AFRICA: THE SERENGETI

AFRICA: THE SERENGETI, a LARGE FORMAT film, produced by GRAPHIC FILMS CORPORATION for SERENGETI PARTNERS, LTD. IN COLLABORATION WITH THE HOUSTON MUSEUM OF NATURAL SCIENCE
Never before have audiences seen such beauty and drama on the giant screen. From the sweeping grasslands of the southern plains to the crocodile-infested waters of the Grumeti River, every nuance of East Africa's Serengeti region comes to life in this breathtaking feature. Giraffes, hippos, lions, and an amazing migration of over a million wildebeests make *Africa: The Serengeti* one of the most colorful and dynamic films ever made.

**Africa: The Serengeti, A Large Format Film**, produced by Graphic Films Corporation for Serengeti Partners, Ltd. in collaboration with The Houston Museum of Natural Science

**Acknowledgements**: This booklet has been prepared by David Bygott and Jeannete Hanby for the Houston Museum of Natural Science.

**Publication Data**: Copyright David Bygott and Co., 1994. All rights reserved. Permission to reproduce any part of this booklet, for any purpose other than non-commercial classroom use, must be obtained from the Houston Museum of Natural Science, One Hermann Circle Drive, Houston, Texas 77030-1799.
At the top of every right-hand page, this animated gnu gallops when you flip the pages. A dung beetle follows along on the top of every left hand page - a reminder of the supporting cast of millions in the Serengeti drama.

### TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>HOW TO USE THIS BOOK</td>
<td>1</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>2</td>
</tr>
<tr>
<td>MAP OF THE SERENGETI</td>
<td>3</td>
</tr>
<tr>
<td>SEASONS and SOILS</td>
<td>4-5</td>
</tr>
<tr>
<td>HABITATS</td>
<td>6-7</td>
</tr>
<tr>
<td>THE ECOLOGICAL PYRAMID</td>
<td>8-9</td>
</tr>
<tr>
<td>GRAZERS and BROWSERS</td>
<td>10</td>
</tr>
<tr>
<td>RESIDENTS and MIGRANTS</td>
<td>11</td>
</tr>
<tr>
<td>GNU TREK GAME</td>
<td>12-13</td>
</tr>
<tr>
<td>HUNTERS</td>
<td>14</td>
</tr>
<tr>
<td>SCAVENGERS</td>
<td>15</td>
</tr>
<tr>
<td>SURVIVAL STRATEGIES</td>
<td>16-17</td>
</tr>
<tr>
<td>THE SERENGETI SCENE</td>
<td>18</td>
</tr>
<tr>
<td>SERENGETI JOB ADVERTISEMENTS</td>
<td>19</td>
</tr>
<tr>
<td>HUMANS IN THE SERENGETI SCENE</td>
<td>20</td>
</tr>
<tr>
<td>ANCESTRAL ART</td>
<td>21</td>
</tr>
<tr>
<td>GREAT GALLOPING GNUS GAME</td>
<td>22</td>
</tr>
<tr>
<td>VOCABULARY</td>
<td>23</td>
</tr>
<tr>
<td>WHAT DOESN'T BELONG?</td>
<td>24</td>
</tr>
<tr>
<td>ANIMALS OF THE SERENGETI POSTER</td>
<td>25</td>
</tr>
<tr>
<td>FURTHER READING &amp; REFERENCES</td>
<td>26</td>
</tr>
</tbody>
</table>

### HOW TO USE THIS BOOK

This package is designed to supplement the film “Africa: The Serengeti” but can also stand alone as a valuable teaching aid at a number of levels. The material has been designed primarily for students aged 8 to 18; teachers can choose how best to present the information and activities for their particular class. We hope that people of any age will find it interesting and enjoyable as well.

The poster will help you to sort out the huge cast of the film: the migrants and the residents, the solitary and the sociable, predators and their prey, the abundant and the rare. The book tries to show how they, as well as our own species, fit into the Serengeti landscape.

Along the bottom of every page, a story is told in silhouettes. It shows the fate of a mother gnu and her calf, as well as the complex interactions of Serengeti predators. Words on page 23.
In the language of the Maasai people, “siringet” means a wide open space. Serengeti is a vast landscape of dramatic skies over wide grassy plains studded with rocky outcrops, creased by wandering watercourses and bordered by ranges of hills. This is the stage for the greatest wildlife spectacle in the world; it is on view all year round and involves a cast of millions. Now you can see some of the drama on film, a spectacle made possible by the Houston Museum of Natural Science and the makers of the film AFRICA: THE SERENGETI.

Most of us find animals fascinating, and animals have much to teach us about how natural systems work. AFRICA: THE SERENGETI offers you the chance to go on “safari”, an adventurous journey to view wild animals that have an intrinsic appeal because of their beauty, power, or sheer numbers. Also, the Serengeti provides a point of reference for learning about biology, animal behavior, ecology, geography, soils, climate, archaeology and ethnography.

Serengeti is the name of the most famous wildlife park in Africa and probably the whole world. The Serengeti is also an “ecosystem” which means a place where the entire landscape, the plants and animals form an integrated self-sustaining community. The Serengeti ecosystem includes much of the area around the Park, including parts of the Maasai Mara and Ngorongoro Conservation Area.

Established in 1951, the Serengeti is the largest and oldest of Tanzania's 12 National Parks. The boundaries of the Park were intended to encompass the migration of the wildebeest, and have been altered as more has been learned about the migration. The entire route of the wildebeest defines the Serengeti ecosystem. In 1981 the Park was made a World Heritage Site and together with the Ngorongoro Conservation Area, a Biosphere Reserve; both designations emphasize Serengeti’s many values.

Let us introduce the star of the Serengeti drama, the white-bearded gnu or wildebeest. Africans named it gnu (say “nu”) for the honking sound gnus make. Dutch settlers in South Africa named them wildebeest. Gnus are in the same family of animals (Bovidae) as cows, buffaloes and antelopes - but NOT deer! The bovids have permanent horns with bony cores (most deer have antlers which they shed).

Gnus live in open grassy plains, from southern Kenya to South Africa. They are the size of small cattle. They look funny, with skinny legs, big shoulders, a heavy shaggy head and hooked horns. It has been jokingly said gnus were “designed by a committee and assembled from spare parts.” But this ungainly looking creature has had that form for at least two million years, as shown by the fossils that are found in the Serengeti. Survival for such a long time must mean that the gnu is well designed for its job. Take a close look at a gnu’s head: its face is long, its eyes are way up on the sides of the head near the top, so the gnu can see over the grass and all around, to spot foes while it is grazing. Its long eyelashes keep the dust out of its eyes, its nostrils can be closed to keep out dust. Its wide square mouth enables it to crop short grass. Its migratory habits help it to make the best use of a changeable environment, and in its thousands makes the Serengeti what it is.
LOCATION: In northern Tanzania between latitude 1° 30' to 3° 20' South and longitude 34° to 35° 15' East.

SIZE: Park - 5,700 square miles (14,700 square kilometers), bigger than the state of Connecticut! The Serengeti ecosystem is twice the size of the park. It is bounded by the Rift Valley and Ngorongoro Highlands to S and E, Lake Victoria to W, and Isuria escarpment to N.

ALTITUDE: From 6000 ft in the east to 3000 ft in the west.
SEASONS AND SOILS

Serengeti is the home of more than two million large animals. These animals cannot live without the plants; plants need soil and water. To understand the Serengeti we must consider its soils and rainfall.

Serengeti's location is the major reason for both its soils and weather patterns. It lies just south of the equator, west of the Indian Ocean and close to the second largest lake in the world, Lake Victoria. These huge bodies of water bring Serengeti its rain. To the south-east of the Park are the Ngorongoro Highlands, composed of eight extinct volcanoes and one active one. These volcanoes are responsible for the productive soils of the plains.

Beneath the whole of Serengeti lie very ancient rocks, the original continental shield of Africa. Some of the rocks stick up out of the plain as outcrops or “kopjes”, or as old eroded hills. To the west and north, these ancient mountains have been weathered for hundreds of millions of years, yielding rather poor sandy soils. But the soil of the plains is volcanic ash blown westwards from the recent eruptions of the Ngorongoro highlands. Rich in minerals such as sodium and calcium, this ash covered the ancient landscape, forming the rolling grassy plain we see today. The pasture of the plains is one of the most productive and nutritious on earth - when there is rain.

Rain rules the Serengeti. Plants grow when there is rain, rest when it is dry. Serengeti’s rain falls sparsely and seasonally - from November through May. June through October is the dry season. Rain falls in different amounts in different parts of the Serengeti (see little map). The winds that bring rain blow from the east. The Ngorongoro Highlands block much rain from reaching the eastern plains; they get less than 600 mm of rain compared to the western and northern parts of the Park which get about 1,000 mm. These wetter areas also lie closer to Lake Victoria, a huge lake that sends a lot of moisture into the air and causes rainstorms.

The Serengeti is mostly a sunny, windy place; storms often pass quickly, watering only small areas, making the grass grow in patches. But at times during the rainy season, rain clouds can settle in over the whole area for days, making the grass grow vigorously everywhere. Then animals travel far to the plains, to eat the fresh, nutritious grass so rich in the minerals they need for growth. When the rains end the grass withers and the waterholes dry up. The migratory herds must move on. Without the southern plains, the Serengeti would still have a lot of animals because there are grasses, bushes, trees and permanent water in other areas. But it is the combination of rich soil and seasonal rains on the plains plus the reserve grass and water in the wooded parts of Serengeti that allows the great gnu herds to live and migrate. And it is mainly the gnu herds that make Serengeti such a very special place.
WET AND DRY SEASONS OF THE SERENGETI

Compare these two drawings of the Serengeti plain. The same scene is shown: during the rainy season – November through May – then during the dry season – June through October. Find 20 differences that reveal some of the effects of season on the wildlife living on the Serengeti plains. Answers below.

Absent in the dry season: rain clouds, migratory animals (gnu, zebra, eland, Thomson's gazelle), tortoise and dung beetle (now dormant), vultures, sand grouse, topi, elephant and giraffe (have moved out), leaves of fig tree, water in pool, two warthog babies (probably the lions ate them), a male lion, an acacia branch eaten by elephants.

Still present: Grant's gazelles, ostriches, bustards, owls, agama lizards, warthogs and some lions. The female lions remain in their territory but there is not enough prey to support the male; he is avoided by the rest of the pride. The aloe is blooming; the kori bustard is no longer in breeding display.

New: An oryx antelope, which thrives in dry areas without water.
Habitats are homes for plants and animals. The major habitats of the Serengeti are grassland, woodland, rivers and rock outcrops. The Park has two small soda lakes, many marshes and water seeps - examples of other kinds of habitat. Habitats can be large, like the plains, or small, like the lakes, but each habitat has its special features and each supports a certain collection of animals.

**GRASSLANDS:** The great plains in the south of the Serengeti roll right up to the base of the Ngorongoro Highlands and the edge of the rift wall in the east. The major feature of these plains is that they are covered by short grass, green in the rainy season, brown in the dry season. Few trees grow on the plains because a layer of limestone just below the topsoil prevents their roots from going deep except where water has eroded the “hardpan”. In the dry season, there is almost no surface water. As you can imagine, the animals that live on the plains all year round have to deal with water shortage.

There are other smaller plains in the Serengeti, tucked among the hills or along rivers. Most of these plains have older soils and receive more rain, so the grasses that grow there are taller and coarser. The grazing animals do not like these grasses as much as the short, nourishing grass of the great plain, but the longer grasses are good reserve pasture when the southern plains dry up.

The year-round residents of the plains include gazelles, warthogs, golden jackals, lizards, birds and insects. Most get moisture from dew or eating juicy food, or do without it by sleeping through the dry times. Where there are trees and bushes more animals can make a living such as dikdiks and impalas, which in turn feed some predators such as leopards. Not an easy life in the dry season. But during the rains, the grass on the plains sustains a vast number of grazing animals in addition to the residents.

**WOODLANDS:** The symbol of the savanna is a thorn tree, typically an Acacia, its twisty branches graced by a leopard, nibbled by a giraffe or shading a pride of lions. There are many different kinds of Acacias that grow in different soils - dry, ashy, wet, clayey. The classic savanna tree is *Acacia tortilis*, and when young stands grow up, they form a thick bush of thorns. Many other types of trees join the acacias in the bushland, wherever there is enough rain and room for their roots.

Trees provide leaves at different levels, while under and between the trees, grass and herbs grow. Thus the woodlands of the Serengeti harbor a great variety of creatures: all of the antelopes, buffaloes, giraffes, elephants, rhinoceroses, monkeys, etc. They can live in the wooded areas all year round because of the moisture in the leaves and the water in the river beds.
HABITATS OF THE SERENGETI

RIVERS: There are no permanently flowing rivers in the Serengeti. Some flow for most of the year and can flow for years in a row, but then they may dry up every dry season for years. Some rivers have deep pools which hold water throughout the dry season. In these pools some hippos, fish and crocodiles can remain. In many dry river beds there is moisture under the sand where fish and frogs can bury themselves.

The major Serengeti rivers have enough water to support a fringe of fig and other fruiting trees along their banks. These attract a variety of monkeys and birds which generally can be found in the river valleys. Many other animals come to the riverbeds to drink or dig holes to find water under the sandy bed. Elephants, antelopes, zebras, etc., can always be found near the rivers in the dry season.

ROCK OUTCROPS: The rock outcrops of Serengeti are one of the Park's most delightful habitats, especially the more visible ones that stand out like islands in a sea of grass on the plains. These are called “kopjes”, an Afrikaans word meaning “little head” and they often do resemble heads or fantastic sculptures. The rocks and hills of the Serengeti are clothed with shrubs and trees. Although the soil is not rich or plentiful the roots of plants can grow into the crevices to reach water trapped below the surface. Also, among the rocks are often little basins or clefts that catch water. This makes it possible for some animals to live there.

Animals that live among rocks are surefooted, small and shy, disappearing into small holes, caves and clefts. Among the rocks one can see hyraxes, and on most hills find klipspringers. Mongooses, leopards, porcupines, bats, lizards, snakes, and birds, all find shelter, food and a place to nest, roost and rear young in rocky, bushy places. Each kopje is indeed like an island with its own community of plants and animals, as well as being a refuge for animals such as a mother cheetah with cubs, or a flock of birds passing through.

OTHER HABITATS: Lakes Magadi and Lagarja and Masek and a few seasonal pools on the plains are alkaline, (i.e. rich in soda). Such water is not very hospitable to wildlife. However, the few species of algae and brine shrimps that flourish in them make them a special feeding ground for some birds, such as flamingoes or avocets. The marshes and swamps around the lakes and in rivercourses have fresh water seeps and pools. These provide dry season drinking water, and support vegetation, such as sedges, which in turn provide shelter for birds, turtles and frogs, and food for larger animals, such as topi and elephants.
THE ECOLOGICAL PYRAMID

The picture shows how the soils, plants and animals of Serengeti depend on one another. Each animal species is dependent on creatures beneath it in the pyramid; the higher up it is, the fewer its numbers and the more precarious its existence because it depends on all those below it. At the base of the pyramid are the primary producers - the plants. It takes a lot of plants to feed the next level - the herbivores such as grasshoppers and gnus. Many gnus are needed to feed the next level - the carnivores such as lions and hyenas, and scavengers such as vultures. Alongside all these levels are the decomposers, such as bacteria and termites, that recycle energy from other levels.

At each level in the pyramid there are factors that affect the productivity or numbers of creatures at that level. For instance, the amount of rainfall and the soil affect primary productivity of the grasslands and regeneration of trees. Fire is a major factor. Fire burns up dry grass, tree seedlings and dead trees; it promotes grasses which can reproduce by seeds or underground stems. Fire affects the presence or absence of ticks and tsetse flies, which directly (i.e. by blood sucking) and indirectly (i.e. by carrying diseases) affect both herbivores and carnivores. Wildlife in Serengeti has mostly adapted to the presence of ticks and tsetses. People and their livestock do not thrive where ticks and tsetse flies are abundant. The tsetse deserves our respect for keeping livestock out of most of the woodland areas of the Serengeti which would otherwise have long ago become farms and eroded, cleared areas.

We humans are factors at every level because it is we who bring livestock and pets (and their diseases), plow up intact soils, plant crops, cut trees, set fires, make roads, hunt animals, divert water from rivers, etc. Serengeti is one of the few remaining natural ecosystems with minimal human influence.

SERENGETI ECOLOGY ACTIVITIES

FOOD CHAINS: On a large mural sized sheet of paper or on the biggest blackboard draw a circle representing the Serengeti. Draw grasses and trees in the Serengeti circle. Draw plant and flesh eating animals or cut out pictures from magazines or make copies of animals from the poster. Each student chooses or “wins” one or more animals to learn about. Pin, paste or tape the animals on/under the grass or near/in the trees. Connect each animal with its food with string or thread. Each student describes his/her animal: what it eats, how it fits into the ecosystem. More advanced students should be able to describe special adaptations such as teeth and stomachs and behaviors for more efficient feeding. Also collectively discuss how the animals eat different parts or kinds of plants or other animals.

ECO FACTORS: Discuss how the following might affect each animal and the ecosystem: an eruption and ash fall from nearby Lengai volcano, fire burning the longer grasses, fire burning the trees, several years of drought, several seasons of heavy rain, lots of hunters or poachers taking meat, a plague of ticks or biting flies, a particular disease epidemic such as rinderpest, that affects cattle (and all the bovids, e.g. gnus) or a disease, like distemper, that affects mostly dogs, or a disease like mange or anthrax that affects most animals. Discuss how dung beetles and termites, mice and bacteria affect the interrelations in the Serengeti ecosystem.
THE ECOLOGICAL PYRAMID

CARNIVORES i.e. lion, hyena, jackal, snake, falcon, spider, ant

SCAVENGERS & DECOMPOSERS i.e. vulture, fly, bacteria, dung beetle, fungi, termites, millipede

HERBIVORES i.e. giraffe, hippo, grasshopper, ostrich, zebra, seed-eating bird, caterpillar, guineafowl, gnu, mouse, gazelle

PRIMARY PRODUCERS
e.g. grass, trees, and other green plants

SOIL NUTRIENTS

BIODIVERSITY: Put cows, sheep and goats into the picture. What plants do they eat? What Serengeti animals do they compete with? Livestock would displace many other hoofed species, such as buffaloes. To keep livestock, you must also take out the big predators. The Serengeti’s plant life would also change. Domestic herds would not migrate around the Serengeti. The sharps hooves of livestock carve trails between water, pastures and home base, causing erosion. Goats eat young trees. Herders set fires to promote grass growth, also destroying trees. Ultimately, there would be less vegetation in the system, hence more wind and rain erosion. Likewise, managed livestock would leave fewer carcasses for scavengers, less dung for beetles and less food for migrating birds. Already the system would be fundamentally changed.

Finally, remove about half the livestock because farmers move in and do not want animals on their crops. Imagine the Serengeti plowed up into farms, bare in the dry windy season, growing maize when it rains. Now what happens to the ecological pyramid? Diversity, numbers, the migration, all change dramatically. The simplified pyramid is the way much of the world is today.
The animals that eat only plants are the most “gnumerous”. They include grasshoppers, termites, caterpillars and many other insects, rodents, hares, hyraxes, all hoofed animals, and elephants. All these creatures great and small are often divided into two categories according to the vegetation they prefer:

**GRAZERS** eat grass. Grass is an abundant food, but often contains tough fibres or crystals which damage teeth or are hard to digest. When dry, it cannot be eaten unless water is available.

**BROWSERS** eat herbs, bushes and trees. Trees offer juicy green leaves even during the dry season, but are often protected by being high above the ground, surrounded by thorns, and saturated with poisons. Browsers overcome these problems with special teeth, stomachs, and body shapes, such as long necks.

Many animals do not fit neatly into these two categories. Warthogs, for example, eat mainly grass but also dig for underground stems and eat fruits and seeds. Impalas switch from eating grass and go for leaves and pods during the dry season. Elephants both graze and browse. Many of the grazers and browsers eat nutritious seeds and fruits when they can. In short, animals are flexible.

From the plants' point of view, all vegetarians are the enemies that they try to repel in such a way as to minimize their own destruction. For example, acacia trees have evolved thorns to help defend themselves. Other trees have poisonous sap. Many grasses have serrated or sharp edged leaves to cut mouths. Others have compounds in their foliage that taste bad. Even if the grazers and browsers don't leave these plants completely alone, they may just nibble carefully, and for short periods, then move on, leaving the plant intact.

One of the most marvelous interactions between plants and animals is that of an ant and the gall acacia, or whistling thorn. This is a rather scrawny tree with short thorny limbs that are studded with black swellings or “galls.” The galls are produced by the tree and are hollow. They provide ideal apartments for a certain kind of ant, which only has to gnaw entry holes. The name whistling thorn comes from the sound made by the wind blowing across the holes. The tree even provides droplets of sweet fluid for the ants. In return, the ants defend the tree by swarming out and attacking anything that tries to eat its leaves. Giraffes eat some leaves anyway, but move on after a nibble.

**HERBIVORE ACTIVITY**

Have the students divide the animals into grazers and browsers and discuss how the animals might change their feeding preferences according to rainy and dry seasons. Also, discuss the specialized mouths, teeth, and stomachs the animals have. For an extended session, use posters, pictures and reference books. Discuss adaptations for processing plant foods and how the plants fight back.
RESIDENTS AND MIGRANTS

Serengeti’s many creatures can also be classified according to whether they stay put all year round or move seasonally.

RESIDENTS live in one area throughout the year, seldom or unwillingly moving to another area, sometimes commuting but returning to a particular home range. Some examples are: impala, dikdik, topi, kongoni, klipspringer, reedbuck, brushbuck, giraffe, buffalo, hippo, warthog, leopard, lion, hyena, serval, civet, mongooses, hyraxes, and many birds.

MIGRANTS move from one spot to another, over short or long distances, but with a regular, yearly route: gnu, zebra, Thomson’s gazelle and eland migrate around the Serengeti. Marabou and Abdim’s storks travel from one part of Africa to another. European storks, swallows, rollers, bee-eaters, kestrels, cuckoos, wagtails, and many others travel from Europe and Asia to Africa.

Some animals have extremely large but stable ranges, and can neither be called residents nor migrants. Examples are wild dogs, elephants, and cheetahs. Most animals tend to settle down - if they can. Animals seem to prefer a particular home range where they know locations of food, water and shelter for themselves and their young. If they defend the range from others of their own kind, it is called a territory. Animals without territory are called migrants - if they move over a regular route, or nomads - if they wander widely with no definite range.

Food supply is the main factor for determining whether or not animals migrate or stay put. Migrant animals are taking advantage of a food supply which is abundant only in a certain area and for only part of the year. A good example is the gnu. Gnus stay in one area if food and water are available all year round. There are resident gnu populations in Ngorongoro Crater and in the wettest parts of the Serengeti ecosystem (the far north and the far west). Only so many gnus can occupy an area of grass and they have to share it with other animals. When the dry season comes, the great herds of gnus that need grass and water, must move. Migratory gnus have worked out a regular route where they can find pasture and water year round.

Besides the animals that migrate within the Serengeti ecosystem there are many birds which visit seasonally from afar. One of the best examples is the white stork which breeds in Europe and Russia. When summer ends and their food supply of insects and frogs dwindles they head south by the thousands, arriving in Africa as the rains start. On grasslands they find population explosions of grasshoppers and armyworm caterpillars, enough to sustain them until the rains end. White storks pass through the Serengeti in huge flocks, along with kestrels and other birds, a migration far exceeding that of the gnus. They fly north in late spring reaching Europe when food is abundant and the birds can find mates, nest, and raise chicks.

© David Bygott & Co. 1994
GNU TREK
The object of the game is to survive the many hazards during the annual migration of the wildebeest of Serengeti.

Each Player is a gnu; two or preferably, more can play. The first gnu back on the plains wins the game. You need: a die, and several small tokens such as buttons or coins. Take turns to throw the die and move your token accordingly. Follow the instructions written in the space where your move ends.

There are two points (the Western corridor and the Mara) where you can choose a quick and dangerous route or a slower, safer one, unless you have already been told which way to go. If you gain a calf on a turn, add another token (a life) to yours. If you lose a life, lose a token. If you lose all your lives, you are out of the game. Have fun and survive!
The great herds of the Serengeti provide food for a few animals that prefer meat to vegetation. Known as predators, hunters, or carnivores, they range from ants to lions. The Serengeti’s many vegetarians support an unusually large number and variety of meat-eaters, including lions, hyenas, cheetahs, African hunting dogs, leopards, jackals, servals, mongooses and bat-eared foxes.

The Serengeti hunter most likely to come to mind is the majestic lion. Yes, lions are hunters, but they also steal and scavenge food from other predators, especially hyenas. Likewise, hyenas both hunt prey and scavenge, as do jackals and leopards. Only cheetahs and African hunting dogs do not regularly scavenge. Most of the small hunters also catch their own prey, but occasionally steal meals or eat dead animals.

Animal flesh is mainly protein and fat - a rich diet that allows predators to get nourishment from a relatively small amount of food. (Plant eaters, even the most efficient, must eat much more to get the same amount of nourishment.) How much meat does a predator need to survive? What they can catch and eat is limited by their own size - a leopard can catch an adult impala but a jackal can only tackle impala babies. Cooperative hunting, as in a group of lions, makes bigger prey available - a pride can kill a bull buffalo whereas one lion cannot. To keep it simple, imagine that lions only catch gnus, which yield on average 125 pounds of meat. A lion needs to eat about 10 lbs. of meat a day, so each lion eats the equivalent of about 30 gnu-sized animals a year. However, to support this offtake, the prey population must be considerably larger. This is why predators are always far fewer than their prey. In the Serengeti ecosystem, there are about 300 large herbivores for every large carnivore.

When the gnus are present, especially during calving time, all the predators in the area can feast. But when the gnus move on, the hunters have to search out other prey. When lions have no more gnus in their territories, they start looking for warthogs or topis, buffalos or gazelles. Most predators are not very specialized feeders - meat is meat - unlike the choosy vegetarians who nibble only certain parts or kinds of plants.

**PREDATOR ACTIVITY**

Predators are especially fascinating to most people perhaps because we have been competitors or companions for so long. Discuss and write stories about how early people might have interacted with lions, hyenas, wild dogs, leopards and jackals in the Serengeti. Discuss why our pets are most often dogs and cats and how these animals might have become domesticated from wild ones. Have students observe their pets and describe some of their behaviors and compare them with the behaviors of wild dogs and cats such as those that live in the Serengeti today. Try to write a story to follow the silhouette sequence at the bottom of the pages of this book. The story is about competition between carnivores as well as a complex food chain. What other aspects of each others’ lives do the different carnivores affect in addition to feeding?
The scavengers and decomposers of the Serengeti are extremely important to the ecosystem. Undoubtedly, the most impressive large scavenger is the hyena. Spotted hyenas are perfectly well able to hunt for themselves, but they can also benefit from carcasses and leftovers. A hyena has a wonderful set of teeth for ripping hides, tearing meat and crushing bones. Hungry hyenas can devour every part of a gnu carcass except the horns. Their digestive juices are so strong that their dung consists of nothing but powdery white mineral matter from crushed bones, and a few hairs. Everything else has been digested.

Among the most important small Serengeti scavengers are dung beetles - especially on the plains. Dung beetles fertilize the soil with little packets of dung. Termites are also small recyclers of vegetation and are extremely important to the health of the woodlands. Termites fertilize, water and aerate the soil by building their tunnels and helping to decompose and distribute vegetation underground. Their mounds and underground mazes of tunnels are wonders in their own right. Termite homes are used by many different animals (see puzzle on this page). The importance of termites and dung beetles to the Serengeti cannot be overemphasized, but flies, ants and bacteria are also significant recyclers of dead plants and animals.

In between these small workers and the big scavengers are a range of others, the most vital of which are the vultures. They can glide for great distances using very little energy and spot carcasses with their exceptionally keen eyesight from high above. They can dispose of most of the large animals that die in the ecosystem. The seven different species of vultures are each specialized for different ways of searching or feeding. Ruppell’s griffon vultures nest in thousands on the cliffs along the rift valley walls to the east of the Serengeti. They depend on the gnu migration for enough carcasses to feed themselves and their young. White-backed vultures are the most common; one is shown resting on the termite mound on this page.

**TERMITE TOWERS** Termites are not only important recyclers of nutrients, their mounds provide food and homes, resting places, lookout points, nest holes, burrows. Search for the eighteen names of mammals, reptiles, birds, insects that utilize termite mounds. Each word may be down, across, diagonal, forward or backward. The red and yellow barbet, shown in bold, introduces this puzzle. They make their nests in tunnels! Answers below.

- aardwolf, aardvark, ants, red and yellow barbet, blind snake, cheetah, genet, hare, hyena, mongooses, monitor lizard, pangolin, porcupine, topi, toad, squirrel, - and termites, of course!
Eating, drinking and sleeping are basic to survival, but animals have to survive the hazards of their environments as well: disease, parasites, calamities, drought, predators large and small, even competitors of their own species. In addition to coping with all of this, if their genes are to survive into the future, living creatures must reproduce.

Survival means being able to get enough to eat, to fight off rivals, escape predators and reproduce. This basic survival strategy is called the four F's: Feed, Fight, Flee, and be Fecund. You can imagine that survival is different for a bacterium or plant than it is for a lion or yourself. In this section we are interested in the strategies that large animals use in the Serengeti scene.

**FORM, COLOR, MARKINGS** are all characteristics that animals have acquired because such traits have helped them survive and reproduce. The total environment determines these characters. Often we really do not know the particular factors that have led to a character. For example, the white beard of the gnu. Why? A beard could be decorative, attractive to mates, useful for defense, etc. It has been suggested that the beard helps to hide newborn babies. We can only guess at the factors.

Camouflage markings are generally more understandable than bold markings such as the zebras’ stripes. Everyone would agree that a mottled sandgrouse or dappled leopard are examples of camouflage coats. But what about giraffes? Can the blotchy patterns really disguise such a huge animal from predators? And who are its predators anyway? Lions can only catch giraffes under special circumstances. It is obvious when you see the animals in real life that many different factors determine the way an animal looks. Discuss the major factors: species and individual recognition, predator avoidance, signalling, advantages in fights, attraction to the opposite sex, uses for bringing up offspring and avoiding diseases (see box on zebra below).

**COAT PATTERNS** Match the coat to its owner. Answers are upside down, below.

---

People have long been arguing about why zebras have such bold black and white markings. Discuss these various reasons proposed to explain the stripes: camouflage in woodlands or at dusk against predators like lions and hyenas, temperature control (black absorbs and white reflects the strong African sun), individual recognition (zebras are social animals and since each stripe pattern is different they presumably can use the coat to recognize individuals); tsetse fly resistance (tsetse flies are not attracted to striped patterns, they tend to settle on dark objects. Zebras, like all the horse family, are exceptionally sensitive to fly bites and vulnerable to sleeping sickness carried by tsetse flies).
**BEHAVIOR** Outer appearance is only one aspect of survival. It is also essential to behave appropriately. Feeding is mainly an individual activity. The other F’s involve another creature. Flight and fight are more often due to competition with one’s own kind than with a predator. To be fecund means to be fertile and reproduce, usually by mating with the opposite sex. Thus animals evolve social systems, strategies for survival that are interwoven with the needs and aims of others of their own kind.

Social systems range from living alone to living in big groups. Generally, if food is plentiful and evenly distributed, as in a bushland or forest, animals stake out territories big enough to feed themselves all year round and stay there as long as possible. In this environment many animals have a simple social system; one female who shares her plot with a male. If the male stays with just one female, as in dikdiks, it is termed monogamy. If a male tries to gain access to several different females, as in leopards, it is called polygyny. Each female rears her own young and when mature, her offspring leave.

When food is abundant enough for a female to share her range with her offspring, a family can grow into a group. Typically, female relatives are the core of such a group; mothers, daughters, sisters. Males who reach maturity leave their home group and join a new one, and surplus males form bachelor groups. Many species show this pattern, such as impalas, lions, waterbucks, elephants, and monkeys. In rare cases, it is the males who stay in a range and the females that leave. The only example in the Serengeti is wild dogs.

Social animals have developed many styles of behavior to cope with meeting and Interacting with one another. They also advertize themselves as groups by scent marking, territorial displays and vocalizations, such as the lion’s marvelous roar. Among the most complicated social behaviors are mating patterns. Males and females have to get together and there is often competition for mates. Mating leads to births. Interactions between mothers and young are very interesting. In most species, the youngster has to learn to follow or find its mother among the other animals in the group and likewise, the mother has to form a strong bond with its own infant. A striking example of this process, called “imprinting”, is seen when a newborn gnu learns by smell and sight to recognize its own mother among the throng.

Watching animals can be fascinating and a way to understanding our fellow creatures, including the human species. Read books, see lots more films, observe animals everywhere, especially in the wild, but also at home, in zoos and safari parks. Try to get on a safari to the Serengeti someday!
This is a view of the heart of Serengeti National Park where the plains merge with woodlands and hills. Here both the resident and the migrant animals meet during the dry season. Here they share or compete for resources and space. All the animals in the picture have different survival strategies, social systems, and patterns of behavior for mating and rearing young. Use the picture together with references, to discuss the lives of the different animals and the ways in which they all fit into the Serengeti scene.

Match these animals' heads to the right horns. Can you imagine why they have horns? Do males and females differ? Why?

Answers: gnu=3, topi=6, oryx=2, hartebeest=7, Thomson gazelle=8, zebra=4, Grant's gazelle=1, eland=5.
By now you will appreciate that every species of animal is adapted for a particular way of life. Scientists use the term “ecological niche” to describe an animal’s position in the ecosystem - what it eats, when, where, and how much. You could almost call this a “job description.” In this imaginary page from a newspaper, see if you can work out which animal would respond to each advertisement. Answers below.

<table>
<thead>
<tr>
<th>SITUATIONS VACANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gardener, unafraid of heights, for pruning trees up to 16ft.</td>
</tr>
<tr>
<td>Garbage disposal team, to process bones, hides and other parts of dead animals. Must be available for both day and night shifts.</td>
</tr>
<tr>
<td>Excavation crew, to clear up dead trees or grass, and replace nutrients deep in the soil. Need to be able to remain long periods underground and build support structures such as ventilation shafts and storage tunnels. Live-in crew preferred.</td>
</tr>
<tr>
<td>Selection Board Members. High profile and big bucks for qualified candidates who can routinely select out the weak, unfit and socially undesirable or fringe members of groups. Needs sharp eyes and keen observational abilities. Camouflage coats come with the job.</td>
</tr>
<tr>
<td>Large Animal Control team. Should have proven experience at immobilizing buffalo, zebra, gnu and other large mammals. Favorable working hours (less than 4 per day); unlimited food, a job you can take pride in.</td>
</tr>
<tr>
<td>Fertilizer spreading crew, need to be able to dig in and work hard at all hours whenever fertilizer becomes available.</td>
</tr>
<tr>
<td>Rock gardeners to keep kopjes tidy. Accommodation available on site.</td>
</tr>
<tr>
<td>Lawn mowers for large area. Must provide own cutting tools with sharp edges to trim grass down to surface levels for nice lawn effect. Plentiful food available for suitable candidates.</td>
</tr>
<tr>
<td>Tree and bush clearance experts. Heavy work that needs special tools. Only the largest and strongest need apply.</td>
</tr>
<tr>
<td>Watchman/”Bouncers” Easy job for bulky applicants with the ability to be in the right place at the right time to keep human visitors in their vehicles or rooms. Relatively easy policing duties-ideal for retired herdsmen. Must be able to do odd heavy jobs such as entering marshy areas to push down vegetation to prepare grazing and visitor use sites.</td>
</tr>
<tr>
<td>Also gamekeeper jobs available for smaller applicants who are able to cover more distance, and are prepared to tackle the removal of livestock and pester their herdsmen over wide areas of woodland in Serengeti National Park.</td>
</tr>
<tr>
<td>Pest removal services. Constant surveillance needed to control insect pests that are destructive to the vegetation of the Serengeti. Any size and type acceptable but must be fast workers, especially in rainy season when pests are abundant. Overseas applicants welcomed.</td>
</tr>
</tbody>
</table>
You are alive to read this page. Imagine an unbroken line of your ancestors reaching far, far into the past. One of them might have lived in Serengeti!

Humans have a long and fascinating history in Serengeti. The earliest record is of a day 3,600,000 years ago when three early human-like creatures (or hominids) walked across the plains, at a place now called Laetoli. A volcano had just erupted, blanketing the plains with ash, which a light rain then dampened. The prehistoric people left a clear trail of footprints. Animals left their tracks too. In a few days, another ashfall buried all the tracks. Over time the ash hardened and became rock, preserving the tracks. Thousands of years passed before the soil on top of the trails eroded away and luckily, archeologists discovered them. The footprints reveal that the early hominids walked erect, meaning that their ancestors must already have been walking upright for millions of years. Hence, for a very long time early people had their hands free to carry babies, food, water, or tools and weapons.

The human story goes on, recorded in the walls of Olduvai Gorge. From the bottom of the gorge to the top there are layers of fossils. Two million years ago there was a lake where Olduvai Gorge is today, and our ancestors must have found it a good place to live. The lake came and went, sometimes drying up or being covered by new volcanic ashfalls, which preserved the fossils in orderly layers. Around one million years ago people started using more stone tools and were probably hunting as well as gathering fruits, digging roots and catching fish in the lake. From that time on the remains show that people lived there right up to now, gradually becoming more like us.

Many thousands of years ago, some people migrated out of Africa to settle other parts of the world. They may have been seeking better places to live, or getting away from their neighbors! We are all descendants of the hominids that once roamed Africa, side by side with odd-looking elephants and giraffes with antlers. Some of the descendants came back to Africa; and back to the Serengeti. Some probably never left.

Waves of people have moved through the Serengeti within the last few thousand years. They made more sophisticated tools, including stone bowls and grindstones, eventually even iron tools appeared. They dug wells to find water under the plains. Some brought livestock, and later came growers of crops. Recently, about 100 years ago, the Maasai people came to the Serengeti area with their livestock. They ousted the Datoga, also a cattle-keeping people who now live south of the Serengeti. The Datoga undoubtedly pushed earlier peoples off the plains. And so it goes, back in time. No one tribe can claim to be the original inhabitants of the Serengeti. Few places in the world can match the Serengeti’s long human history.
ACTIVITY - ANCESTRAL ART

Nowadays we have access to wonderful films that show the Serengeti and its wildlife in close-up and action packed. There are also illustrated magazine articles, posters, photographs of all sizes. All this material makes you feel as though you are right there among the gnus and other animals. Viewing these modern forms of portraying animals is mostly a passive activity. But in ancient days people were much more active participants in the Serengeti drama. Try to imagine what it was like living in little groups, dependent on one another for survival. You all had to gather wild foods and hunt or scavenge animals to get meat. Some of you could make fine stone tools, others could weave baskets. Probably someone had the skill to make beads out of the ostrich egg shells that you all used to carry water.

Your clan camped among the rock outcrops, preferably those near water and with a view so you could see out over the plains. Inevitably someone would take some charcoal out of the fire and draw on the rocks. Or take a rock and bang on a boulder. Maybe you all danced and sang, pounding out a rhythm and acting out the actions of the hunters who made a kill worth remembering.

WRITE STORIES Write short stories, preferably with illustrations, about what your life might have been like in the Serengeti. Pick a time, such as one million years ago; or ten thousand, or imagine more modern peoples like the Hadza who still hunt and gather wild foods at Lake Eyasi, just south of Serengeti, or the Datoga and Maasai who herd livestock and who fought over cattle and the right to live on the plains.

DISCUSS how modern people have changed or stayed the same as our ancestors of thousands of years ago. What are our interactions with animals like these days? Where do you see wildlife? Have you ever met a lion or a gnu personally? Are you afraid of wild animals? Do you realize that many more people are killed and hurt by cars than by animals?

ANIMAL ART Draw an animal, on a piece of paper or a rock or on sand. Trying to get the form right, the colors and patterns, horns or hooves, makes the “artist” focus attention on whatever he or she is trying to depict. This activity helps humans think about - maybe even think like - other creatures. There are a lot of reasons why our ancestors may have liked to paint pictures on rocks, maybe we will gain insights if we try it ourselves!

CLAN ART Organize the class or group into small groups (three is about right). Each group can choose a clan name. Each clan gets chalk or crayons in black, white, yellow and red - the natural colors of charcoal, clay, ochre, etc. Put up a large long blank piece of paper on each wall of the room or use chalkboards. The paper or board represents a rock overhang where the clan is living for a time. One or more clan members draw what they can imagine in the Serengeti scene, trying to act and draw as our ancient ancestors might. After about 15 - 20 minutes, the clans all change rock shelters. Then they see the other clan’s drawings; what do they think? The newly arrived clan now draws on that “rock” too, adding whatever they think our ancestors might have added. Again, the clans change sleeping sites and talk about what they see on the rocks. Again they add their own “art” or messages. At the end of the session, discuss what has been written in “art on the rocks”.

© David Bygott & Co. 1994
AIM OF GAME
Gnus “migrate” from one end of the field to the other without being confined within clear boundaries. See how many gnus survive the hazards. Game can be played until all the gnus have been caught or until all the hazards have been taken off the field. Vary the numbers of categories and numbers of players in categories to see the effects on gnu survival.

WAY TO PLAY
Divide players into GNUS, LIONS, RANGERS AND POACHERS. The numbers of players in each category can be made appropriate to the numbers of people available and the size of the playing field. If played on a regular, football or soccer field, we have found that any number of GNUS can be players but it’s best if it’s over ten. LIONS should divide up the field into territories, eight lions is a good number, but can vary from one to 16 or more. Instead of more lion territories put more lions into a pride within a territory. RANGERS can be from 1 to as many as can “realistically” be hired by the National Park service, about eight, four to each side of the field is appropriate. POACHERS should be about the same number as the rangers, and it is nice if the rangers and poachers are paired along the borders, but numbers can vary too.

The game welcomes some OBSERVERS or RESEARCHERS to check what is going on. Added factors such as FARMERS, who live along the borders and try to kill gnus that trample their crops and CROCS that can catch gnus at specified points, can add realistic complications for the practiced players who want even more hazards in the game.

PROPS
Each gnu has a “tail”, a piece of rope, string, or grass, breakable or pull-off-able, hanging from waist. Lions all have “manes” around their heads, made of wound tinsel, wreaths or grass or cut out paper. Rangers all have caps or paper hats that can be easily grabbed off heads. Poachers all carry a “snare” or tearable loop of paper that they wear crossed over their chests like a bandolier.

RULES
GNUS try to get from one end, the Plains, to the other end of the field, the Mara, without getting their tails ripped off. Gnus without tails at the other end of the field are out of the game. Gnus may not fight with poachers, rangers, lions or each other. Their sole aim is to get to the end of the field without getting caught. Surviving gnus can then run again to get back to the plains. This can go on until all gnus are caught.

LIONS try to grab gnus who pass through their territories. If a lion goes into the territory of a neighboring lion, that lion can try to grab off the intruder’s mane. If a lion loses its mane, it is out of the game.

POACHERS try to kill gnus and lions by taking tails and manes. Poachers can defend themselves from Rangers by taking rangers’ caps. Poachers who lose their snares are out of the game.

RANGERS try to block poachers from killing gnus and lions by taking away poachers’ snares. Rangers who lose their hats are out of the game.

No one can use hands for anything other than taking a tail, mane, hat or snare. Gnus can rest a few minutes on the Plains or Mara or can just keep moving. Prizes could be given to the surviving gnu(s). Try doubling the number of poachers or lions; halving the number of rangers, quadrupling the gnus, adding more hazards. Invent other variants. Use your inge-gnu-ity!
archaeology - the search for and study of the material remains of early human ancestors.
biodiversity - the numbers and different kinds of living things.
browser - an animal that eats the leaves and shoots of herbs, bushes and trees.
carnivore - an animal that eats the flesh or meat of other animals.
ecology - the study of the relationships between plants, animals and their environment.
ecosystem - an interacting “community” of living things and their non-living environments.
ethnography - the description of specific human groups and their culture.
fecund - to be fertile, to reproduce plentifully.
grazer - an animal that eats mainly grasses.
habitat - the home of an animal; having a special combination of water, food, shelter, climate, etc.
hominid - modern humans and our extinct human-like ancestors.
hardpan - soil hardened into a crust by water and minerals (eg calcium salts).
herbivore - an animal that eats plants.
kopje - an Afrikaans word meaning “little head”, referring to the rock outcrops of the Serengeti.
monogamy - a mating system of one male with one female.
outcrop - a rock formation that projects above the soil; in the Serengeti outcrops are usually granitic.
polygyny - a mating system of one male with two or more females.
predator - an animal that hunts and eats other animals, callal “prey”.
primary producer - plants that use the energy of the sun to produce living matter.
range - the area in which an animal normally lives and obtains food.
cycle - to reclaim waste materials for further use.
rift - a crack or fault caused by tension in the earth’s crust. The Great Rift Valley of East Africa is primarily a subsiding strip of land between two parallel faults.
safari - a Kiswahili word meaning any journey or trip; in English it has the sense of an overland expedition to see or hunt wild animals, especially in Africa.
scavenger - an animal that eats dead vegetable or animal material.
species - a population of closely related organisms which can freely interbreed but not breed with other species.
territory - an area that is defended against rivals of the same species.

SILHOUETTE STORY The main things that are happening are noted here page by page:
1: gnu mother giving birth, 2: gnu mother with newborn baby, 3: mother and baby head for herd, 4: mother alarmed, runs with calf, 5: cheetah chase, 6: cheetah catches calf, mom fights back, wild dogs appear, 7: wild dogs chase cheetah away, pursue mother and calf, 8: dogs attack mother gnu, calf runs off; hyena pops out of hole, 9: calf runs away, 10: dogs kill female, hyena goes after calf, 11: hyena chases calf, 12-13: (the baby was doomed without its mother, but we spare you its sad end as an orphan by letting its quick death feed the hyena) 14: jackals come and hang around dogs; another hyena approaches, 15: dogs chase away hyena and threaten jackals, 16: lions appear and chase away dogs, 17: lions settle down to the carcass; hyenas and jackals hang around the periphery, 18: mother lion leaves; another chases jackals and hyenas, 19: mother fetches her cubs, 20: mother returns with cubs to join others at carcass, 21: the pride’s two adult males rush in to join the females, frightening all away briefly; vultures have spotted the kill, 22: the hungry mother and cubs return to feed and are tolerated by the males; more vultures arrive, 23: lions joined by a film crew who have missed all the previous action and mistakenly think they are filming a lion kin, 24: a dung beetle buries what is left of the gnu, 25: gnu skull provides food for hornworm moths; the buried dung fertilizes Serengeti grass and flowers.

ANSWERS TO WHAT’S WRONG? (page 24)
Tortoise in tree; ostrich flying; velvet monkey hanging by tail; owl upside down; leopard with lion tail; giraffe with stripes; kangaroo; rhino with glasses; Indian elephant; impala with two heads; egret’s wings are reversed; penguin; buffalo with braided hair and spots; weaver bird in basket; bat standing up; jackal with monkey feet; snake moving with vertical curves; dikdik with five legs and bushy tail; dung beetle with wheel-barrow, bush with hoof.
Can you find the 22 deliberate mistakes in this scene of the Serengeti?
Answers on page 23.
This poster can be used as decoration but also in many fun and educational ways. Some suggested uses are listed here:

* **LEARN ABOUT THE ANIMALS OF SERENGETI** Hang up, use with all previous sections of this booklet to identify and discuss individual animals: i.e. largest and smallest, grazers and browsers, omnivores, predators and prey, residents, migrants, nocturnal and diurnal, mammals, birds, reptiles, plains livers, bush dwellers, riverine inhabitants.

* **QUESTIONS AND ANSWERS GAME** Teacher or teams can ask a question and individual or teams give answers within a time limit, i.e. which Serengeti animal on this poster can eat the most grass each day, which has the most offspring, which is the least often seen, etc. Game can be played with answers given first and the individual or group has to guess the animal, i.e. I am a female of this species and I have proper horns, I live around marshes and swamps. I eat mostly grass and live in a small loose group of my kind. I have one young a year at most. Who am I?

The information necessary to ask the right questions and give the right answers is included in this booklet, can be found in the books listed on the references page (p. 26), especially the two books by R. Estes, or can be "read" from the poster itself. Each animal is given its common English name, its scientific name and its Kiswahili name.

* **ANIMAL CHARADES** Select animals, write names on slips of paper and put in a bowl or sack. Each person draws a name and has to act out the animal while others try to guess. (Can be with or without sounds!). This can be a team game as well, and can be played in a room or outdoors.

* **NOAH’S ARK** A variant of animal charades is amusing: divide the group into two teams and make two sets of animal names on slips of paper, so there are as many names as players. Each team then draws names from its set of names. The game starts with all of the participants acting out their animals and trying to find the "mate" on the other team. When the two partners identify each other, without aid of human speech, but possibly with animal vocalizations, they sit or stand together. The game continues until all the animals are paired up. Check cards to see if the right mates are in pairs!

* **COPYCAT** Photocopy, trace or draw from the poster any animals wanted for the ecoweb activity (pg 9) and other instructional games.

* **ANIMAL CUT-UPS** Paste the cut out copies of the animals on heavy card or paper. Cut into thirds: heads and necks, bodies, rumps. Mix them all up and put them together in funny combinations or time yourself and others or teams to see who can put the real animals back together the fastest. Another game is to pile the cards face down and have players draw three each turn. If the three cards are a whole animal, put aside, if not return to pile face down and try to remember where the parts are for the next turn. Player with most whole animals wins.

* **GREETING CARDS** Photocopy the animals and cut out and paste or trace onto stiff cards. Fold cards in half and use as cards for messages, birthdays, get well, Christmas, etc. Animals can be colored in realistically or fantastically.

* **TRACERS AND STENCILS** Use for T-shirts, scarves, jackets, skirts, etc. Cut out photocopied animals and trace onto cloth with waterproof, laundry marker pens. Animals can be used one by one or mixed in creative ways. You can also glue the copied animals onto heavy paper and cut very carefully along outlines, to make stencils. The stencils can then be used on cloth, poster board, doors, metal, etc. ensuring that the appropriate paints or dyes are used on the different substrates.
REFERENCES AND FURTHER READING

GENERAL
Croze, H. and Reader, J., 1977 PYRAMIDS OF LIFE. London: Collins
Grzimek, B. and Grzimek, M., 1960 SERENGETI SHALL NOT DIE. New York: Dutton
Leakey, L.S.B., 1969 ANIMALS OF EAST AFRICA. Washington: National Geographic Society
Hayes, H., 1983 THE LAST PLACE ON EARTH. New York: Stein & Day
Turner, M., 1987 MY SERENGETI YEARS. New York: Norton

SPECIAL INTEREST AND DETAILED INFORMATION
Beckwith, C. and Ole Saitoti, T., 1980 MAASAI. New York: Abrams
Estes, R. D., 1993 THE SAFARI COMPANION. Vermont: Chelsea Green
Leakey, M., 1979 OLDUVAI GORGE. London: Collins
Leakey, M., 1983 AFRICA'S VANISHING ART. London: Hamish Hamilton
Van Lawick, H. and Goodall, J., 1971 INNOCENT KILLERS. London: Collins

PHOTOGRAPHIC BOOKS
Iwago, M., 1987 SERENGETI. San Francisco: Chronicle Books
Johns, C., 1992 VALLEY OF LIFE. New York: Thomasson Grant
Karmali, J., 1980 BIRDS OF AFRICA. London: Collins
Kunkel, R., 1992 NGORONGORO. London: Harvill
Scott, J., 1988 THE GREAT MIGRATION. London: Elm Tree
Van Lawick, H., 1971 SAVAGE PARADISE. London: Collins

MAGAZINES such as NATIONAL GEOGRAPHIC, NATURAL HISTORY, SMITHSONIAN, RANGER RICK, INTERNATIONAL WILDLIFE, and many others frequently feature excellent articles about Serengeti wildlife.

FILMS such as "AFRICA: THE SERENGETI," are excellent sources of information as well as inspiration and beauty. Hugo van Lawick and his team make numerous fine films about the Serengeti, showing the fascinating lives of large and small animals. Also well worth seeing are "CASTLES OF CLAY" (about termites), "ISLANDS IN A SEA OF GRASS" (about kopjes), "YEAR OF THE WILDEBEEST," all by Alan and Joan Root. Many other classic films of the Serengeti wildlife have been made for TV by teams (i.e. National Geographic, BBC) and by independent film-makers, and are available on video. You will learn a lot as you watch and enjoy these Serengeti films.