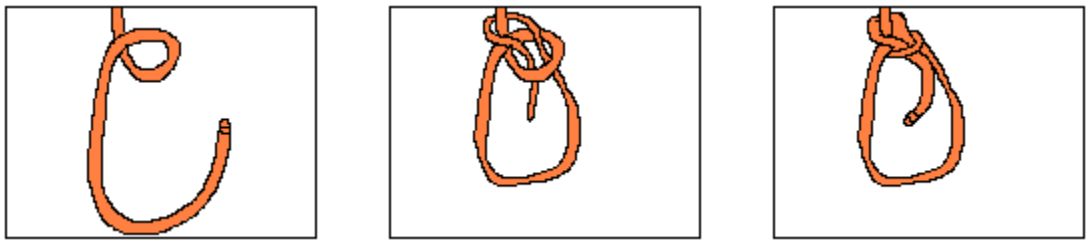
Joining two pieces of wood



Effective diagonal lashing is vital for building a shelter and any sort of x-shaped support. Finish off knot with a clove hitch.

© Lee Gutteridge – 2 December 2005

Making a Bow line



This loop will not slip

Making Fire in a survival situation

When you're up against the elements fire can be a life saver. A good fire will cook and preserve you food, sterilize water, keep animals at bay and show people where you are. To make a fire you need some to know some basic things: to work a fire needs air, heat & fuel. You can spend any amount of time coaxing a fire into life so once it is lit make sure you keep feeding it.

Think about where to start your fire – look up to see if the flames are going to reach a tree, make sure that it won't spread by accident. If necessary clear the ground around the fire. If it is windy make sure that you take wind direction into consideration when finding a place to build your fire.

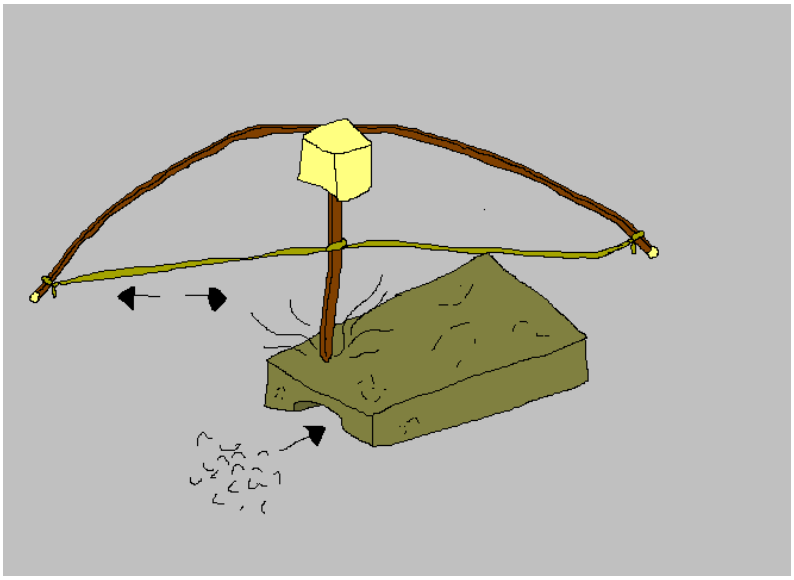
Natural Tinder
Wood shavings – scrape some wood into fine shreds.
Decayed wood – look for fallen tree branches. Pull off bark and dig out soft, rotten wood.
Dried bark – peal bark off trees in strips.
Lining from bird's nests – makes perfect tinder
Resin – when conifers are damaged they bleed resin which burns very easily.
Termite mounds – pull off chunks and crumble.
Dung and droppings from herbivores can be used as tinder as long as it is dry.

Man-made Tinder
Petrol
Ammunition - hold the bullet casing in one hand, grip the bullet between the finger and thumb of the other hand and work it free. Be careful to point the bullet away from camp & yourself. Pour contents carefully onto your tinder, mix it up & apply the spark.
Cotton wool & Tampons

© Lee Gutteridge – 2 December 2005

Making Fire

Stick Method



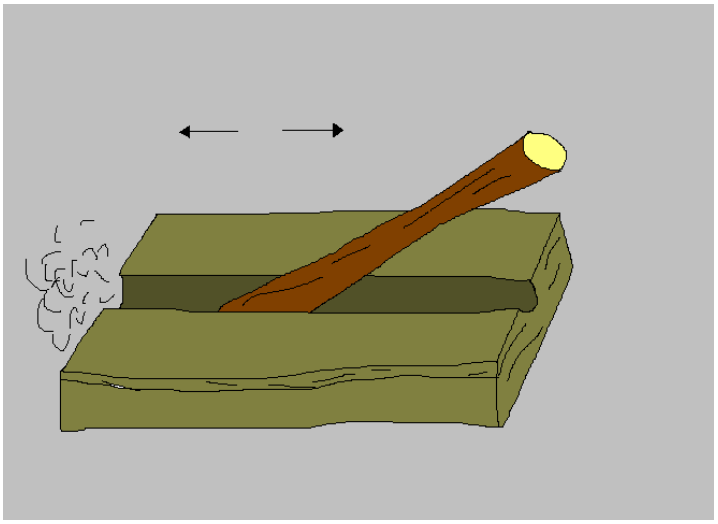
You are creating a short drill, but instead of making a hole you want to make as much friction as possible. Eventually the heat will light the dust and create an ember. This ember can be used to light your kindling and you have a fire.

For this method to be effective the wood must be very dry. The bit needs to be straight, round about 25cm long and 2-3 cm thick. Carve the end that will be turning on the wood into a point. The bit needs to be made from a harder wood than the base. The base wood needs to be around 30cm by 10cm. it has to be long enough for you to hold steady with your foot whilst you turn the bit. The block needs to hold the bit steady whilst you work, so it needs to fit into the palm of your hand. Make it out of wood. The bow should be 60 – 7- cm long, you may have to notch the ends to take the cord.

Dig a slight depression in the base wood at one end and cut a notch from the edge of the board to the depression. This is where you want the glowing embers to fall. Make an ember pan out of a flat piece of wood or bark. This stays under the notch to catch the embers; you'll be putting tinder on it to make the first flames. Slip the bowstring over the bit and get into the position as shown in the diagram. Everything needs to be as steady as possible. Try and steady the block against your shin and keep your foot firmly planted on the bas wood, put your driest timber by the notch on the ember plate. Start drilling by moving the bow back and forth. It is important to keep the bow horizontal & the bit vertical. The friction form the bit bores dust from the base wood and heats it to burning point. When you see smoke coming from the tip of your bit, carry on for another half a minute, then put the bow and bit aside. You may have to coax the ember free of the base wood on to the ember tray. Blow softly but firmly until you see it glow strongly, add tinder and blow again. When it flames put it into the fire.

© Lee Gutteridge – 2 December 2005

The Fire Plough



The plough also works by friction. It relies on pushing a hard wood "plough" up and down a groove cut into a softer wood. The plough creates heat, kindling and embers as part of the same process. Its advantage is that you can use the plough on a fallen tree trunk with no more preparation than cutting a straight shallow groove into it.

Sun Rays

Any glass piece that can concentrate the suns rays can be used to make fire. Lenses from binoculars, cameras, telescopes, glasses or the base of a bottle are ideal. Concentrate the rays on pile of dry grass, experiment with your finger to find the "hot spot"

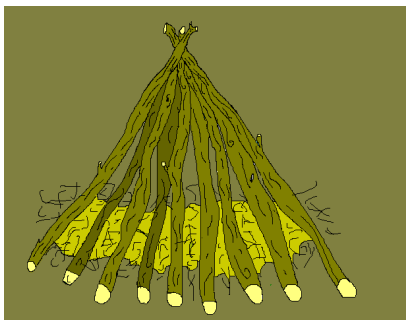
Electricity

A vehicle battery can be used to start a fire. Short the battery poles with any metal object. It will create a spark; do this in prepared dry materials.

Magnesium fire starting kits

These key shaped magnesium sticks are available at outdoor shops, and are used by scraping some magnesium off the stick under the kindling, and then a spark is made by quick movement of the knife blade over the magnesium rod. This should, with practice, ignite a fire.

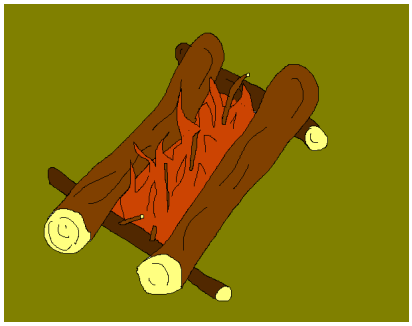
Standard Wigwam Fire



To start the fire, arrange some kindling in a small pyramid with an opening on the windward side for inserting a light. Make a spill from one or more strips, light it and apply to the kindling. Lay smaller, then larger, pieces of fuel on the kindling but don't make too big a fire.

© Lee Gutteridge – 2 December 2005

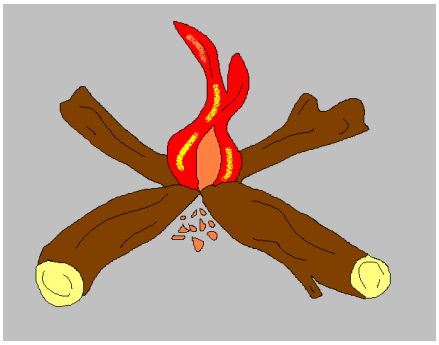
Long Log Fire



Gather pieces of timber as long as you like, make a base for them out of smaller sections laid at right angles to where you are going to sleep. Lay the long pieces on top – two or three deep, parallel to your body.

Star Fire

This is a very economical fire and can be easily controlled. Get the fire going then lay 4 logs in a star shape, the ends meeting in the fire. To create more heat push the ends close together, to reduce, pull them apart, if you are leaving the fire, put a flat stone over the burning ends to protect them. When you return remove the stone and blow the embers back to life.



Always remember to keep a sizeable green leafy branch close by in case the fire gets out of hand.

Finding Food

When you are foraging for plants, there are certain signs to watch out for that should put you off. Avoid these unless you are 100% certain about the identification of the plant.

- Most red plants
- Plants with a milky latex in the stems
- Grasses with hooks on stems and leaves
- Mushrooms and toadstools are a very poor food source and although few are poisonous, the risk of making a mistake are great
- Green / unripe fruit
- Smells strongly of peaches or almonds
- Avoid cucumber & tomato like plants
- Taste bitter
- Plants that are old, rotten, worm-eaten or mouldy.

© Lee Gutteridge – 2 December 2005

If you suddenly go onto a diet of vegetables and herbs your stomach will be unused to it and you will most likely end up with a sever case of diarrhoea. So start with a light meal the first day and gradually increase the amount. Rather have several small meals a day than one or two large ones.

Testing food when no cooking facilities are available:

- Spread the fruit on your lips, inner side of upper arm, and wait 5 minutes. If no burning sensation occurs continue with the tests.
- Take a teaspoon of the plant food, prepare it in the way it is to be eaten, then hold in your mouth for 5 minutes.
- If by this time, no burning sensation occurs, swallow.
- Wait 1 hour
- If you do not experience any ill effects – such as nausea, cramps, or diarrhoea eat a handful and wait 8 hours.
- If no side effects occur this plant may then be considered edible.
- Make sure that you carefully note the description of the plant as you do not want to re-test it.

Testing food with cooking facilities

- Get rid of any disagreeable taste by boiling the plant in water for 5 – 10 minutes
- Take a teaspoon of the plant food, prepare it in the way it is to be eaten, then hold in your mouth for 5 minutes
- If by this time, no burning sensation occurs, swallow.
- Wait 1 hour
- If you do not experience any ill effects – such as nausea, cramps, or diarrhoea eat a handful and wait 8 hours.
- If no side effects occur this plant may then be considered edible.
- Make sure that you carefully note the description of the plant as you do not want to re-test it.
- Do not test two foods at the same time. You will not know which is giving you a bad reaction.

Keep the water that you boiled the plant in – if it is edible you can then drink the nutrient rich water.

Remedies for food poisoning

When testing whether food is edible or not make sure that you have some activated charcoal on hand as it acts as an antidote for many known food poisons. Fire is a good source of activated charcoal – scrape burned woods, pulverise into a powder, and place in an airtight container. If needed use a handful with some water to wash it down into the stomach.

Making Potash

Potash is used in medicines and soap as well as in food preparation. Place ash from a fire in a small pot with a spout or tap at the bottom. Collect the water that is allowed to drip out. This is potash.

© Lee Gutteridge – 2 December 2005

Roots and tubers

The best time to harvest roots & tubers is spring; cook them first to make them easily digestible. Don't peel them as all the goodness lays in or just below the skin.

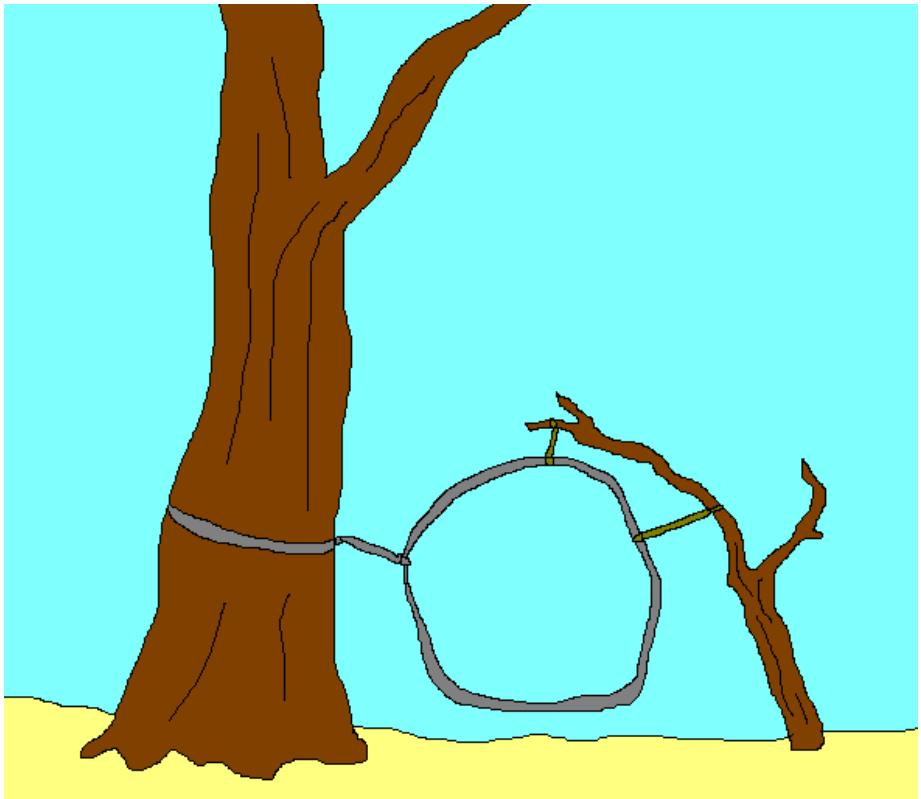
Snaring game, reptiles and birds

Snares can be made in many ways, using string made from plants, leather thongs cut from animal carcasses or using shoe laces or wire that you have with you in a survival situation. Cars or aeroplanes have no shortage of wiring that can be used. Snaring can be an efficient energy conserving way of obtaining protein.

Some examples of snare building methods are as follows.

Simple snare

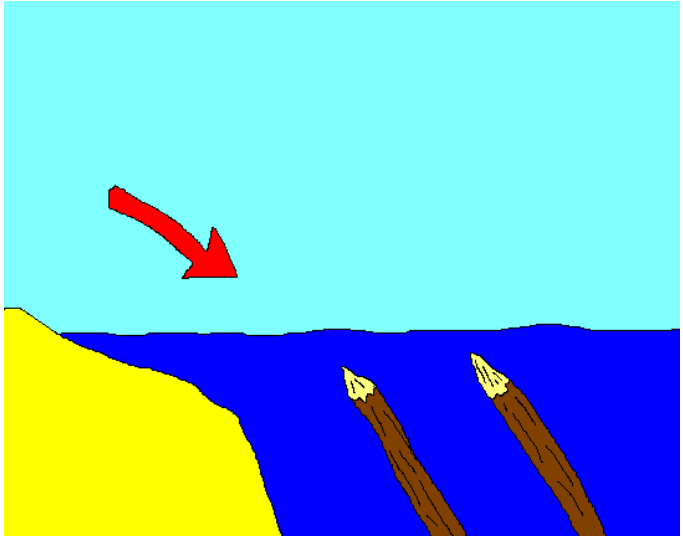
This is simply a loop of wire over a game trail, attached to a sturdy tree. One can use small strips of bark to hold the loop in place. Use a regularly used trail, and sprinkle animal dung around the area to disguise your scent. Always check the snare frequently, at least daily, and keep away from it if it has not sprung as your scent will chase away game. You can also use logs and branches to channel game onto your trail.



© Lee Gutteridge – 2 December 2005

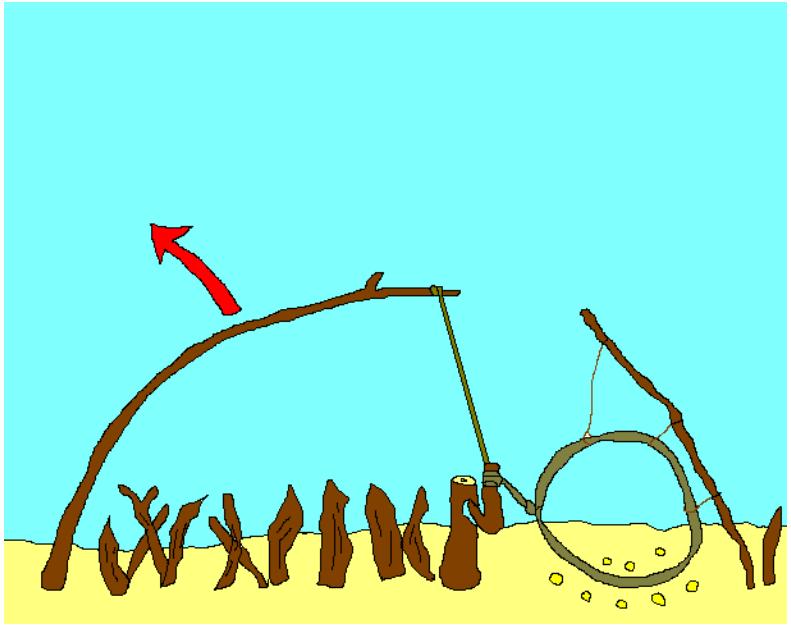
Stake traps

This horrific method of killing game is widely in use in Africa, and focuses mainly on hippopotamus. Large wooden spikes are hammered into the bed of a river on a hippo access point. These are then sharpened and situated below the surface of the water. The hippos are startled into running for water and impale themselves on the stakes.



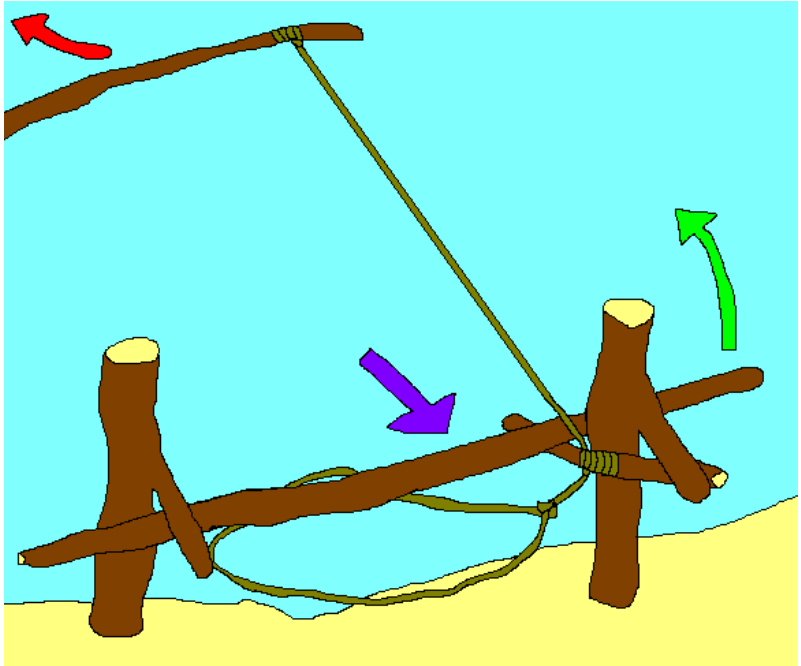
Whip snare

This snare is spring loaded with a bendy stick. A hook is made from wood which is tied to the snare line. This hook hangs upside down and hooks into another notch hook carved into a stump in the ground. When pulled tight the hooks should latch into each other, causing the whip stick which can be a planted stick or a living sapling (which must be bendy) to be bent and sprung. When the hook is touched it should be loose enough to slip out and whip back in the direction shown by the arrow below. The snare is then attached to this simple trigger system, and when set the animal should be pulled violently, hopefully breaking the neck of the bird or small mammal. Use seed or fruit to bait this trap. Build a wall to channel the prey if needed.



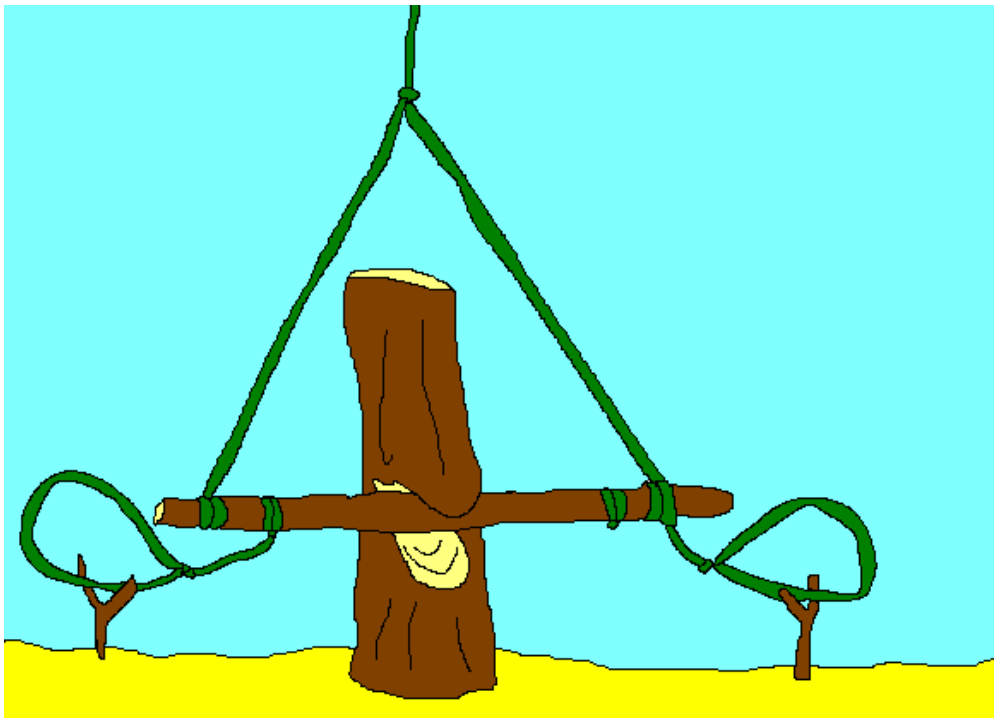
© Lee Gutteridge – 2 December 2005

This is an adaptation on the trigger mechanism of the whip snare. A trigger stick (purple arrow) is hooked into an upside down, planted fork stick. It is then placed below a smaller stick tied into the snare rope which is also hooked into a second (planted upside down) fork stick. When the trigger stick is touched the snare moves upwards (green arrow). The red arrow shows the direction of the whip stick.



Double whip snare

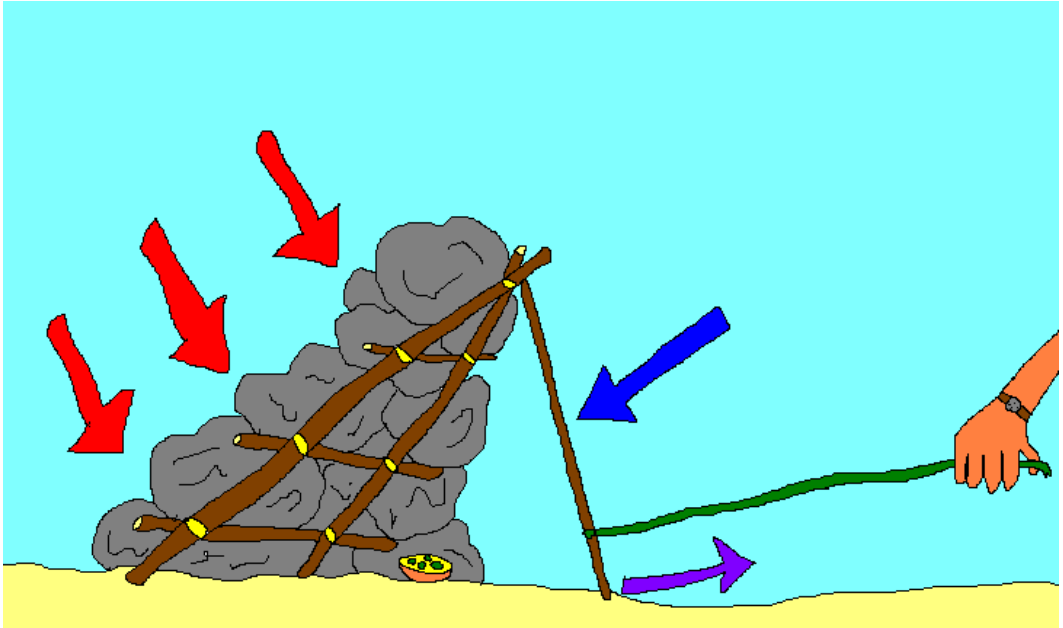
This snare can be used to cover two small game trails simultaneously. It is a modification on the whip snare with a trigger that covers two snares. The depth of the groove on the upright will determine the sensitivity of the trap.



© Lee Gutteridge – 2 December 2005

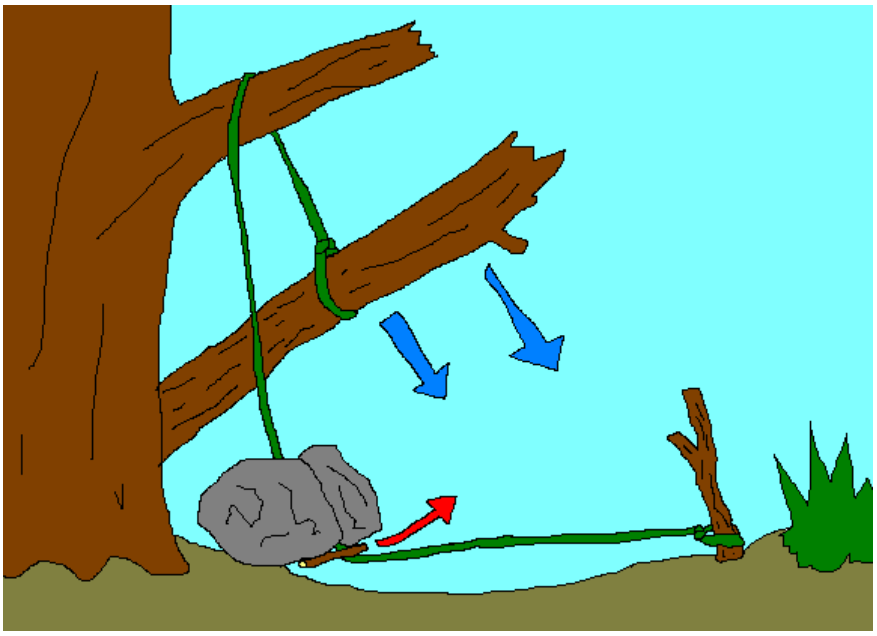
Rock trap

This is a snare which is attached to a pull line if you have a long enough string available such as a fishing line. It can also be set up that the slightest movement will disturb it. It is useful for small mammals such as porcupine or scrub hare, and needs to be baited. The red arrows show the direction of the dropped rock fall. The blue arrow is the trigger stick and support. The purple arrow shows the direction of the pull line to spring the trap.



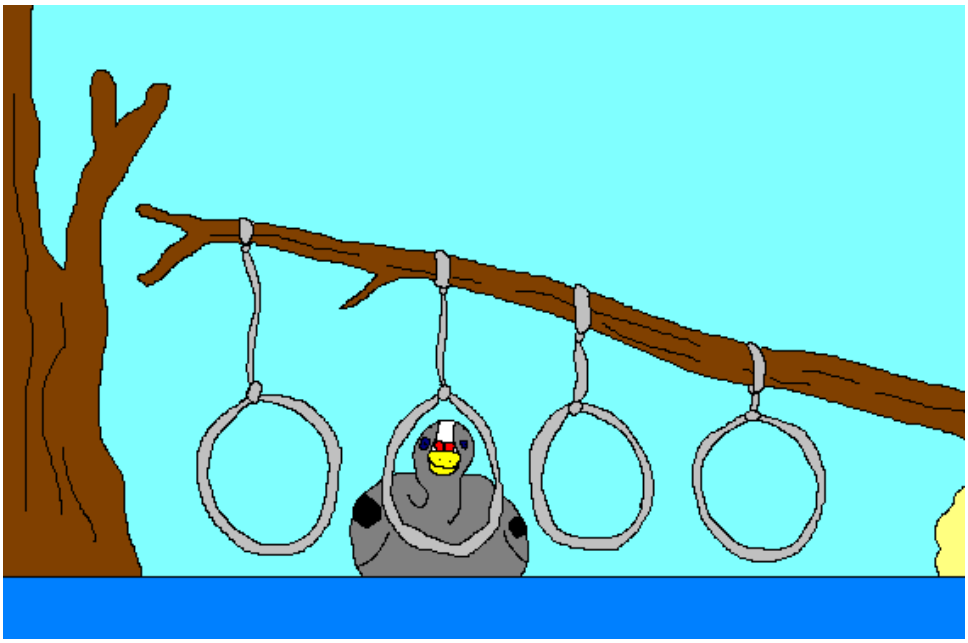
Big game dead fall trap

This trap is designed to break the back of an antelope. It is important that you need to be strong enough lift the dead weight. Also you need a sturdy rope and rocks heavy enough to hold the trigger stick down. When the rope is touched the trigger moves in the direction of the red arrow, and the log falls in the direction of the blue arrows, hopefully immobilising the prey. Take great care not to drop the trap on yourself whilst setting it.



© Lee Gutteridge – 2 December 2005

Hanging snare over water
This snare type can be set in narrow streams for ducks and waterfowl.



Movement

This can be an important aspect of survival as if you move around too much in the hot times of the day you will be shortening the amount of time that you have until you need another drink and something to eat.

Good guidelines are:

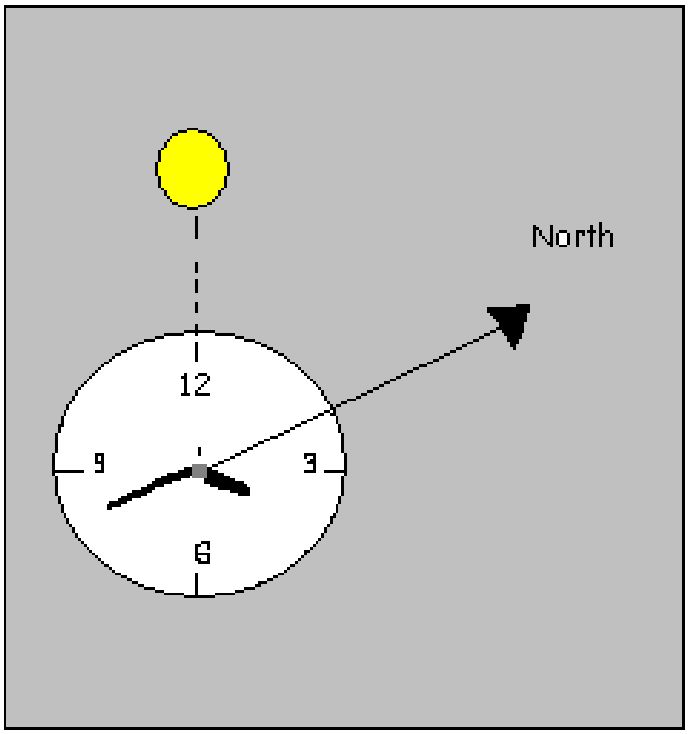
- Avoid all unnecessary movement
- Breathe through your nose to avoid excessive moisture loss, don't talk
- Use a stick as a support in steep sections as it can prevent unnecessary slipping
- When you find food and water in abundance eat and drink as much as possible & take with you what you can
- If possible stay in groups – don't split up
- Tray and gain some direction – if you know where there is settlement or road head for it.

© Lee Gutteridge – 2 December 2005

Navigation

Methods of determining direction during the day:

Sun & Watch Method



Southern Hemisphere Wrist Watch Method – hold your watch horizontal in front of your chest. Point the 12 towards the sun, take a piece of grass and put it on the 12, let the shadow fall on the watch over the middle towards the 6, bisect between the 12 o'clock numeral & the hour hand – this is North.

Natural Methods

Anthills – termites build the tip or the hill towards the hottest direction of the sunrays, with the result that most termite mounds tend to tilt over to the North or Northwest.

Scorpion holes – entrances holes usually face east

Vegetation and plant growth –

- trees are darker on the southern side than the northern side
- flowers will often face north as they tend to grow towards the sun

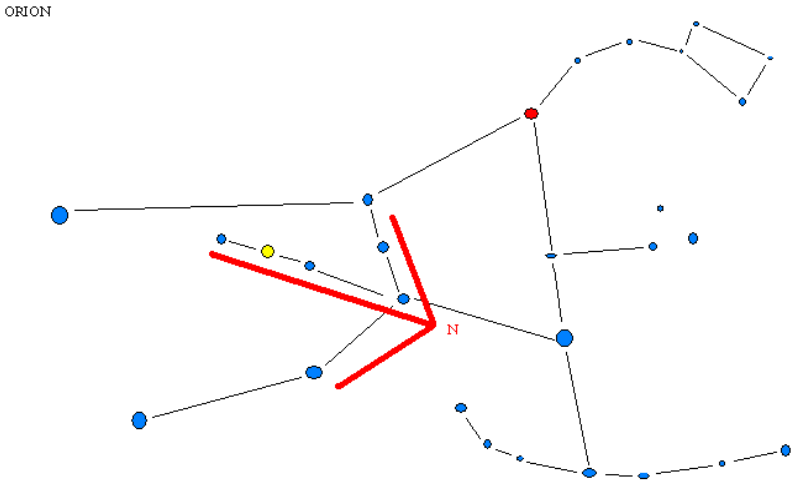
Methods of determining direction during the night:

Moon – Rise and set
The moon always rises in the East and sets in the West

© Lee Gutteridge – 2 December 2005

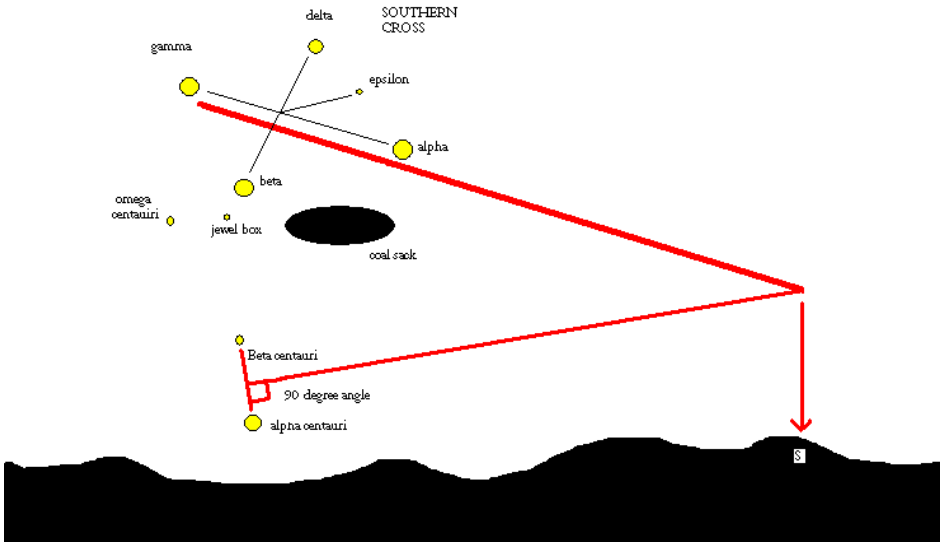
Orion

Always rises in the East & sets in the West. A line drawn through the sword and belt shows a Northerly direction. See below.

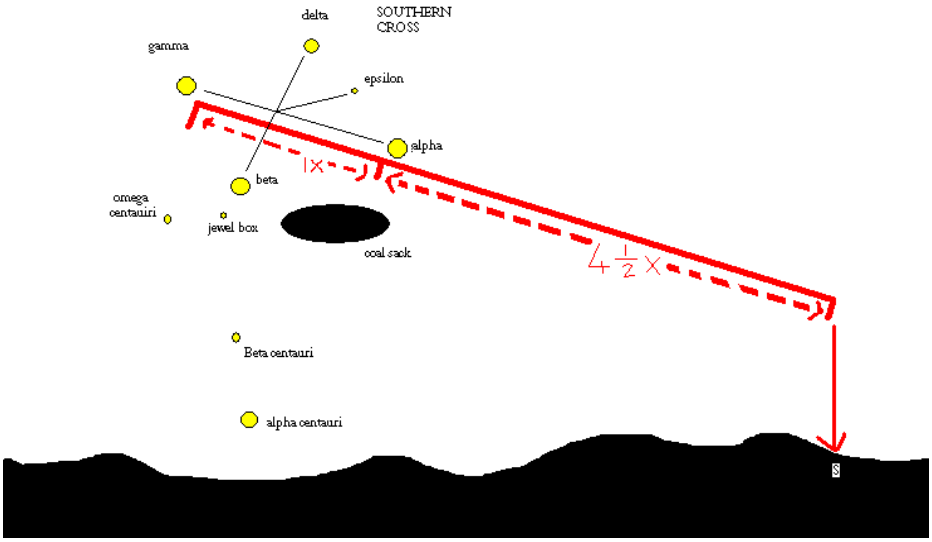


Southern Cross

Two navigation methods are shown below.

1. 

© Lee Gutteridge – 2 December 2005

2. 

© Lee Gutteridge – 2 December 2005

REFERENCES

This list is a list of some of the fantastic books I have had the pleasure of learning from. Also, many facts have been learned through listening to other guides, and on many wildlife courses I have attended.

REPTILES AND AMPHIBIANS

SNAKES AND REPTILES OF SA – BRANCH
SNAKES OF SA– FITSIMONS
SNAKES OF AFRICA- ISEMONGER
REPTILES OF SA – PATTERSON
FROGS – WAGER

BIRDS

LIFE OF BIRDS – ATTENBOROUGH
BIRDS OF SA – ROBERTS
BIRDS – NEWMAN
NESTING BIRDS – STEYN

INSECTS AND ARACHNIDS

SCORPIONS – LEEMING
SPIDERS – FILMER
INSECTS OF SA – HOLM
BUTTERFLIES OF SOUTHERN AFRICA – PENNINGTON
BUTTERFLIES – MIGDOLL

MAMMALS

BEHAVIOUR GUIDE – ESTES
MAMMALS OF THE SOUTHERN AFRICAN SUBREGION – SMITHERS
KINGDON FIELD GUIDE TO AFRICAN MAMMALS– KINGDON
LIFE ON EARTH – ATTENBOROUGH

BOTANY

PLANTS OF THE WATERBERG – GUTTERIDGE
PROBLEM PLANTS OF SA – BROMILOW
FLOWERS OF NORTHERN SA – FABIAN/GERMISHUIZEN
GRASSES OF SA – VAN OUDTSHOORN
TREES OF SA – PALGRAVE

ASTRONOMY

NIGHT SKIES – MACK
BEFORE THE BEGINNING – REES

GEOLOGY

A FIRST INTRO TO THE GEOLOGY OF THE BUSHVELD COMPLEX – EALES

FISH

FRESHWATER FISHES – SKELTON
LIFE ON EARTH - ATTENBOROUGH

© Lee Gutteridge – 2 December 2005

Advanced Weapon Handling (A.W.H.) And Viewing Potentially Dangerous Animals (V.P.D.A.).

© Lee Gutteridge – 2 December 2005

THE .375 HOLLAND AND HOLLAND MAGNUM

This is the minimum calibre that we as field guides are allowed to carry in dangerous game areas on guided walks. It has a bolt action and can carry 3 – 5 rounds in the magazine. This is also the rifle of choice at most reserves. Here are some statistics on the weapon.

Bullet weight	monolithic solid	300 grains
Muzzle velocity	2550 f.p.s	
Muzzle energy	4330 ft.lbs	

What does this mean to the ranger carrying this rifle on in the field?

Bullet weight , measured in grains is the physical weight of the projectile.
One gram is equal to 15 grains. Therefore our bullet from the .375 weighs 20 grams.
As a comparison a .458 WIN MAG has a 500 grain solid, weighing 33.3 grams

Muzzle velocity , measured in feet per second (f.p.s), this is how fast the bullet is moving when it leaves the barrel.

Muzzle energy is the combination of the above two factors the formula is:
weight in grains multiplied by the speed in feet per second (squared) divided by 450 000.
This will give you the muzzle energy in foot pounds.
It basically tells you the amount of power that the rifle has in a number form for comparison with other calibres, and gives a figure to the amount of energy delivered.

What is Ballistics ?

Basically, ballistics in our working environment is the study of the scientific laws which will affect our rifles and bullets, and how we can use these laws to predict their performance. Three types of ballistics affect us, namely internal, external and terminal.

Internal Ballistics
This is the study of what happens inside your rifle from when the bullet is ignited to the point where the projectile leaves the barrel.

External Ballistics
This is the study of what happens to the projectile from when it leaves the barrel to just prior to impact.

Terminal Ballistics
This is the study of what effect the projectile has on the target and the target has on the projectile.

© Lee Gutteridge – 2 December 2005

What is Recoil?

Recoil is basically the reciprocal energy from the rifle pushing out a high speed projectile. Every action has an equal and opposite reaction. However we reduce the reaction of recoil with careful design, as listed below.

An example of a .375 HH MAG weighing 4.4 kg firing a 300 grain bullet at 2650 fps delivered 40 ft-lbs of energy, rearward movement of 52 cm and upward movement of 55cm.

This amount of movement on a rifle will seriously effect the time taken to realign for a second shot. To minimize recoil the following factors are taken into account. Stock design, barrel length, weight of the rifle and the use of a muzzle break. When a bullet is forced from its case during ignition there can be as much as 60 000 pounds of pressure per square inch (PSI) in the chamber. This is nearly 28 tons PSI. But by the time it has reached the end of the barrel it is down to 8000 PSI.

Ammunition

There are several different types of ammunition, but the three that we will come into contact with most are monolithic solids, full metal jackets and Softs (or soft points).

Monolithic solids

These are turned brass and will not deform or change shape to too great a degree, so will penetrate deeper than the following two rounds. These bullets are for use on

Thick-skinned animals like elephant and animals with thick bony heads like buffalo. On soft-skinned animals like lion this bullet might travel straight through soft tissue, and unless it hits a vital organ or bone it may not do enough damage to stop the animal.

The PMP rounds we use are 300 grain.

Full Metal Jacket

These are soft centred rounds, cased in a harder metal jacket. Often made of lead wrapped in copper. The thickness of the copper determines the performance and the terminal ballistics of this projectile. Thinner jackets will allow more deformity of the projectile and less penetration with more resultant tissue damage. Bone will however often stop these bullets, or cause them to break up. Thicker jackets allow for deep penetration similar to the monolithic solid.

We use 300 grain FMJ rounds made by Winchester. They are Spitzer shaped with a flat nose

Softs

These rounds are designed to do maximum tissue damage at shallow depths. They are ideal for dealing with the big cats. On thick-skinned animals however there would probably not be enough penetration to reach a vital organ like the brain or heart.

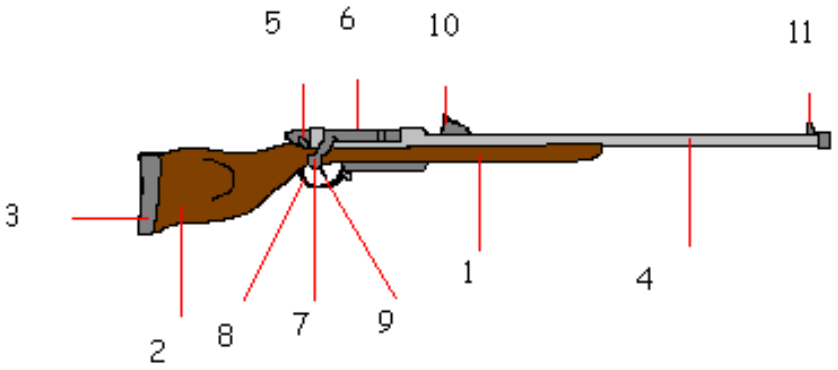
We use 300 grain Softs.

© Lee Gutteridge – 2 December 2005

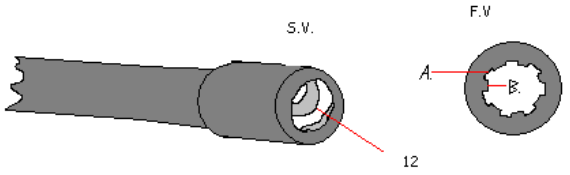
Rifle parts

There are dozens of parts to a rifle. In the BRNO ZKK trigger mechanism alone, there are more than 25 working parts. We will concentrate on 26 of the most visible parts, and key action points.

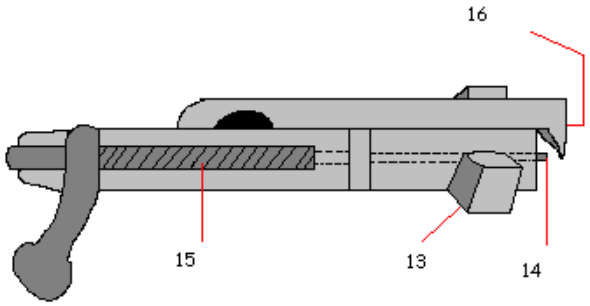
1. Stock
2. Butt
3. Recoil pad
4. Barrel
5. Safety catch
6. Bolt
7. Cocking handle
8. Trigger guard
9. Trigger
10. Rear sight
11. Front sight



12. Rifling
    A. Bore
    B. Lands

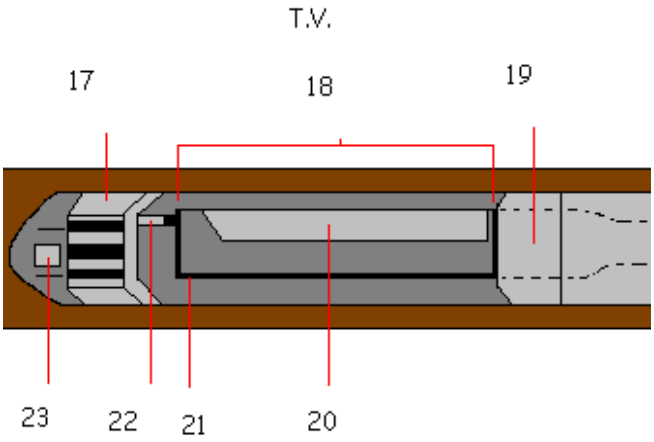


13. Bolt locking lugs
14. Firing pin
15. Main spring
16. Extractor

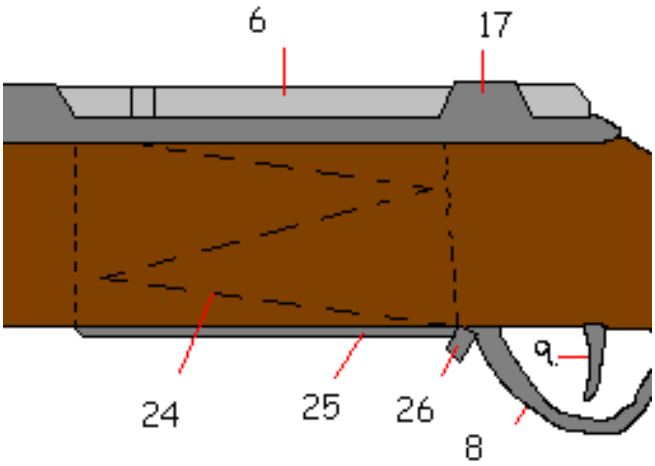


© Lee Gutteridge – 2 December 2005

17. Bridge of receiver
18. Receiver
19. Chamber
20. Magazine follower
21. Magazine box
22. Ejector
23. Sear



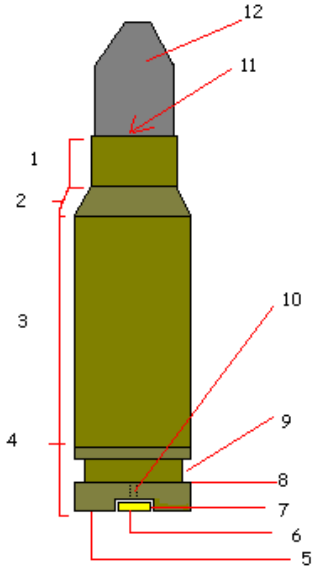
24. Magazine spring
25. Magazine floorplate
26. Magazine latch



© Lee Gutteridge – 2 December 2005

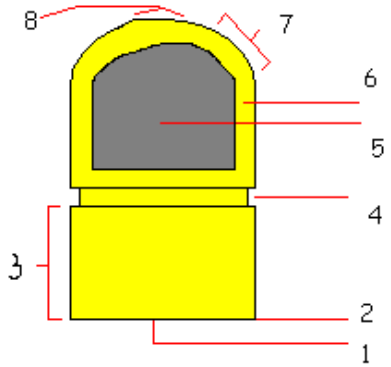
Parts of a cartridge

1. Neck
2. Shoulder
3. Body
4. Head
5. Base
6. Primer
7. Primer pocket
8. Rim
9. Extractor groove
10. Flash hole
11. Mouth
12. Bullet



Parts of a bullet (projectile)

1. Base
2. Heel
3. Shank
4. Cannelure
5. Core
6. Jacket
7. Ogive
8. Meplat



© Lee Gutteridge – 2 December 2005

What happens when you pull the trigger of your rifle?

Basically, what happens is the trigger lowers the sear, which allows the firing pin to move forwards, propelled by the main spring. The pin shoots out through the face of the bolt and strikes the primer of a cartridge. The amount of time taken for this to take place is called Lock Time. Lock time would be on average 0.0035 seconds. This is where INTERNAL BALLISTICS comes into play. The primer will explode, releasing hot gasses into the cartridge causing the powder to burn. This is an almost instantaneous burn and the sudden pressure created in the cartridge by gasses can be as high as 60 000 PSI.
This pressure will then force the bullet down the barrel where it catches onto the Lands (rifling) and starts to spin. The spinning will stabilize the bullet when it leaves the barrel. This spinning can be in excess of 200 000 RPM. The bullet is in fact slightly larger than the bore and will compress slightly sealing off gasses to maximize pressure. The barrel will also expand slightly while the bullet passes through any given point. When it leaves the barrel EXTERNAL BALLISTICS begins. The time taken for Internal ballistics is on average about 0.004 seconds. In this instance a rifle will actually work for 4 seconds per 1000 shots fired. In the case of our .375 the bullet will be moving at about 2550 feet per second. External ballistics is basically, for our purposes the study of the flight path of the bullet and the energy it has. There are several factors affecting External ballistics but for our purposes we need to know that as soon as the bullet leaves the barrel it starts to slow down and gravity starts to pull on it. Gravity will affect the trajectory of a bullet, and slowing down will affect the final or TERMINAL BALLISTICS. This deals with the effect that the bullet will have on its target. In the case of a monolithic solid, the bullet is designed to go through any bone or tissue matter it encounters and come out in more or less the same shape as it went in. Softs will deform upon impact and become flattened out, with a larger surface area causing more damage to tissue but not usually penetrating very deeply. These bullets may break into several pieces if they strike bone or even hard muscle. The speed of the bullet when it hits its target will affect its effectiveness and the damage it will do to the target. Muzzle energy is, basically speaking, a number given to how much energy a bullet has on impact. Hopefully by now you understand how speed and weight of bullet will be the two main factors influencing this.

There are 7 primary functions of a bolt action rifle.

1. Cocking
2. Unlocking
3. Extracting
4. Ejecting
5. Feeding
6. Locking
7. Firing

It is imperative that your issued rifle is kept clean and serviceable, as if your weapon is not looked after there is more chance of a problem occurring when you need to use it in a dangerous situation.

© Lee Gutteridge – 2 December 2005

Safety
There are rules and drills for safe handling of a rifle.

1. Always treat a rifle as if it is loaded.
2. When you hand the rifle to another person open the bolt.
3. Never point a rifle at anything you do not intend to shoot.
4. Do not trust safeties.
5. Do not load your weapon indoors
6. Chambering rounds can lead to accidental discharges. Be aware of this and always unload in a safe direction if you do not have a hinging magazine floorplate.
7. Lock weapons away when not in use.
8. Remove bolt and ammunition and keep it with you if you have to place the rifle in the care of another ranger.
9. Check the barrel of the rifle for obstructions before every drive or walk.
10. Use the correct ammunition (calibre and type).
11. Carry enough ammunition.
12. Do not walk around with a round in the chamber. Only chamber a round in a potentially dangerous situation.
13. Don't mix alcohol and rifles.

<u>When picking up you rifle</u>

1. Unlock and open bolt.

2. Look if there is ammunition in the magazine.

3. Check with your finger if there is ammunition in the chamber.

4. Load ammunition into the magazine.

5. Depress the ammunition and close the bolt over halfway.

6. Recheck with your finger that there is no round chambered.

7. Close bolt.

8. Depress trigger.

9. Lock bolt.

Accidental discharges (AD)
This is when a round is fired by accident and usually happens when cleaning or unloading. I.e. at times when you least expect it to happen. For this reason when we are handling our rifles we must ALWAYS be AWARE of where our BARREL is POINTING. Accidental Discharges can kill people as easily as a well placed shot.
Bullets are indiscriminate.

© Lee Gutteridge – 2 December 2005

WALKING SAFARI INFORMATION

1. NOTIFICATION FOR OTHER GUIDES AND OPERATORS
Before setting out on a walk it is important to know that you will not be disturbed by other guides in vehicles, as the presence of a game drive vehicle in a sighting on foot could present new problems or detract from the experience.

2. PRE WALK ORIENTATION
Walking safaris can be a highlight of a guests experience if conducted safely and with attention to detail. There are very serious rules for safety on a walking trail in dangerous game areas like Entabeni. We don't only focus on large mammals on walks, but this is an opportunity to use our knowledge of the smaller plants, insects, arachnids, geology etc.

SAFETY AND PRE WALK ORIENTATION
1. On a walk we carry a rifle, this is purely our last line of defence and we will endeavour to avoid having to use it.
2. On trail we will walk quietly, so that if there are any warning sounds we will hear them. We will also hear the sounds of nature without the sound of an engine.
3. Walk in single file to minimize impact on the environment.
4. Guests must stay behind the guide and rifle at all times.
5. Explain your hand signals to the guests. I.e. stop signal, sit down signal.
6. You let your guests know that in a dangerous game situation you do not run, as there are no dangerous game species that we as humans can out run.
7. If you do find yourself in a safe situation for viewing big game on foot remember to take wind, topography and sun into account.
8. A successful encounter on foot with big game is one where the animal was never aware of your presence. A charging or a running animal is a failure on your part.
9. If you as the guide see an opportunity to get your group to safety during a dangerous animal encounter and give them an instruction of any kind, they must obey it **immediately and without question**.
10. Let the guests know that when animals see people on foot they react differently to vehicles.
11. Ask about the interests of your guests.
12. Assess the fitness levels of your guests. Reassess them regularly for signs of fatigue or injury.
13. Don't walk too fast, you need to be aware of what is around you and if you are walking too fast you may bump into something unexpected.
14. Do not do a route march to exhaust your guests. A walk should be a pleasant experience.
15. Ensure that your guests are correctly attired. Bush colours.
16. Take water if necessary
17. Always take your first aid kit, you may ask a guest to carry it in order to free your hands for your rifle.
18. Take your binoculars.
19. Check if your guests have any allergies that they think you need to know about, such as allergies to the stings of bees and wasps.

© Lee Gutteridge – 2 December 2005

20. Always be aware of the direction of the barrel of your rifle.
21. Encourage the guests to ask questions, and always wait for the entire group to be present before you answer it, sometimes the guests at the back might miss out on some interesting information if you do not wait.
22. We do not have to go into detail about the damage caused by our rifles if we shoot something, as some guests may take offence to hearing about animals being shot. This is a very sensitive subject and to be discussed cautiously.
23. Make sure you have enough of the right calibre ammunition in your magazine, and never walk with a chambered round, except during an actual confrontation with a dangerous animal. In these circumstances be aware of the direction that your rifle is pointing.
24. **Never** allow guests to handle the rifle.
25. No more than 4 guests on a walk, wherever possible. If there are more than 4 try to organize a back up. There will however be circumstances in your guiding career where a back up is not available. Do your best to avoid this.
26. No smoking on trail. Smoke breaks are an option, but don't leave cigarette butts in the bush.
27. Don't litter. Leave only footprints and take only photographs.
28. Don't eat anything in the wild without guidance from the ranger, there are many poisonous plants. Rangers may only offer field food if they are 100% sure of the plant in question.
29. Careful where you place your feet, be aware of snakes and scorpions.
30. Cell phones and watch alarms must be off.
31. Cameras may only be used when deemed safe to do by the ranger as the sound may attract unwanted attention.

3. GROUP CONTROL

Ensure that your group always listens to your instructions. This must be done without the need for threats, or aggravating the guests. Be firm and in control at all times.

4. YOUR SURROUNDINGS ON THE WALK

When walking always be aware of thickets and areas where dangerous situations could arise. Keep checking for escape routes. Avoid cornering yourself and guests in areas such as gullies, dongas or against cliff faces or rocks. Also move away from thickets, long grass and reed beds. Avoid climbing ridges on a spoor, as if the animal is on the ridge waiting for you, you will have a dangerous animal above you. This can aggravate a situation as an animal may be more inclined to charge if it has a height advantage.

5. LISTEN TO YOURSELF AND YOUR SURROUNDINGS

Listen for warning calls of animals and birds, or eerily quiet situations. Also avoid approaching game which will give a warning at your approach, and give away your location. Be aware of sounds made by your rifle i.e. .458 rifles without spacers, as the ammunition will slide forward and make a metallic click if you lower and raise the barrel. This can give away your presence to an animal. Also metallic items such as keys, spare ammo and Zippo lighters. These can also make noise. Nothing in nature makes a metallic sound so animals can be quite sensitive to these sounds. Watch where you walk, as you may lead your guests over a noisy substrate. Loose rocks, lichen covered rocks, thick leaf litter, twig strewn areas and thick grass in winter are examples of areas to be avoided. You do not ideally want the animals to hear your approach. Stealth is the order of the day.

© Lee Gutteridge – 2 December 2005

6. SPOOR INTERPRETATION

Interpretation of spoor can give a guide a very good impression of what the animal that he is tracking is doing. For example territorial behaviour of rhino - such as foot dragging, urine spraying and dung kicking all leave clear signs on the ground and can tell a guide that the rhino could be potentially aggressive and will most likely be fairly fast moving. You would therefore need to follow the tracks quite quickly and carefully if you are going to catch up.

7. WALKING PACE

The guide should continually check on the pace of the back marker of the group. Move at the pace of the slowest guest. Do not expect the guests to move at your pace. Check, using your peripheral vision every few steps that everyone is okay. You need to know where all of your guests are all of the time when walking dangerous animals. Check that your guests are not nervous or scared. Do not take your guests too close for their comfort.

AVOID CONFRONTATIONS WITH DANGEROUS GAME AT ALL COSTS
……WHAT PART OF AVOID DO YOU NOT UNDERSTAND……

8. WIND, TOPOGRAPHY AND SLOPE, ADVANTAGES AND DISADVANTAGES

Use wind direction, and the sound of the wind to cover your approach where possible. Sometimes the sound of wind blowing through vegetation can mask the sound of the guests and yourself walking. Remember to use this and keep in mind that wind can also carry your sound to your quarry. Topography and slope are very important, as if you are uphill from the game you are approaching you present a more intimidating front than if you are down hill, (and therefore smaller than the dangerous animal you are approaching). If the wind changes you must be aware of it, and on an assessment you need to indicate this awareness to the assessor. Drop some sand and watch the dust, or drop some dry grass, or even wet your finger and raise it to the wind. An assessor will not assume that you noticed the change so you must make sure that you display that you are aware. If you are moving with the wind the reason needs to be made evident to the assessor.

9. SUN POSITION AND PHOTOGRAPHY

The position of the sun will affect your view of the game, and also, to a lesser degree the photography aspect of the walking trail. Photography needs to be closely governed on a walk. Do not hesitate to tell your guests not to use their cameras if the situation dictates that it is not safe. But if it is possible to safely photograph the game let the guests do so. Be aware of noises made by digital and video cameras.

10. CAMOUFLAGE

Use vegetation and cover such as rocks to hide your approach from the animals. Do not walk into an open area, leaving only your rifle as your defence. Have something to hide behind, other than your rifle. Remember the aim of an assessment walk is to get in and out without being seen by the game, but still have a good view of the animal.

11. GENERAL

- Keep a safe distance from the animal.
- Make sure the animal has an escape route. A reed bed full of water is not an escape route for lions but it would be for hippo or elephant. Use your knowledge of the animal's behavioural traits.
- Know the behaviour of the animal you are approaching. Anticipate its response to your approach and prepare yourself for this behaviour. Watch for pre warning signs, and signs that the animal has noted your presence. For example: If a sleeping lion angles its ear towards you, be aware that it

© Lee Gutteridge – 2 December 2005

may have already have noted that something is amiss. This may be a safe time to back out. Or if an elephant stops feeding it may have sensed you, so keep an eye out for any further behavioral warnings.

12. BEFORE YOU APPROACH

- Check if the terrain is safe to approach.
- Check the behaviour and mood of the animal.
- Note if there is one animal or a herd or pride.
- Note the age, sex and social status.
- Check condition and activities of the animals.
- Be aware of young animals.
- Be aware of comfort zones.
- Be aware of general wind conditions.
- Be aware of sun position.
- Ensure that should you be noticed you have an escape route planned, and that the animal has an escape route available.

13. IF THE CONDITIONS ARE NOT PERFECT, DO NOT WALK

Do not play with dangerous animals. They do not have a sense of humour, and if need be they will kill you. Rather cancel the walk if the conditions are not good. Walk on another occasion, or with different individuals.

14. ACTUAL CHARGE SITUATIONS

This is a situation that no guide wants to be in. It effectively means that you have made a mistake in either approach, choice of walking area, reading the animals behavior, reading your guests behaviour or wind conditions. Not all of these mistakes are avoidable. Some instances arise when the option of defending your guests with your rifle is the only one available, but this can generally be prevented with careful planning. If an animal charges with the intent of killing or injuring you and your guests you need to be committed to the protection of yourself and your group. In a charge situation you need to make several decisions:

- Is this a real charge, does the animal seem serious?
- Is the behaviour of the animal match up with what I have learned is a real, committed charge?
- Where is the point of no return? Draw an imaginary line which is where you will shoot the animal if the charge persists. Remember that a lion often breaks its charge at less than 10 metres. (I have experienced lion charges which have halted at three metres, and another guide has told me of a charge where the lioness fell over and slid into the legs of himself and his tracker. On neither of these occasions was a shot necessary, although both are probably instances where it could have been justified to shoot the animal involved).
- When you have committed to shoot the animal, do so. Make sure you are ready for any change in attack direction or sudden behavioural change which may imply that the animal has lost its nerve, and will stop the attack.

© Lee Gutteridge – 2 December 2005

15. WHEN DO YOU CHAMBER A ROUND?

A round is only chambered when you decide there is a danger of an actual charge. If a lion sees you on a walk and gets up, load your rifle only if you think it is close enough to be a danger to you and your group. For an example, a lion 300 metres away would probably be too far to need to load. However if the animal is 40 metres away (about 2 seconds of running at full charge speed) it is time to load your weapon. This would also depend upon the behavior of the animal. If it gets up and runs away, would it be necessary to load? These questions will be answered only in the individual circumstance. Suffice to say that the weapon should only be loaded in the last possible moment before it becomes a risk to the life of your group.

16. HOW MANY ON A WALK AND OTHER LEGAL REQUIREMENTS

On a guided walk in an area where dangerous game occurs there should be a maximum of four guests on a guided walk. When there is a back up on the walk 8 guests is the legal maximum. Minimum age on a walk with dangerous game in the area is 16 years.

17. SPOOR

A guide walking in dangerous game areas should know the spoor of all of the potentially dangerous game occurring in the area. Remember that the animal you are tracking may not be the only dangerous animal in the area.

FIRST AID EQUIPMENT SHOULD ALWAYS BE PRESENT ON A WALK

18. SHOT PLACEMENT

In a charge situation the only realistic option for the guide is a brain shot. Heart lung type shots do not always kill the animal out right, and an injured animal on adrenalin will inflict a great deal more damage upon the group than a dead animal with a well placed brain shot.

BELOW ARE SOME EXAMPLES OF BRAIN SHOT PLACEMENT FOR DANGEROUS GAME

LION




THE BRAIN IS POSITIONED JUST ABOVE AND BETWEEN THE EYES IN A FRONTAL SHOT. THE BRAIN IS APPROXIMATELY 7CM IN DIAMETER.

© Lee Gutteridge – 2 December 2005

LEOPARD


THE BRAIN IS SITUATED SIMILARLY TO THE LION, AND IS THE SAME SIZE.

RHINO

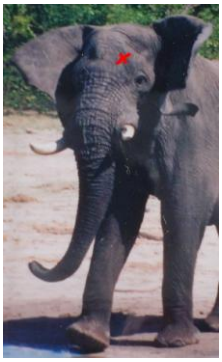

RHINO HAVE A PROPOTIONATELY SMALL BRAIN (11 CM DIAMETER).
IF YOU IMAGINE A LINE FROM LEFT EAR TO RIGHT EYE, AND FROM RIGHT EAR TO LEFT EYE THIS WILL GIVE THE BRAINS POSITION IN A FRONTAL SHOT.

BUFFALO


A BUFFALO'S BRAIN IS ABOUT 12CM ACROSS. IT IS LOWER THAN MOST PEOPLE ANTICIPATE, AS THERE IS A THICKENED SECTION OF BONE CALLED THE BOSS BELOW THE HORNS.

© Lee Gutteridge – 2 December 2005

ELEPHANT

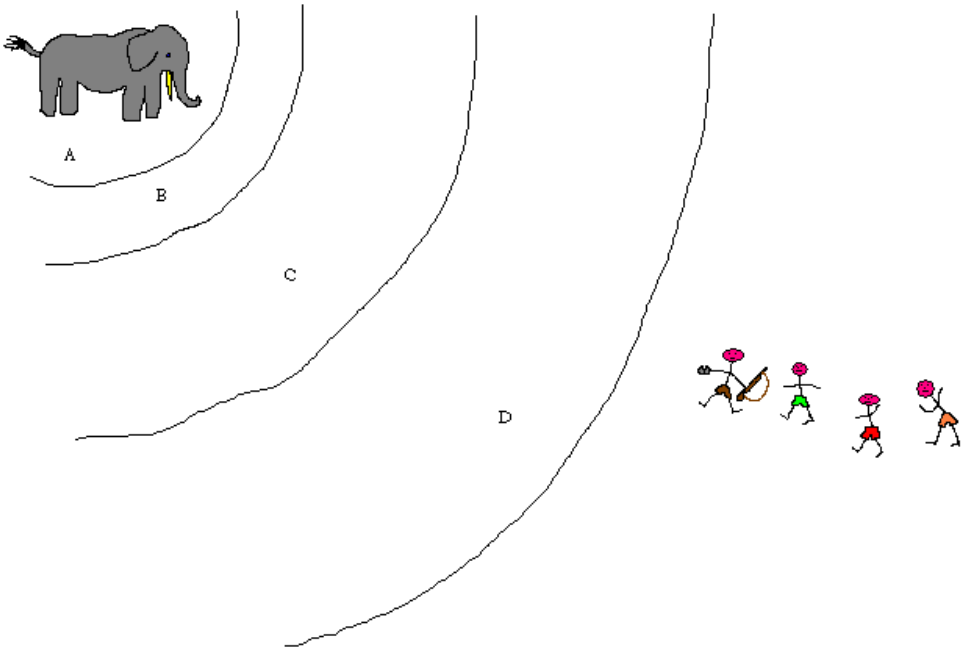


TO IMAGINE THE LOCATION OF AN ELEPHANTS BRAIN, PUT AN IMAGINARY BROOM STICK THROUGH ONE EAR HOLE AND OUT OF THE OTHER. IN THE MIDDLE OF THIS IS THE BRAIN OF THE ANIMAL. THE BRAIN IS ABOUT 24 CM ACROSS.

19. COMFORT ZONES

An animal has various zones of comfort around it.

- These include the comfort Zone which is D. Here the animal is comfortable with your presence.
- Then there is the alert zone where one will note behavioural changes such as stopping feeding, or staring at you. This is Zone C.
- Then there is a warning zone which is where the animal will display discomfort with your approach. Zone B.
- Then in Zone A, which is the flight fight zone, you are either going to be attacked or the animal will flee.



© Lee Gutteridge – 2 December 2005