



### About the pagination of this eBook

Due to the unique page numbering scheme of this book, the electronic pagination of the eBook does not match the pagination of the printed version. To navigate the text, please use the electronic Table of Contents that appears alongside the eBook or the Search function.

For citation purposes, use the page numbers that appear in the text.

# MAMMALS



# Britannica Illustrated Science Library

Encyclopædia Britannica, Inc.

Chicago - London - New Delhi - Paris - Seoul - Sydney - Taipei - Tokyo

### **Britannica Illustrated** Science Library

© 2008 Editorial Sol 90

All rights reserved.

**Idea and Concept of This Work:** Editorial Sol 90

**Proiect Management:** Fabián Cassan

Photo Credits: Corbis, ESA, Getty Images, Bryan Mullennix—Riser/Getty Images, Graphic News, NASA, National Geographic, Science Photo Library

Illustrators: Guido Arroyo, Pablo Aschei, Gustavo J. Caironi, Hernán Cañellas, Leonardo César, José Luis Corsetti, Vanina Farías, Manrique Fernández Buente, Joana Garrido, Celina Hilbert, Jorge Ivanovich, Isidro López, Diego Martín, Jorge Martínez, Marco Menco, Marcelo Morán, Ala de Mosca, Diego Mourelos, Pablo Palastro, Eduardo Pérez, Javier Pérez, Ariel Pirovansky, Fernando Ramallo, Ariel Roldán, Marcel Socías, Néstor Taylor, Trebol Animation, Juan Venegas, Constanza Vicco, Coralia Vignau, Gustavo Yamin, 3DN, 3DOM studio

**Composition and Pre-press Services:** Editorial Sol 90 Translation Services and Index: Publication Services, Inc.

### Portions © 2008 Encyclopædia Britannica, Inc.

Encyclopædia Britannica, Britannica, and the thistle logo are registered trademarks of Encyclopædia Britannica, Inc.

### **Britannica Illustrated Science Library Staff**

### **Editorial**

Michael Levy, Executive Editor, Core Editorial John Rafferty, Associate Editor, Earth Sciences William L. Hosch, Associate Editor, Mathematics and Computers

Kara Rogers, Associate Editor, Life Sciences Rob Curley, Senior Editor, Science and Technology David Hayes, Special Projects Editor

### **Art and Composition**

Steven N. Kapusta, Director Carol A. Gaines, Composition Supervisor Christine McCabe, Senior Illustrator

### **Media Acquisition**

Kathy Nakamura, Manager

### **Copy Department**

Sylvia Wallace, Director Julian Ronning, Supervisor

### **Information Management and Retrieval**

Sheila Vasich, Information Architect

### **Production Control**

Marilyn L. Barton

### **Manufacturing**

Kim Gerber, Director

### Encyclopædia Britannica, Inc.

Jacob E. Safra, Chairman of the Board

Jorge Aguilar-Cauz, President

Michael Ross, Senior Vice President, Corporate Development

Dale H. Hoiberg, Senior Vice President and Editor

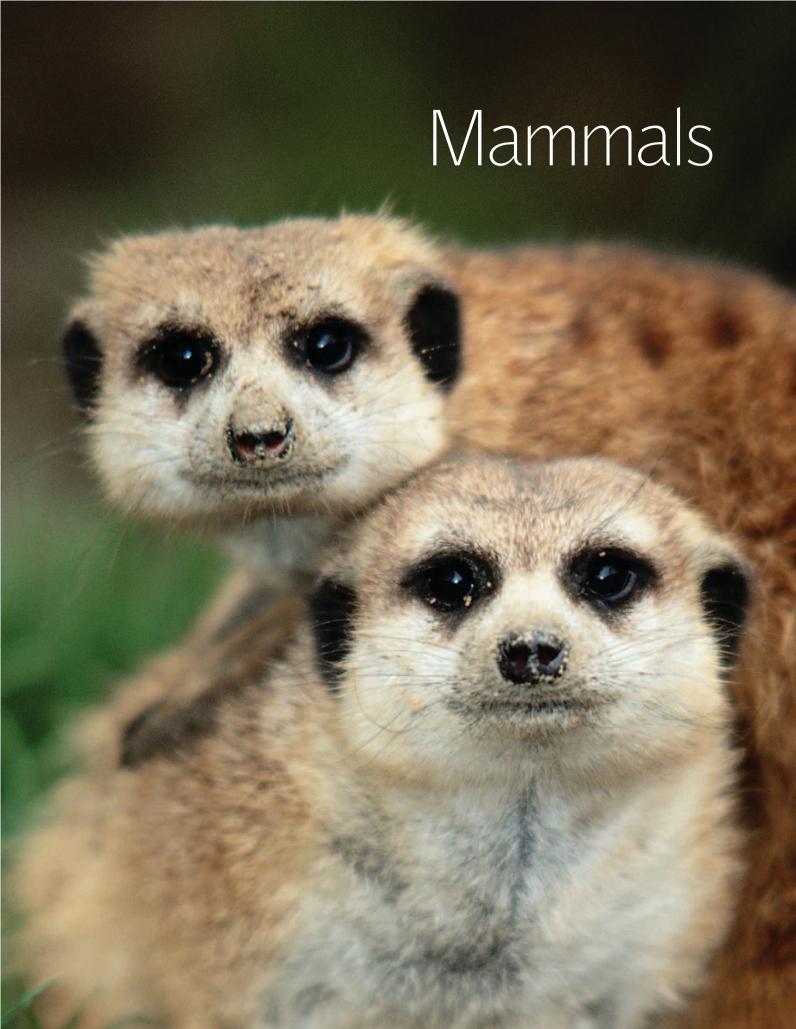
Marsha Mackenzie, Director of Production

International Standard Book Number (set): 978-1-59339-797-5 International Standard Book Number (volume): 978-1-59339-808-8 Britannica Illustrated Science Library: Mammals 2008

Printed in China



www.britannica.com



# Contents



### WALES

Land of green meadows and gentle hills, Wales is famous the world over for the quality of its wool production.

# Unique and Different

ammals began to dominate the Earth about 65 million years ago. Without a doubt, modern humans are the most successful mammals—they occupy all the Earth's habitats! Their domestic coexistence with other species began barely 10,000 years BC, when human culture transitioned from a world of nomadic

hunters and gatherers to a society based on agriculture. At that time, humans began to benefit from the meat and milk products of small mammals and to use large animals for labor. The first animals to be domesticated were sheep (about 9000 BC) in the Middle East. Pigs, cows, goats, and dogs followed. However, the great majority of mammal species continue, even today, to live in the wild.

here are 5,416 known mammal species distributed over different land and aquatic environments. Despite the characteristics that make them part of the same class, their diversity is such that the smallest of them, the shrew, may weigh only one tenth of an ounce (3 g), and the largest, the blue whale, can reach 160 tons. But their diversity is also evident in their adaptation to different environments. There are mammals that run and others that glide—some fly, and others jump, swim, or crawl. Most aquatic mammals have suppressed the development of hair or fur, replacing it with thick layers of fat. The rigors of low temperatures have made some animals—such as polar bears, dormice, and certain bats—exceptions to the vital law of homeothermy, as they spend the winter sunk in deep sleep to save energy.

Seals, dolphins, bats, and chimpanzees all have upper limbs with similar bones, but the environmental niche they occupy has made seals develop flippers, dolphins fins, bats wings, and chimpanzees arms. Thus from the polar tundra to the dense tropical jungle, through the deep oceans and high mountain lakes, the whole Earth has been populated by thousands of mammal species.

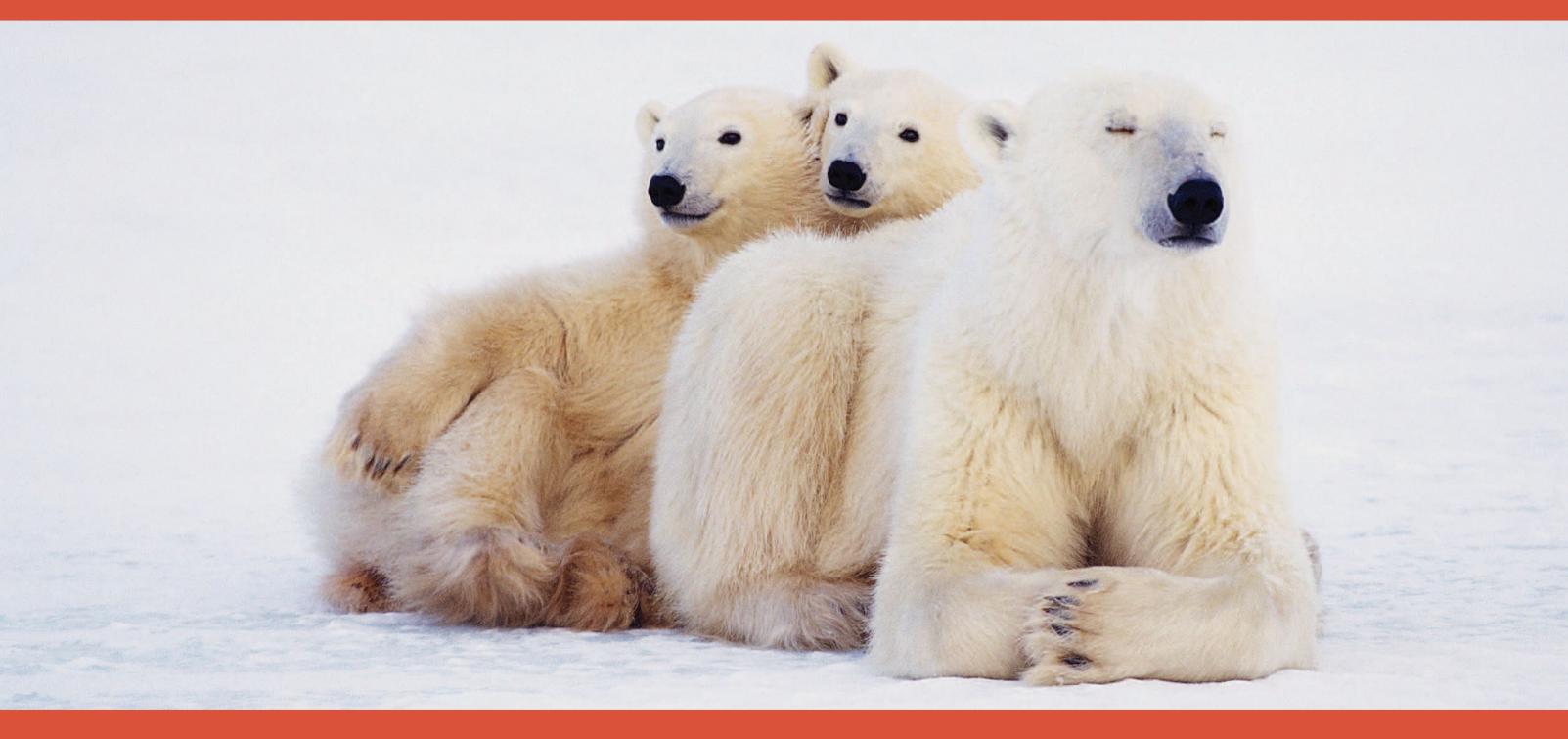
ut this marvelous animal world has been disturbed by its most numerous species—humankind. Indiscriminate hunting, illegal trade, deforestation, urbanization, massive tourism, and pollution have left more than a thousand species (many of them mammals) endangered or vulnerable. However, science allows us to understand nature's many wonders, and it can help us respect the world's ecological balance. In this book, which includes dazzling photographs and illustrations, we invite you to discover many details of mammals' lives: their life cycles, their social lives, their special features, and their characteristics, from those of the greatest friend of them all, the dog, to the mysterious and solitary platypus.



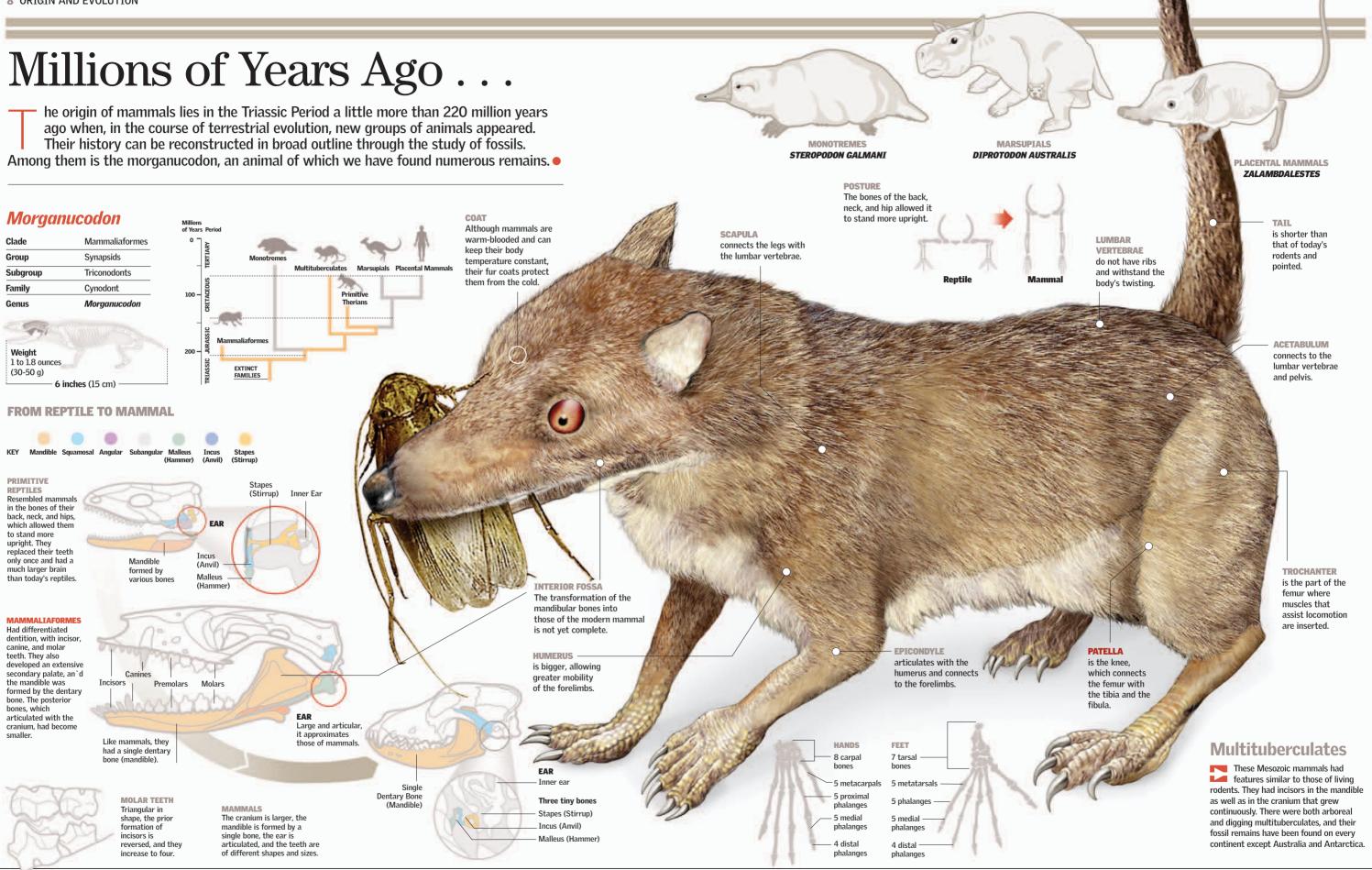
# Origin and Evolution

DOLAD READ

Also called the white bear, they are without a doubt "Lords of the Arctic." Nevertheless, they are on the road to extinction MILLIONS OF YEARS AGO . . . 8-9
NAMES AND GROUPS 10-13
WHAT IS A MAMMAL? 14-15
CONSTANT HEAT 16-17



olar bears are all-around athletes, as agile in the water as they are on land. Excellent swimmers, they move at a speed of 6 miles per hour (10 km/h) using a very rapid stroke. They can rest and even sleep in the water. Like all mammals, they have the ability to maintain a constant temperature. This allows them to tolerate the extreme cold of the Arctic ice. Here we will tell you many more things about the particular properties that distinguish mammals from the rest of the animals. Did you know that mammals appeared on Earth at almost the same time as dinosaurs? Since they were unable to compete with the large reptiles of the time, at first they were very small, similar to mice. Turn the page and you will discover many more things. •



**MAMMALS 11 10** ORIGIN AND EVOLUTION

Names and Groups

**ECHIDNA** 

Family Tachyglossidae

on ants and termites that it

catches with its tongue. Its

skin has hair and spines.

**CURRENTLY** 

**SPECIES KNOWN** 

Platypuses use

Also known as the "spiny anteater" because it feeds

he mammals class is divided into two subclasses: Prototheria, which lay eggs (like other classes such as birds), and Theria. The Theria, in turn, are divided into two infraclasses—Metatheria (marsupials), which grow to viability within a marsupium, or pouch, and Eutheria (placental mammals), whose offspring are born completely developed and who today represent the great majority of living mammal species, including humans.

### **Prototheria Order Monotremata**

Oviparous mammals (Monotremata) are the oldest of all known groups. It is believed that their origin could be independent from that of other mammals and that they descend directly from the Synapsid reptiles of the Triassic Period (more than 200 million years ago).

Monotremes are the only mammals that lay eggs. However, the shape of their craniums, the presence of hair, and, of course, mammary glands show that they belong to the mammal group. The mammary glands lack nipples, so the young have to lick milk from a tuft of hair.

The only living representatives of this order are echidnas and the platypus. The platypus is a unique species that, because of its similarity to birds, was impossible to classify zoologically for a long time.

### **Theria Infraclass Metatheria**

The principal characteristic of metatherias, or marsupials, is the way they reproduce and develop. They have a very short gestation period compared to other mammals (the longest is that of the giant gray kangaroo, only 38 days), which means that their newborn are not very developed but have bare skin and eyes and ears that are still in the formative stage—although they have a sense of smell, a mouth, and digestive and respiratory systems adequate for survival. When they are born, they crawl across their mother's abdomen in search of her mammary glands. Kangaroo offspring climb to the edge of the mother's pouch (marsupium). They then crawl in and affix themselves to one of the mammary glands, from which they feed until they complete development and leave the pouch.



**SOUTH** 

### **ALMOST PATRIMONY**

Unlike the rest of the world. almost no placental mammals live in Australia and its neighboring islands. The island continent possesses 83 percent of the unique (endemic) species of mammals.



Family Didelphidae They spend most of their lives perched in trees and are very timid.

**Mammals Colonizing the World** 

The first fossils of marsupials and placental mammals were found in rocks dating from the late Jurassic and

separate. But the placental mammals evolved further, and at the beginning of the Eocene Period (56 million years ago), opossums were the only representatives in America of marsupials, which otherwise prospered only in Australia's particular

### the earliest part of the Cretaceous periods. At that time, America, Africa, and Australia were united in a single continent (Gondwana) and were beginning to climate and geographic isolation.

Subclass **Prototheria** 

**HORNY BEAK** 

riverbeds and mud

is used to

# **PLATYPUS** Family Ornithorhynchidae

A monotreme with semiaguatic habits. Its feet and tail possess membranes that make it palmate, which is useful for swimming. It feeds off any living thing it finds at the bottom of Australia's rivers or lakes by rummaging with its horny beak.

# **GEOGRAPHICALLY CONFINED**

Platypuses and echidnas are found only in Oceania—the platypus only on Australia and the echidna (of which there are four species) also on the islands of Tasmania and New Guinea.

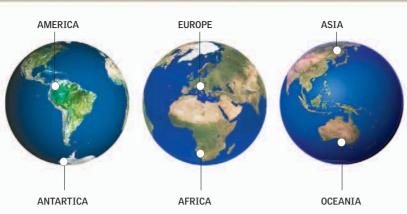


### **TASMANIAN DEVIL** Family Dasyuridae

The largest of the carnivorous marsupials became extinct in Australia 600 years ago, but it survives on the island of Tasmania. It is a predator the size of a small dog.

Commonly called placental mammals, they are the typical mammals. They probably began diversifying during the Cretaceous Period (65-150 million years ago) from a different line of the metatherians. They are characterized by the fact that their embryos are implanted in the uterine cavity and develop an outer layer of cells in close union with the maternal body, the placenta. They receive nutrients directly from the placenta during their development until they are born with their vital organs (except for those responsible for reproduction) fully formed.





### THROUGHOUT THE WORLD

The eutherians, or placental mammals, are the most important group of mammals because of the number of living species they represent. Their geographic distribution covers almost the entire planet, including on and beneath bodies of water and polar areas. These animals cover a wide range of ecosystems and forms of life and make up 19 orders of viviparous placental mammals.

### **Jurassic Beaver**

Scientists thought that mammals were able to conquer the Earth only after dinosaurs became extinct. But the recent find of a fossil of this beaver in China suggested that, by the Jurassic Period, when the giant reptiles were at their peak, mammals had already diversified and adapted to water ecosystems 100 million years earlier than had been believed. The Castorocauda lufrasimilis lived 140

million years ago.

SEALS
Order Carnivora
Along with elephant seals, they make up the Pinnipedia suborder. They move very clumsily on land, but they are very good swimmers. They feed on fish and crustaceans and prefer to inhabit marine waters near the poles, although they reproduce on

dry land.

THERE ARE OVER

4,000

SPECIES OF EUTHERIANS.

A fur coat and subcutaneous fat

protect the animal from extreme cold.

**MAMMALS 13** 

**NECK** allows them to

reach the highest leaves.

GIRAFFE

Order Artyodactilae

These are the tallest of living land

animals—they can be over 18 feet

Their blood pressure is almost twice

that of other large mammals, and their tongues are over 18 inches (0.5 m) long. They live in Africa.

tall (5.5 m). They are herbivores.

### MANDRILL

Order Primates
Weighing up to 120 pounds (55 kg),
these are the largest monkeys in the
world. The males are much larger
than the females, and they have a
brilliantly colored face, with deep
grooves running down both sides
of their snout. Mandrills live in
Africa's tropical zones. They
are omnivores, eating
anything from grasses to
small mammals.

Infraclass Eutheria

Order Carnivora

Order Cetacea

Order Chiroptera

Order Hyracoidea

Order Hyracoidea

Order Lagomorpha

Order Perissodactyla

Order Primates

Order Proboscidea

Order Scandentia

Order Scandentia

Order Sirenia

Order Sirenia

Order Sirenia

Order Tubulidentata

Superorder Xenarthra

**Subclass Theria** 



for tearing, and incisors for gnawing.

In rodents such as chipmunks,

the teeth are renewed by

continuous growth.

CHTPMIINK

Family Sciuridae

which the females feed their young during their first months of life. These glands give the class its name











Humans have adapted to almost all habitats through

certain elements of their

They often create tools to help them adapt to their they do not need to rely habitat to their advantage. on natural evolution alone.

### **A Perfect System**

Polar bears, like all mammals, keep their internal temperature constant. These bears tolerate the extreme cold of the Arctic ice because they have developed a sophisticated system to increase their ability to isolate and capture sunlight. Their transparent hair receives a large part of it and therefore appears to be white. The hair transmits this light inward, where there is a thick layer of black skin, an efficient solar collector. Their fur is made up of hollow hairs, approximately 6 inches (15 cm) long, which insulate the bear in low temperatures and keep the skin from getting wet when in the water.

products—among other things.

Polar bears swim with ease in open waters and reach a speed of 6 miles an hour (10 km/h). They propel themselves with their great front paws and use their back feet as rudders. The bear's hair is hollow and filled with air, which helps with buoyancy. When the bear dives, its eyes remain oper

### **SLOW AND STEADY SWIMMING**

**HYDRODYNAMIC** 

function as

and provides not only thermal insulation but also an energy reserve. When the temperature reaches critical levels—at the Pole it can drop to between -60° and -75° F (-50° to -60° C)—the animal's metabolism increases and begins to

-60° C)—the animal's metabolism increases and begins to rapidly burn energy from fat and food. In this way, the polar bear maintains its body temperature.

4-6 inches (10-15 cm) thick

RESPIRATORY

LAYERS

PRINCIPAL FAT

Thighs, haunches,

membranes in their snouts that warm and humidify the air before it reaches the lungs.

THE FLOATING SLAB

When they tire of swimming, they rest, floating. They manage to cross distances of over 37 miles (60 km) in this manner.

**ANTISLIP PALMS** 

Their palms have surfaces with small papillae that create friction with ice, keeping them from slipping.



**UNDER THE ICE** Females dig a tunnel in the spring; when they become pregnant, they hibernate without eating and can lose **ACCESS** 45 percent of their weight. **TUNNEL** 

SECONDARY

CHAMBER OR REFUGE

MAIN ACCESS TUNNEL

ENTRANCE

## **Curling Up**

Many cold-climate mammals curl up into balls, covering their extremities and bending their tails over their bodies as a kind of blanket. In this way, the surface area subjected to heat loss will be nal. Hot-climate animals stretch out their bodies to dissipate heat.

over  $6\,\text{miles}\,\,\text{\tiny (10\,km)}$ 

PER HOUR IS THE AVERAGE SPEED AT WHICH POLAR BEARS SWIM



# What They Are Like

BENGAL TIGER

Panthera tigris tigris is the largest member of the feline family, easily recognized by its orange fur with black stripes and white spots. GRACE AND MOVEMENT 20-21 EXTREMITIES 22-23

WHAT DOESN'T RUN, FLIES 24-25
LOOKS THAT KILL 26-27

DEVELOPED SENSES 28-29
SOFT CONTACT 30-31

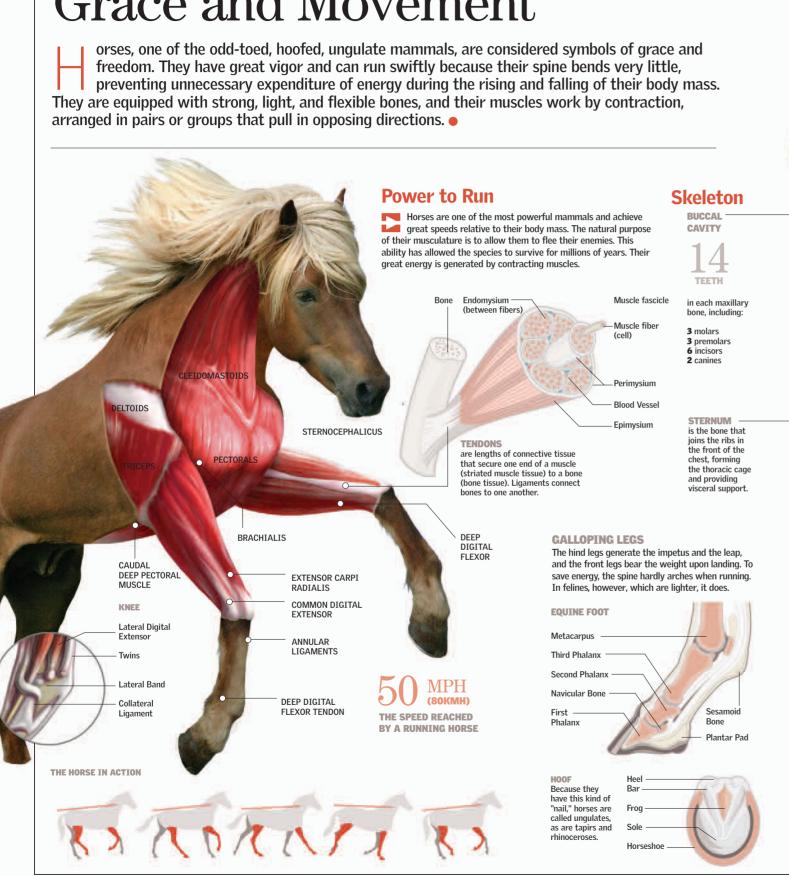


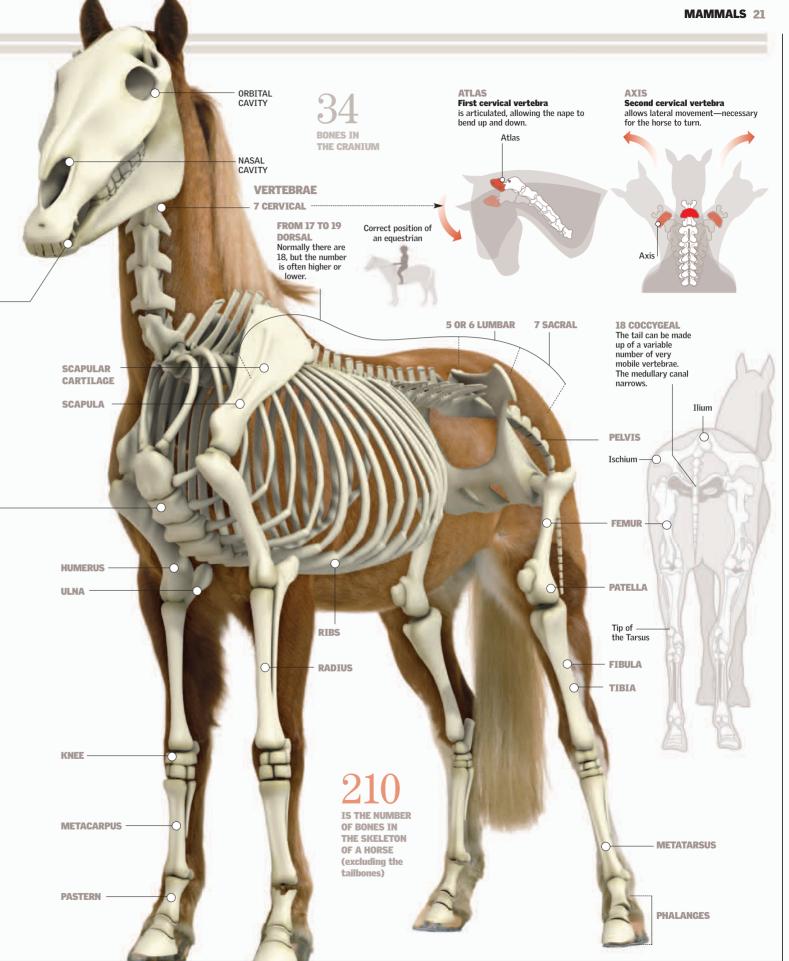
ll mammals have stereoscopic vision, which gives them depth perception. Moreover, in the case of hunters such as tigers, their

night vision is six times keener than that of humans. There are many species that have a very keen sense of smell, and the sense of taste is closely linked to that of smell. Hair, too, performs various functions in these animals' lives—conserving body heat, providing protection, and serving as camouflage. Those that have almost no hair and live in environments where the

temperature is very low, such as whales, have developed a layer of fat under their skins.

# Grace and Movement





# Extremities

ammals' extremities are basically either of the foot or chiridium type but modified according to the way in which each species moves about. Thus, for example, they become fins for swimming in aquatic mammals and membranous wings in bats. In land mammals, these variations depend on the way the animal bears its weight in walking: those that use the whole foot are called plantigrades; those that place their weight on their digits, digitigrades; and those that only touch the ground with the tips of their phalanges, ungulates.

KEY

Tibia/Fibula Tarsi

Metatarsi

# Another criterion for classifying mammals by their legs, in addition to their morphology, is the function the legs perform. Cats, dogs, and horses have four limbs for locomotion. Primates have differentiated forelimbs, and they also use legs to capture food or bring it to their mouth. Others use legs to swim or fly.

### **UNGULIGRADE I**

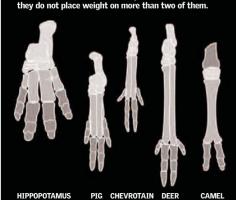
**HORSES**If you observe their footprints, you will see that only their hooves leave marks. Horses' hooves are made up of only one toe.

### **UNGULIGRADE II**

**Functionally Adapted** 

The majority of ungulates, such as goats, have an even number of toes. They are called artiodactyls as opposed to perissodactyls, which have an odd number of toes.

# LYING FOOTPRINTS Other species of unguligrades (or simply ungulates) can have more toes that make up their hooves, but



### **DIGITIGRADE**

These mammals place the full surface of their toes (or some of them) on the ground when walking. They usually leave the mark of their front toes and a small part of the forefoot as a footprint. Dogs and cats are the best-known examples.

# **PLANTIGRADE**

BIG TOE

5 toes

FOR MAMMALS:

**HAVE FEWER.** 

**RUNNING SPECIES** 

THE NORMAL NUMBER

DISTAL PHALANX

WALK OR CLTMB

There is a fundamental difference

of a monkey. The monkey has a long, prehensile digit in its foot

between the human foot and that

similar to that in its hand. Monkeys

use their feet to grab branches as

they move through the trees.

Primates, and of course humans, bear their weight on their toes and much of the sole of the foot when walking, particularly on the metatarsus. Rats. weasels, bears, rabbits, skunks, raccoons, mice, and hedgehogs are also

# TOE

SECOND

METATARSAL

**TARSI** 

**CUNETFORM BONES** 

**SCAPHOID BONI** 

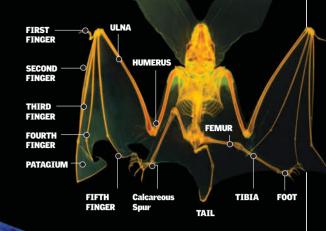
**ASTRAGALUS** 

**CUBOID BONES** 

METATARSAL

### Chiroptera

From the Greek, meaning "winged hand," this is how bats are designated because their forelimbs are modified, the fingers thinning and lengthening to be able to support a membrane that functions as a wing. The hind limbs did not change similarly: they have claws.



### Cetaceans

Whales adapted so well to the sea that they seem to be fish. But inside their fins —modified front legs there is a bony structure similar to that of a hand with fingers. They have no hind limbs: the tail, placed horizontally and used to move in the water, has no connection to those limbs.

> **MAMMALS THAT SWIM. AS DISTINCT**

### **Felines**

The function of their paws is to support their agile and elastic bodies, allowing them to move about. The front paws also help in hunting to catch and hold prey



EVOLUTION
It is thought that from ancient

### **RETRACTABLE NAIL**



# DIGITAL PAD PLANTAR PAD TOE

# What Doesn't Run, Flies

hey are meteors of flesh, bone, and hot blood. Cheetahs are the fastest of the land animals and unique members of the Felidae family, which hunt using their keen vision and great speed. They can reach over 70 miles per hour (115 km/h) in short runs and reach 45 miles per hour (72 km/h) in an average of only 2 seconds. They can get above 60 miles per hour (100 km/h), but they can sustain that speed for only a few seconds. They look like leopards, although their physical characteristics are different: they are longer and thinner, and their heads are smaller and rounded.



NOSTRILS

Very wide, they allow

it to receive more

oxygen as it runs.

The flying squirrel does not actually fly-it glides Between its front and back limbs is a membrane of skin that, like a delta wing. jumps and stretches its legs. Thanks to that it can glide from the top of one tree to the trunk of another

### LANDING

While gliding, the squirrel can change its landing angle.

Just before landing, it lowers like an air brake. It lands very gently on all four paws.

# **Flving** Squirre

Siberian

Flying squirrels (Pteromys volans) belong to the same rodent family as common squirrels, to which they are similar in both appearance and way of life. They live in the mixed forests of northern Europe, across Siberia, and into East Asia.

### Cheetahs

Whereas tigers prefer to lie in wait for prey and then jump on it, the cheetah uses explosive speed of over 60 miles per hour (100 km/h) to run its prey down.

The cheetah begins running by lengthening extending its

### **SPINAL**

Then it gathers its legs under its body, contracting its cervical spine to the

CONTRACTION

### TAIL

Large compared to the rest of the body, it acts as a pivot used to suddenly change direction.

### **EXTENDING** THE SPINE

In a counterthrust opposing the contraction, the spine extends, creating forward momentum. The cheetah can cover 26 feet (8 m) in a 70 miles per hour  $(115 \, \text{km/h})$ MAXIMUM SPEED, BUT CAN BE MAINTAINED FOR ONLY

550 YARDS (500 M)

Long and agile. It has a powerful, flexible skeleton

and musculature.

flexion of the shoulder allows it to take very

SHOULDER

The extensive

Upon landing, it grabs

HEAD Small and aerodynamic, with low air resistance.

Carnivora Felidae

Species Acinonvx jubatus (Africa)

**BIPEDS VERSUS** 

**QUADRUPEDS** 

venaticus (Asia)

FIRST POINT OF CONTACT As it runs, only one leg touches the ground at a time, but during the

cervical contraction, the entire body lifts from the

### SECOND POINT OF CONTACT

Extending its four legs again, it picks up more momentum supporting itself only on one back leg.

### ZIGZAGGING AT HIGH **SPEED**

Cheetahs can make sharp turns

These movements are possible because its nails are not retractable, so firmly grip the

# **PAWS**

DIGITS 5 in the hands 4 in the feet

NAILS

Unlike other felines, their nails are not retractable, allowing them to grip the ground better.

# Sloth

These animals are notable for their extremely slow metabolism. They take half a minute to move a limb! They are also somewhat myopic, their hearing is mediocre, and their sense of smell barely serves to distinguish the plants on which they feed. They are at the extreme opposite of cheetahs. However, since they practically live perched in trees, they do not need to move or see or hear precisely. They are perfectly adapted to

THREE-TOED SLOTH Native to the Amazon River basin

### 18 MPH (29 KM/H) SIX-LINED RACERUNNER Cnemidophorus sexlineatus

HUMAN BEING

### 23 MPH (37 KM/H)

Track record: Asafa Powell (Jamaica), 110 yards (100 m) in 9.77 seconds

### 42 MPH (67 KM/H) GREYHOUND

A dog with a light skeleton and aerodynamic anatomy

# 50 MPH (80 KM/H)

An anatomy designed for running, powerful musculature

# 70 MPH (115 KM/H)

It only takes 2 seconds to reach a speed of 45 miles per hour (72 km/h).

# Looks That Kill

igers are the largest of the world's felines. Predators par excellence, they have physical skills and highly developed senses that they use to hunt for prey. Their daytime vision is as good as that of humans, except for a difficulty in seeing details. However, at night, when tigers usually hunt, their vision is six times keener than that of a human being, because tigers' eyes have larger anterior chambers and lenses and wider pupils.

### **Seeing Even in the Dark**

Right Field of

Hunting animals depend on the keenness of their senses to detect their prey. Felines can dilate their pupils up to three times more than humans, and they see best when light is dim and their prey's movements are very subtle. A system of 15 layers of cells forms a sort of mirror (tapetum lucidum) located behind the retina or back of the eye. This mirror amplifies the light that enters and is also the reason that the animal's eyes shine in the dark. At the same time, their eyes are six times more sensitive to light than those of people. Tigers' nocturnal vision also increases because of the great adaptability of their circular pupils when they are



BINOCULAR VISION

Part of the field of vision of one eye overlaps that of the other eye, which makes three-dimensional vision possible. Hunters' skills depend on binocular vision, because it allows them to judge the distance and size of their prey.



FIELD OF VISION

Tigers have a 255° angle of vision, of which 120° is binocular, whereas humans have 210° with 120° of it binocular.



FOCUS 2

**CAPABILITY OF THE RETINA OF FELINES** 



They regulate the passage of light to the retina by contracting in bright light and dilating in the dark. In each species of mammal, the pupils have a distinctive shape.

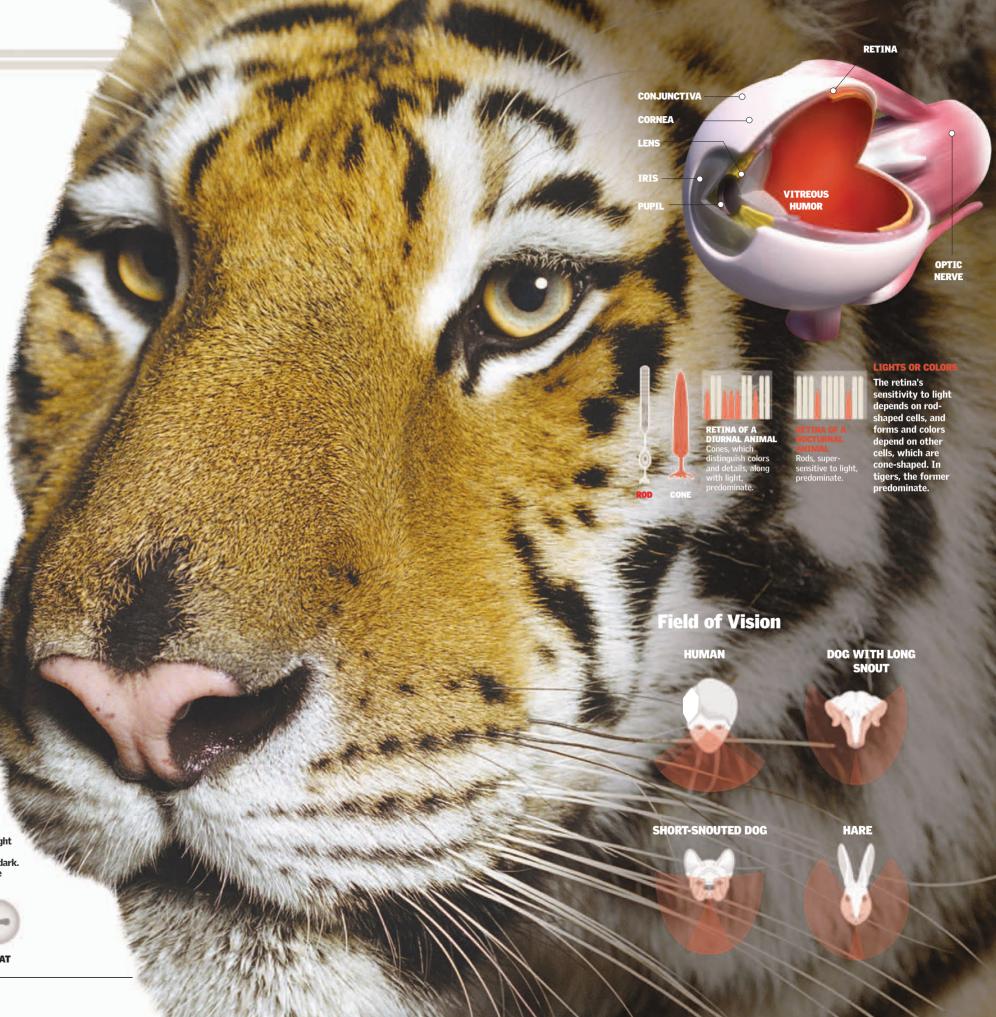




CAT







28 WHAT THEY ARE LIKE

MAMMALS 29



# Soft Contact

dmired, adored, and coveted by humans, a mammal's fur coat is much more than a skin covering. It acts as a protective layer against mechanical injuries, prevents invasion by germs, and regulates the loss of body heat and moisture. In many species, such as the Arctic fox, it provides camouflage by changing color and texture from winter to summer.

### **Fur and Mimicry**

Mammals from cold regions, such as polar bears, have white fur to camouflage themselves in snow. Others, such as polar, or Arctic, foxes and the American hare, change their fur color with the seasons. because they live in areas that are snowcovered in winter, where their brown summer fur would make them easy prey. Lions' beige color helps them avoid being discovered while they stalk their prey.

### WINTER Arctic foxes have two

kinds of color phases. White phase foxes are almost pure white in allows them to camouflage themselves in the snow and ice.



The fur coat of the Arctic fox (Alopex lagopus) in summer is half as thick as that of winter, with less than half the underfur. In summer, "white" phase animals turn a graybrown to gravish color. and those that have a browner and darker



**FUR SERVES TO PROTECT** THE SKIN FROM

### The Skin

**EPIDERMIS** Outer layer formed by resistant, flat cells

### DERMIS

Layer with blood vessels, glands, and nerve endings. It is a layer of sebaceous glands that secrete an oily substance. sebum, on the surface of the skin.

**FATTY TISSUE** This is a specialized conjunctive tissue made up primarily of connective cells called adipocytes, which store energy in the form of triglycerides.

### **SWEAT GLANDS**

When the body is hot, the glands secrete sweat, which passes through the sweat ducts to the surface of the skin.

# **STRUCTURE**

Scaly Cuticle

The majority of mammals' fur is made up of more than one type of hair, and its different colors are due to a group of proteins called melanins. Each coat has different lavers. Guard hairs are the first laver. providing protection. Underneath that, there is a fine layer called underfur, formed by constantly growing short hairs that renew the coat.

**Diverse Hairs** 

# insulating capability of the inner laver.

### attaches the dermis to the epidermis. MERKEL'S DISK

**DERMAL PAPILLA** 

A sense receptor under the skin's surface that responds to light, continuous touch and pressure

# **SEBACEOUS**

GI AND secretes a waxy substance, or sebum, which moistens the skin. making it waterproof.

### PACINIAN CORPUSCLE

Sense receptors under the dermis. The Pacini receptors lie under the layer of deep fat and detect vibration and

COATI

### BEAR HATR Each one of its hairs is hollow and filled with air. This heightens the

BAT HATR Each strand of hair

has an outer

cuticle formed by

superposed scales.

### **Insulating** Skin

Insulation is one of the functions of animals' skins and hair. It not only helps to conserve body warmth but also, as in the case of camels, protects them from excessive heat. Its color often blends in with its surroundings, serving as camouflage.

# LAVER OF FAT

### **WOOL FIBER**

Protofibril Microfibril -Macrofibril Cortex 90%

This is the most complex natural textile fiber in existence. It absorbs moisture but repels water

### **PORCUPINE QUILLS**

Called guard hairs, they are located outside the fur. In the case of the porcupine, they have been modified to form defensive quills.

THE NUMBER OF QUILLS THAT COVER A PORCUPINE (148 PER SQUARE INCH [23 PER SQ CM])



### **ERECTION** MECHANISM

the Quill

Fnidermis

When the quill touches a strange surface, it exerts a light downward pressure on the epidermis.

> The fine tissue that covers the root of the quill hreaks

The erector pili muscle receives the contact signal

Retinaculi

CHINCHILLA

HATR

**STRATUM** 

RUFFINI'S

**ORPUSCLE** 

SWEAT

MACAQUE

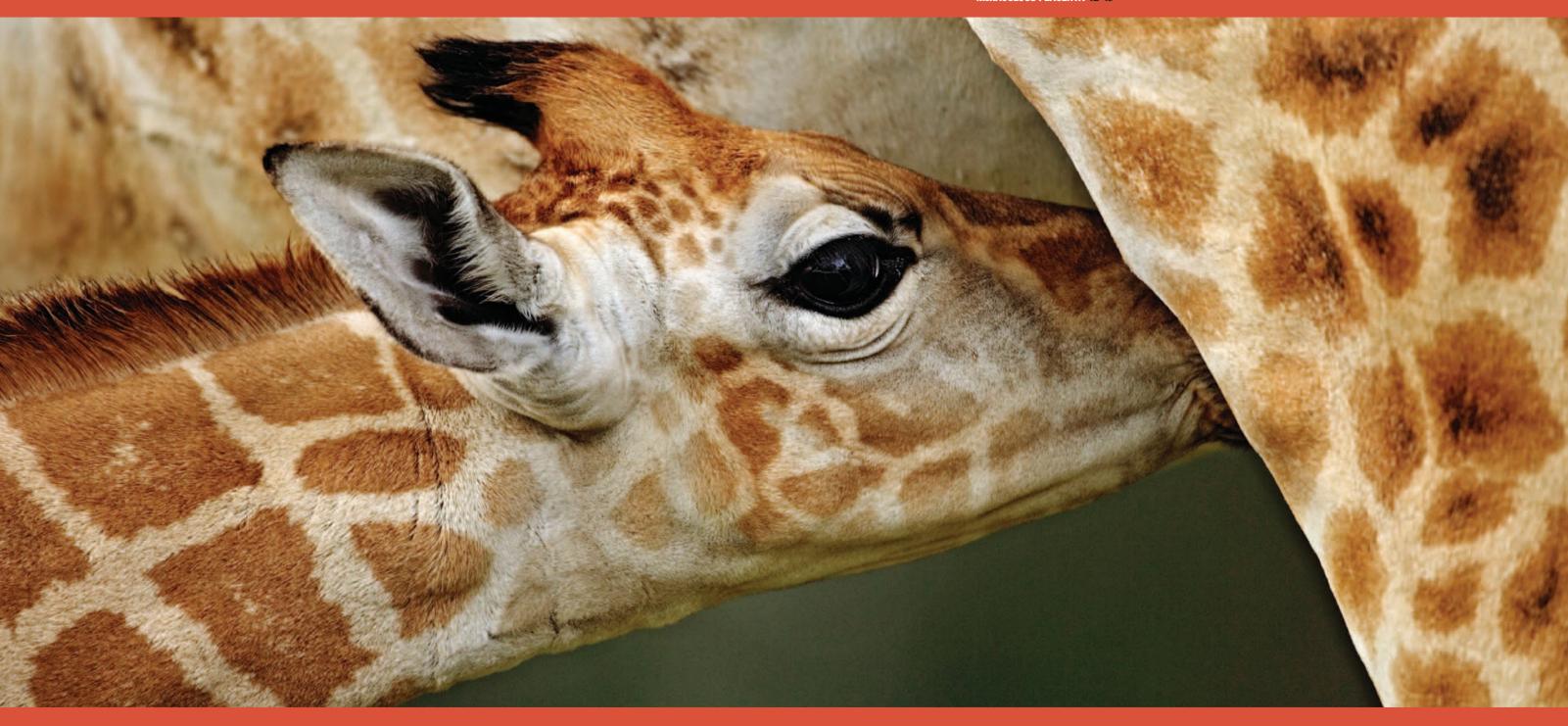
# Behavior and Life Cycle

An hour after birth, the giraffe gets up and with its 8 feet (2.5 m) of height begins to take its first steps in search of its mother's teat.

LIFE CYCLE 34-35
BEAUTY AND HEIGHT 36-37
OVIPAROUS MAMMALS 38-39
EFFICIENT NURSERY 40-41
MIRACULOUS PLACENTA 42-43

THE FIRST DAYS 44-45
TRADEMARK 46-47
DEVELOPMENT AND GROWTH 48-49
OF FLESH THOU ART 50-51

HERBIVORES 52-53
THE GREAT CHAIN 54-55
ONE FOR ALL 56-57
WOLVES IN SOCIETY 58-59



amma sexua fertili involv betwe

ammalian reproduction is sexual and by internal fertilization, which involves copulation between the male and the female. Mammals are also characterized by the offspring's dependence on its parents. In any case, there is a group of mammals called monotremes that is oviparous; that is, its members reproduce by laying eggs. Mammalian behavior consists of a mixture of inherited components and components that can be shaped by learning. Part of this process is accomplished through play, since the young use such encounters to practice jumping, biting, hunting, and other survival skills. You will discover this and much more when you turn the page.

# Life Cycle

irth, maturity, reproduction, and death: this life cycle has certain particularities among mammals. As a general rule, the larger a mammal, the longer the members of its species tend to live but the fewer offspring are born to a single female per litter or reproductive season. Most mammals, including humans, are placental mammals; their vital functions are fully developed inside the body of the mother.



### **Placental Mammals** This is the largest group of mammals, the one that has multiplied most on the planet, although its form of

gestation and lactation produces great wear and tear on the females, making them less prolific. They are generally polygenetic: a few males (the most competitive) fertilize many females, and other males, none. Only 3 percent of mammals are monogamous in each season. In these cases, males participate in rearing the offspring, as they also do when resources are scarce. If resources are abundant, the females take care of the young alone. and the males mate with other females.

> They have four to five

pairs of

breasts

4 inches

(10 cm).

AT BIRTH

some 1.5 to 1.8

ounces (40-50 a).

They do not open

### Lactation 25 TO 30 DAYS

fed upon milk, although they can digest solid food after 20 days. The young abandon the burrow after 35 or 40 days and remain in the area where they were raised (philopatry)

### Gestation 28 TO 33 DAYS

They spend it in a collective burrow (warren) dug in the ground and covered with

vegetation and fur. The female will abandon it as soon as lactation ends.

**NUMBER OF OFFSPRING** In general, it is inversely proportional to the species' size.



3 to 9 Young

PER LITTER, AND FROM 5 TO 7 OFFSPRING LITTERS PER YEAR

### Weaning **35 TO 40 DAYS**

They make

use of natural

COTTONTAIL

RABBIT

They are born

semitranslucent

caves or dig

Young rabbits remain with their mother even after nursing ends for protection and the inculcation of species-specific behavior

rabbits can

**5 TO 7 MONTHS** The better rabbits are fed, the more quickly they become capable of reproducing. They

Sexual

**Maturity** 

are considered adults at 8 or 9 months, when they weigh some 2 pounds (900 g).

Longevity

4 to 10 years







### **COMPARTSON OF EGG SIZE**



The shell is soft and facilitates the offspring's birth. Unlike birds, they do not have beaks

### **Marsupials**

Very short gestation period, after which they develop in a sort of partially open pouch (the marsupium), which the female carries on her belly. The majority of the roughly 300 known species of marsupials are solitary, except in mating periods. In general, they are promiscuous animals, although some, such as wallabies (small kangaroos), tend to mate with the same female all their life.

### Lactation 22 WEEKS

A muscle inside the pouch prevents the infant from falling out. At 22 weeks. it opens its eyes, and a type of pap produced by its mother is added to its diet, which will prepare it for an herbivorous diet.

### Gestation 35 DAYS

With its extremities and functional organs barely developed at birth, the newborn must crawl by itself from the cloaca to the pouch to continue its development.

By the end of lactation, fur

covers the

0.8 inch

1 offspring 1 BIRTH PER YEAR

# Leaving the Pouch

The offspring reaches a size that allows it to fend for itself. It has already incorporated herbivorous food into its diet. The mother can become pregnant again, but its young will remain nearby.

### Sexual **Maturity**

**3 TO 4 YEARS** At two years, koalas already have developed sexual organs (females earlier than males). But they do not start mating until one or two years later.

### **LONGEVITY**

| People    | <b>70</b> years |
|-----------|-----------------|
| Elephants | 70              |
| Horses    | 40              |
| Giraffes  | 20              |
| Cats      | 15              |
| Dogs      | 15              |
| Hamsters  | 3               |
|           |                 |

### **Monotremes GESTATION PERIODS**

Mammals whose females lay eggs are generally solitary species for most of the year. Platypuses are seen as couples only when they mate. Although they have a period of courtship for one to three months, the males have no relationship with the females after copulation or with the offspring. Shortbeaked echidna females practice polyandry, copulating with various males in various seasons.

### Incubation **12 DAYS**

Eggs gestate for a month before hatching. They incubate within a pouch for about 10 days to remain at the proper temperature until the young are born.



**EGGS AT A TIME** 

Offspring

### In the Pouch

The young animal fastens itself to its mother and is carried around

> Dominant males keep the offspring and other

> > males mate

with all the

Some females

strong males

Phascolarctos

Longevity

15 to 20 years

leave to look for

young males apart.

by her, clinging to her shoulders.

**2 TO 3 MONTHS** After breaking the shell, the young are suckled while they remain in a kind of pouch of the female

a cave among rocks The fur is

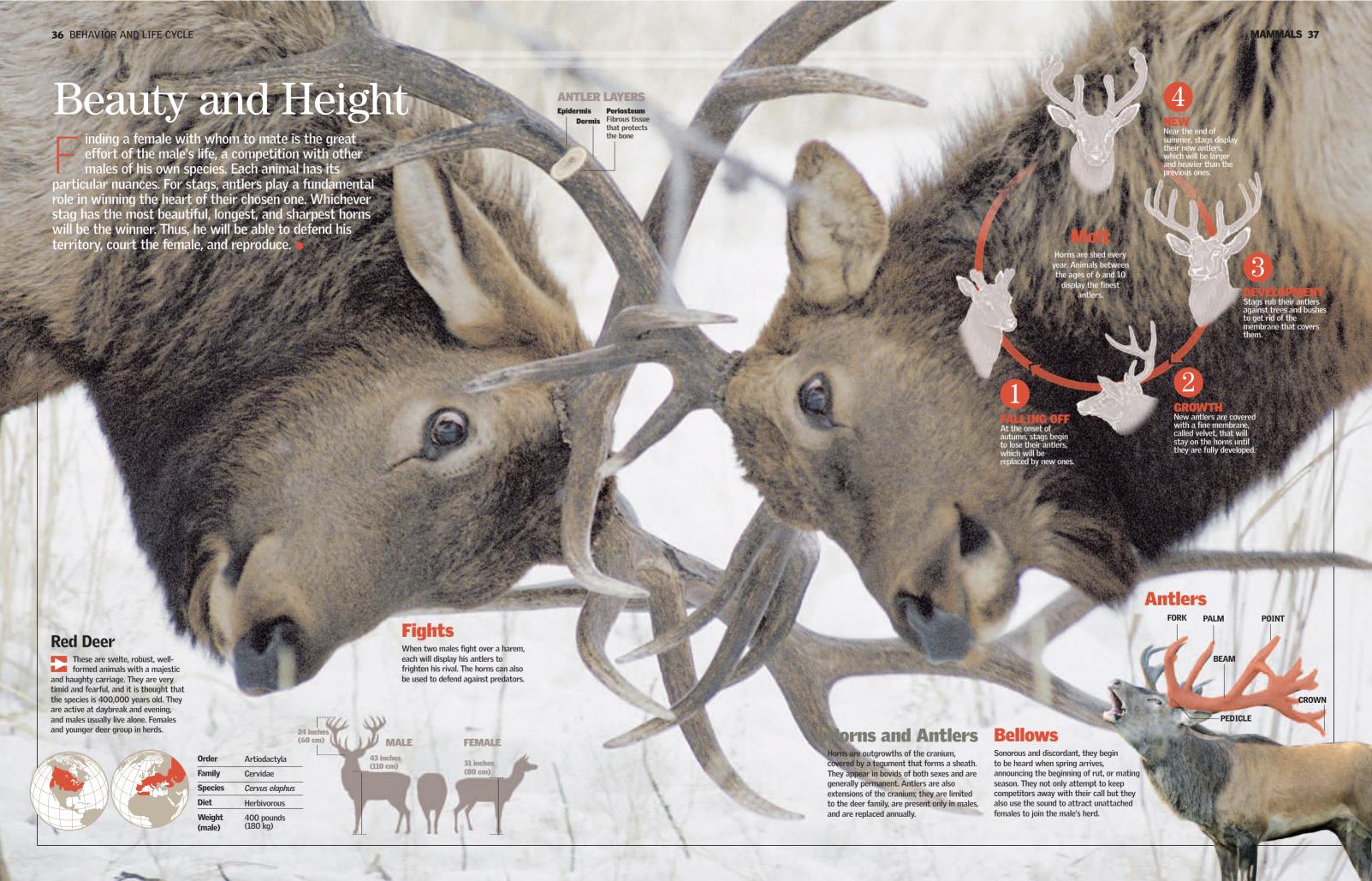
Weaning already spiny. **4 TO 6 MONTHS** After three months, the offspring can leave the burrow or remain in it alone for up to a day and a half before finally separating from the mother.

Underground cave or

# Longevity

SHORT-BEAKED Tachyglossus

50 years



# Oviparous Mammals

or a mammal to lay eggs seems improbable, but the surprising monotreme females, instead of giving birth to young, are oviparous. They are warm-blooded, have hair, and feed their newborn through mammary glands despite having no nipples. Platypuses seem like a cocktail of nature, inasmuch as parts of their bodies resemble those of other types of animal. The other monotremes, echidnas, are covered with spines, and their young grow in the mother's pouch.

### **Platypus**

Combining the skin of a mole, the tail of a beaver, the feet of a frog, and the beak of a duck, platypuses are semiaguatic mammals endemic to the eastern part of Australia and to the island of Tasmania. They construct burrows in riverbanks consisting of a long passageway.

Ornithorhynchidae **Ornithorhynchus** Herbivorous

Weight 5.5 pounds (2.5 kg)



### Reproductive Cycle

The platypus has three reproductive cycles ar and spends most of the year in solitude. Platypuses are seen as couples only when they mate. They have a period of courtship before copulation, which is period of courtship before copulation, which is performed by a juxtaposition of cloacae. Their reproductive rate is low since they lay only one to three eggs. The female platypus digs a burrow before laying her eggs, whereas echidnas have a pouch in which they incubate their young. Unlike the hair on the other parts of its body, the hair in the echidna's pouch is soft.

For reproduction, the female

makes a deep burrow, where it

hides. It lays the eggs when it finishes digging the burrow.

The eggs are covered by a soft shell, and incubation lasts two weeks.

After 16 weeks, the young begin to feed on ants and other small insects.

The sharp spines

originate within the fur

The mother has no nipples but milk comes out through pores in her abdomen, from which the offspring suck.

### BILL

has sensitive electroreceptors that can perceive the electric field generated by the muscles of their prey.

100 feet

Lives in Australia, New Guinea, and Tasmania. It has an elongated snout in the form of a beak, no teeth, and a long, retractable tongue. It is a notable digger and hibernates underground. Echidnas can live up to 50 years, and their hair varies according to the species.

Tachyglossidae

Tachyglossus aculeatus



RETRACTABLE

A sticky substance on the long and slender tonque allows it to catch termites and ants.

**EYES** are kept closed underwater

SNOUT is used to search for and catch food.

have claws at the tips of their feet, which help in digging rapidly.

The Cycle A The egg is the size of a grape and stays at the bottom of the female's

1/3 incl



one half inch long. The front feet hold on to the mother's pouch, where it crawls in search of food.



the mother's pouch, and the mother will place it in a burrow, where she will feed it for three

TEAT

grows in
tandem with th
offspring and
can reach 4
inches (10 cm)
long. Then it

When preparing for the birth of an offspring, the female kangaroo licks its coat to form a kind of path some 5.5 inches (14 cm) long, which the offspring will follow to reach the entrance to the pouch located higher up on the belly.

2

### A Marathor

Small kangaroos are born after a few weeks of gestation in an early stage of their development, weighing less than 0.2 ounce (5 g). They cannot see or hear. They only move their front paws, with which they drag themselves, following their mother's trail of saliva and guided by their sense of smell.

The baby kangaroo must get to the pouch within three minutes or it will not survive

MOVING OUT OF THE MARSUPIUM

At eight months, the offspring leaves the pouch and begins to add grass to its diet, but it will continue to be suckled until it is 18 months old.

3

### Lactation

Upon reaching the marsupium, the baby fastens its mouth upon one of the four teats inside. At this point, the baby is red and looks very fragile. However, it will grow continuously over the next four months, during which it will not leave the pouch.

0.8 inch (20 mm)

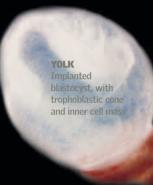
THE SIZE OF AN OFFSPRING WHEN IT ENTERS THE MARSUPIUM 42 BEHAVIOR AND LIFE CYCLE MAMMALS 43

# Miraculous Placenta

he largest reproductive group is formed by placental mammals, in which the unborn offspring develop in the female's uterus. During gestation, food and oxygen pass from the mother to the fetus through an organ known as the placenta, which allows the exchange of substances through the blood. At birth, the offspring often have no hair, are deaf and blind, and feed on milk secreted by the female's mammary glands, which become active after birth.



Gestation lasts between 22 and 24 days. Whereas the placenta is discoid and hemochorial, the ovaries are essential for maintaining gestation. If an ovariectomy is performed at any stage of gestation, it will always bring about a miscarriage or the reabsorption of the fetuses since the placenta does not produce sufficient progesterone to maintain gestation. The growth of the uterine horns becomes visible on the thirteenth day of gestation.



### 6 to 8 Days

The blastocyst has now implanted and established itself in the uterus. The fetus begins to form, and the blastocyst becomes a yolk sac.





### 1 to 2 Davs

Rat embryo at the two-cell stage. By the second day, it will have four cells, and on the third day, it will enter the literus

### 4 to 5 Days

At this point, the embryo is composed of four cells and is covered with a thin layer of glycoprotein. It implants itself in the uterus.

BRAIN

**LEGS** 



From whales to shrews, placental mammals are characterized by gestating their young inside the mother and giving birth when they are well developed. To do so, they have a special organ, the placenta. This is a spongy tissue that completely surrounds the embryo, allowing the exchange of substances through the blood. In this way, the mother can transfer nutrients and oxygen to the embryo, at the same time that she absorbs the metabolic waste of her future offspring. After birth, the placenta is immediately devoured by the mother, who uses her teeth to help the young leave the structure.

> They grow very rapidly, and by day

already covered.

The spine can be distinguished and is ready to support the little rat.

SPINE

TOES Toes on the front limbs can also be

ORGANS The organs are now almost complete and ready to go out into the world.



### **11.5 Days**

The embryo has now fastened itself to the embryonic sac (a sort of balloon that covers the fetus) and to the placenta. The brain, eyes, and legs begin to form.



### **14.5 Davs**

Eyes and extremities are now visible, and the internal organs begin to develop. A pre-cartilaginous maxillary and the outer ear begin to form.

The brain is Internal organs forming; it appears begin to form and transparent. become visible.



## **17.5 Davs**

The eyelids grow very rapidly, and within a few hours the eyes will be completely covered. The palate has already completed its development, and the umbilical cord



### 19.5 Davs

Only a few days are left before the female will give birth to a new litter of little rats. At birth, they are helpless despite the fact that all their organs are developed.



**MAMMALS 45** 44 BEHAVIOR AND LIFE CYCLE

Litter 3 to 8 Offspring

realizes if any pup is taken away from her

# The First Days

ammals whose offspring develop within the uterus devote a lot of attention to their young compared to other animals, because their pups are unable to live on their own at birth. That is why they are cleaned, fed, and warmed. Dogs have various developmental stages. First is the neonatal stage, which lasts from the opening of the pups' eyes until

THE DEN

The mother builds a

den in a warm place away from noise.

SURPRISE

At 20 days, pups

start to hear and

react to sound.

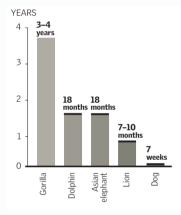
REFLEX

they begin to hear. Then comes the socialization stage, which runs from days 21 to 70, and, finally, the juvenile stage,

from 70 days on.

### **Lactation Period**

This period is essential in the reproductive process of mammals. The young of most placental mammals are totally dependent in the first stages of their life on mammary milk secretion.



### **Birth**

Like humans, dogs develop slowly after birth, because they are not fully developed when they come into this world and are incapable of living on their own. They need a structured environment in which they are cared for by their parents and other members of the pack.

### Birth



Placenta, which

covers the pup

**Up to 20 Days** This period, in which pups depend totally on the

mother, lasts from birth to 15 or 20 days, when the pups open their eyes. But until then, they are completely dependent on their mother, seek contact with the mammary glands, and whimper if they are alone. They have little ability to keep themselves warm, and they even need the stimulation of their mother to pass body wastes.

> remain shut second or

TACTILE REFLEX

They push with

their snout until

they are hidden.

**EXTENSOR REFLEX** 

extend their hind legs

At 12 days, pups

when picked up.

THE MOTHER'S

down to make it

easier for the pups

POSITION The mother lies

to reach her.

At birth, pups do not innately recognize members of their species; they do not seem to know that they are dogs. They must learn this, and the mother and the rest of the litter are in charge of teaching them this.

The Pups

Short and

soft hair

**BLIND EYES** Still closed

> To move her weak pups, which cannot vet walk, the mother picks them up by the skin on the napes of their necks and places them in the den. Fifteen days after birth, mother dogs experience what is called the bonding phenomenon: they become aware of the litter's existence, see them as a group, and notice if any puppy is missing.

moves the pups without hurting them.

The relationships of pups to their mother and siblings are essential to dogs' later development, because, although their social structures and relationships are largely innate, they must be shaped, tested, and practiced to develop properly.

### **STANDING UP**

The mother no longer needs to lie down and is free to move away.

### From Day 21 to Day 70

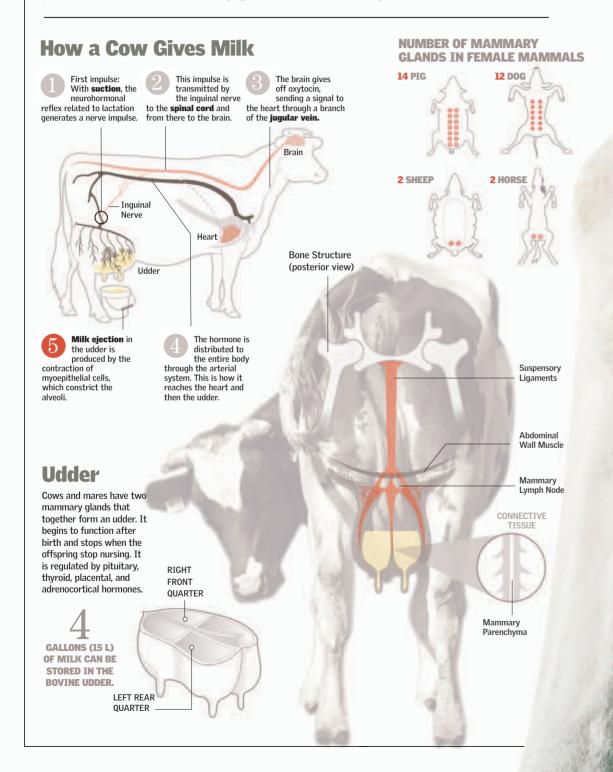
Natural weaning involves offering pups predigested food as a replacement for milk. When the mother comes back from hunting, its mouth has an odor, and the pups, stimulated by the odor, smell her, lick her snout, rub it, and nibble her jaws and face, which stimulates the regurgitation of food. At this stage, in which the pups have milk teeth, they can begin to eat these foods.

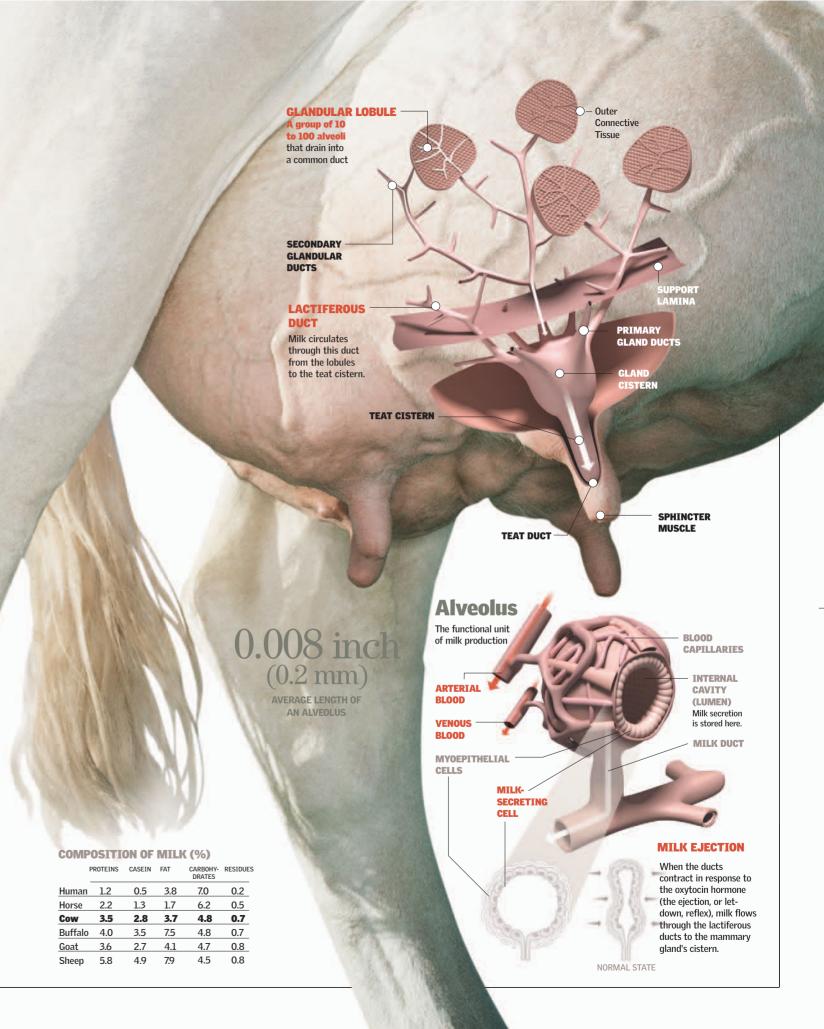
# The pups are now able to be on their own.



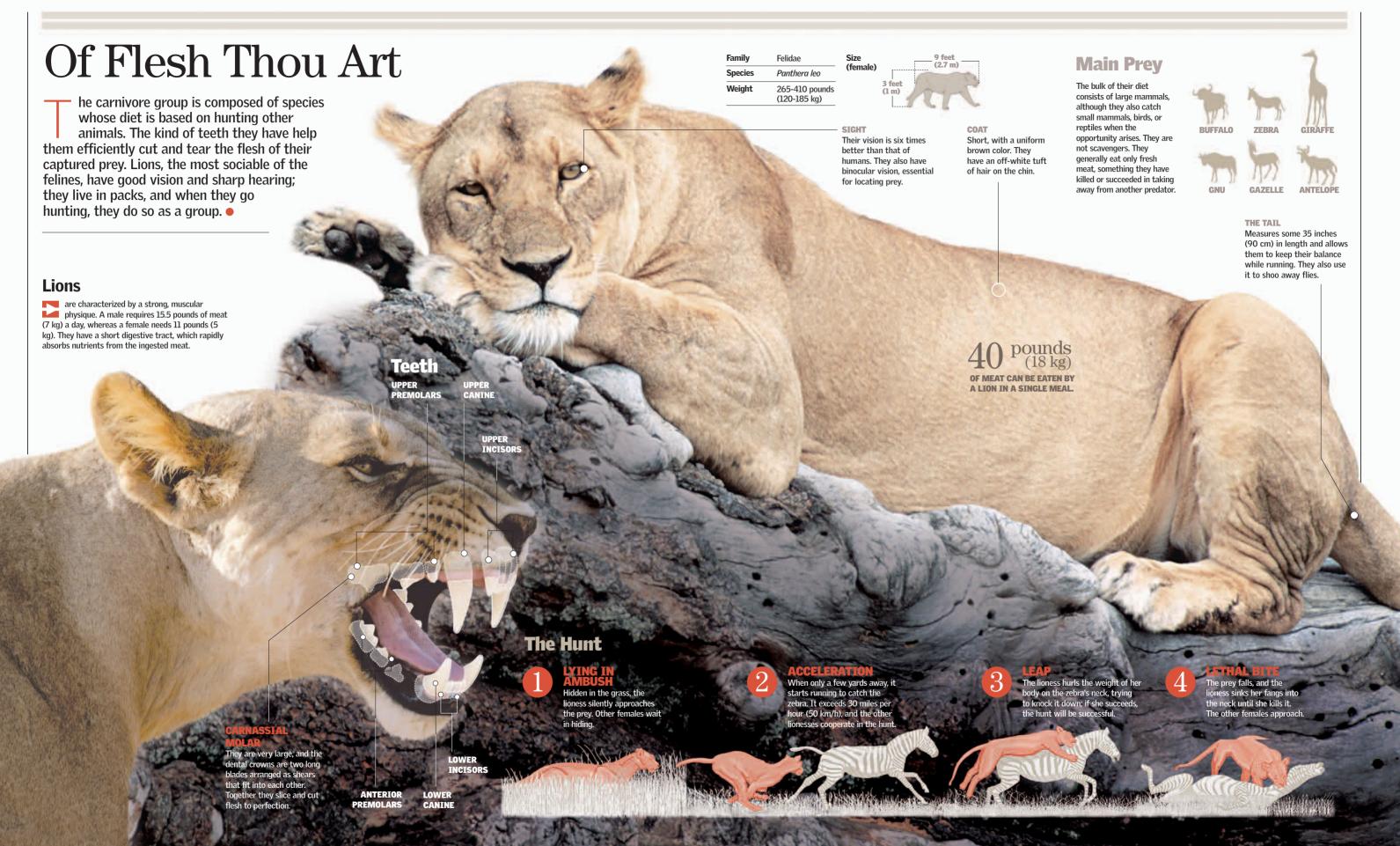
# **Trademark**

he exclusive characteristic of mammals, the one that immediately identifies them, is the presence of milk-producing glands with which the females of all mammalian species feed their offspring after they are born. The number and arrangement of mammary glands vary by species. Teats are arranged in pairs and are present in both sexes, although only females possess functional mammary glands—and that only while lactation lasts. •





50 BEHAVIOR AND LIFE CYCLE



RETICULUM

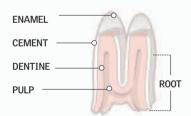
# Herbivores

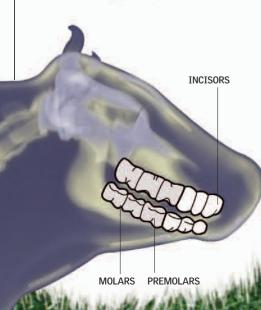
uminants, such as cows, sheep, or deer, have stomachs made of four chambers with which they carry out a unique kind of digestion. Because these animals need to eat large quantities of grass in very short times—or else be easy targets for predators!—they have developed a digestive system that allows them to swallow food, store it, and then return it to the mouth to chew calmly. When animals carry out this activity, they are said to ruminate.

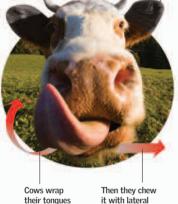


### **Teeth**

Herbivorous animals such as horses and bovids have molars with a large flat surface that reduces food to pulp, as well as incisors for cutting grass. Grinding is also done by the molars.







their tonques



Cows lightly chew grass and ingest it into their first two stomachs: the rumen and the reticulum. Food passes continually from the rumen to the reticulum (nearly once every minute). There various bacteria colonies begin fermenting the food.

When cows feel satiated, they requrgitate balls of food from the rumen and chew them again in the mouth. This is called rumination; it stimulates salivation, and, as digestion is a very slow process, cows make use of rumination to improve their own digestion together with the intervention of anaerobic microorganisms such as protozoa, bacteria, and fungi.

OF SALIVA ARE PRODUCED DAILY IN THE PROCESS.

### THE RUMINATION PROCESS

helps ruminants reduce the size of the ingested food particles. It is part of the process that allows them to obtain energy from plant cell walls, also called fiber.











REINGESTION

**RUMEN BACTERIA INSIDE THE OMASUM** 



INTESTINE

The rumen creates an environment appropriate for the growth and reproduction of microbes. The absence of oxygen inside it favors the growth of bacteria that can digest plant cell walls to produce simple sugars (glucose), Microbes ferment glucose and provide energy to grow and produce volatile fatty acids as the final product of fermentation.

As they grow, microbes in the rumen produce amino acids, the building blocks of proteins. Bacteria can make use of ammonia or urea as sources of nitrogen to produce amino acids. Without bacterial transformation, ammonia and urea would be of no use to cows.

FOOD IS USED FOR DIGESTION

After the main process of digestion and absorption of nutrients, what remains continues through the small and large intestines. There the remaining digestive products ferment, and wastes, or feces, are formed.



ABOMASUM

Only small particles reach

stomach. Many are recycled

and absorbed as nutrients.

the omasum, the third

The abomasum secretes strong acids and digestive enzymes that finish breaking down the food bolus (the mass of chewed food).

**HOURS OF** RUMINATION DAILY

# The Great Chain

aintaining ecological balance requires the existence of prey and predators. Predatorial species bring about a sustained reduction in the number of individuals of the prey species. If predators did not exist, their prey would probably proliferate until the ecosystem collapsed, because there would not be enough food for them all. Disappearance of predators is the cause of many imbalances created in certain habitats by people, whose predatory ability exceeds that of any other living species. Like all other animal species, mammals do not make up a food chain in themselves, instead depending at all times on the participation of plants and other animals.

Level 2

Primary consumers devour

autotrophic organisms (plants or

algae), because they depend on

them for subsistence. And other mammals feed on them.

### Level 4

Large carnivores are at the top of the food chain—there are no other predatory species that regulate their population.

### **SMALL-**

**SPOTTED GENET** Like many highly predatory large felines and dogs, it is in danger of extinction as a result of human activity.

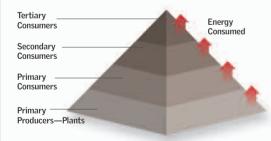


### **Equilibrium of the System**

There is a very efficient natural equilibrium in the food chains of a terrestrial ecosystem, of which mammals form various parts. For this balance to be maintained, there can never be more herbivores than plant food or enough carnivores to overwhelm the herbivores. If there were more herbivores than plant food, they would eat all the vegetation and then suffer a drastic population reduction. A similar situation would occur if there were enough carnivores to overwhelm the herbivores.

### **Trophic Pyramid**

Energy is transferred from one level to another in an ecosystem. At each level, a small amount of energy is lost. What is retained at one level is the potential energy that will be used by the next. Biomass is the total mass of living matter; it can apply to a specific level of the trophic pyramid, a population of individuals of the same species, or a community of different species.



# **Population**

**IS GREATER AS ONE GOES** DOWN THE PYRAMID.

### Level 1

Because of photosynthesis, only plants and algae can transform inorganic matter into organic matter. They form the beginning of the food chain.



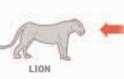
# competition. Cheetahs will rapidly flee

**Kings of the Jungle** 

Lions are great carnivores (one of the largest in size) and strong, with little or no from lions if the latter arrive to challenge them for their food. Only when a lion is alone might a pack of hyenas, for example, confront it to steal its meal.

















### **Scavengers** eat meat from animals that

are already dead. Some carnivores become scavengers under conditions of scarcity.



# One for All

eerkats are small mammals that live in underground colonies, posting guards while the mothers take care of their young. During the day they go above ground to feed, and at night they go into the burrow to take refuge from the cold. In this large family, made up of dozens of members, each one fulfills a function. When faced with danger, they employ various tactics to defend themselves. One of these is the squeal that lookouts emit in the face of even slight dangers.



ocial Structure

IS THE NUMBER OF

MARTIAL EAGLES
The most dangerous enemy they have and the one that kills the greatest number of meerkats

### Defen



# SURROUNDING THE ENEMY

They emit a type of squeal. They rock back and forth. They try to appear larger and more ferocious than they are.

on their backs to protect their necks, showing their fangs and claws.

PROTECTION
When it is an aerial predator, they run to hide. If taken by

When a predator is detected, the lookout warns its group so that all of them can take cover in a nearby hole. This role rotates among different members of the group, and the warning is given by a very wide repertoire of sounds, each of which has a distinct meaning.

SIGHT Binocular and in color, it allows them to locate their greatest predators, birds of prey.

It is common to see them in the highest places of their territory on rocks or tree branches.

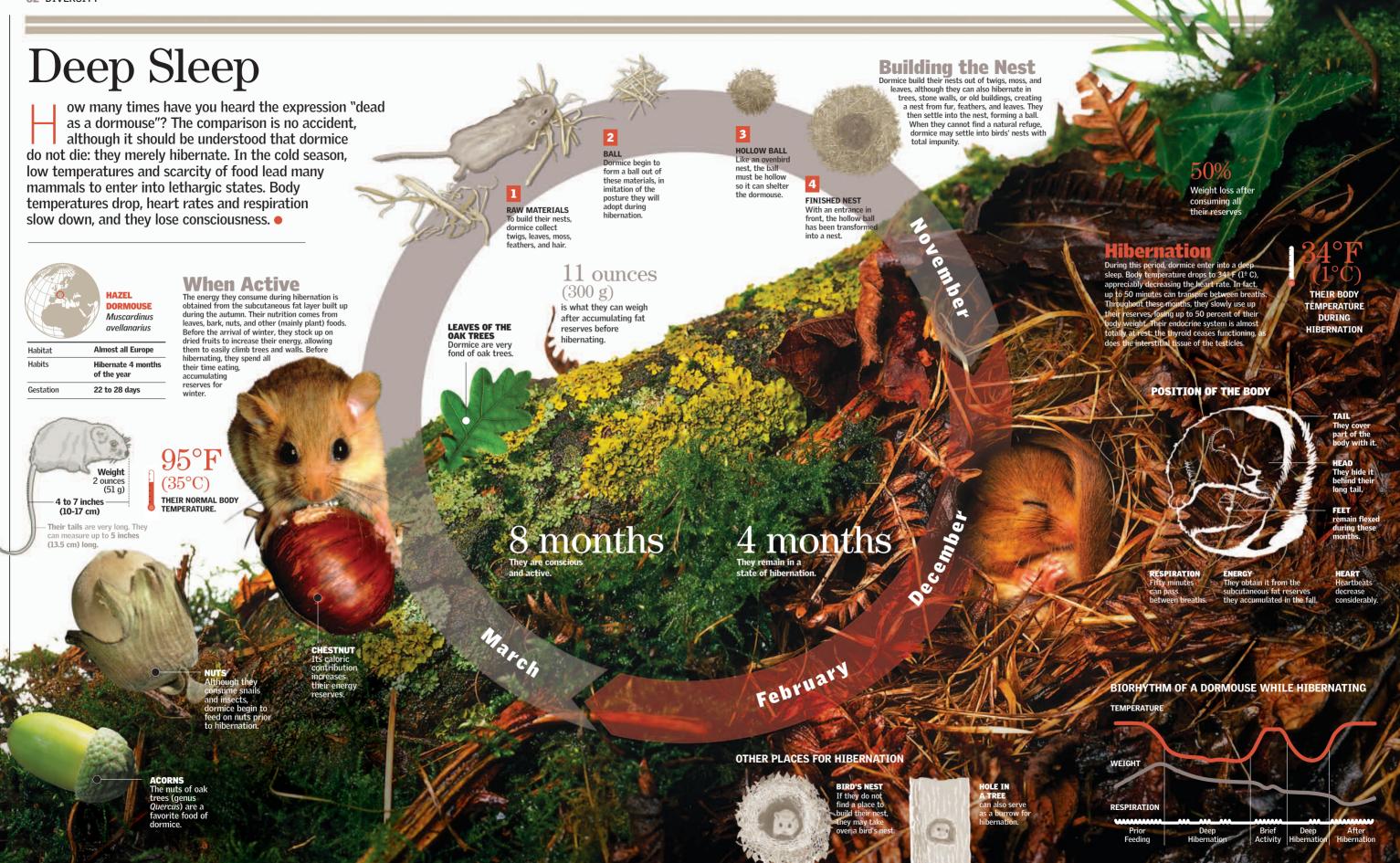


and stand watch.



here is great variety among mammals, and in this chapter we try to show you some representatives of the most outstanding differences among them. For example, here you will discover that there are species, such as bats, that are expert fliers, while others, such as dormice, enter into a deep winter sleep that allows them to save

energy during times when food is scarce. Here we will also show you how the bodies of some mammals (whales and dolphins) are adapted to aquatic life. In addition, we will also consider the ability of certain mammals to adapt to the hot and dry conditions of the desert. Camels, in particular, are very adept when it comes to retaining and efficiently using liquids. •





**MAMMALS 67 66** DIVERSITY

# Record Breath-Holders

Nostril

My manner manner man

perm whales are unique animals whose species is remarkable for many reasons. On the one hand, they have the ability to dive to a maximum depth of 9,800 feet (3,000 m) and remain underwater without oxygen for up to two hours. They are able to do this by means of a complex physiological mechanism that, for example, can decrease their heart rate, store and use air in the muscles, and prioritize the delivery of oxygen to certain vital organs such as the heart and lungs. They are the largest whales with teeth, which are found only on the lower mandible.



| Habitat         | Deep waters |  |
|-----------------|-------------|--|
| Status          | Vulnerable  |  |
| Sexual Maturity | 18 years    |  |



20 to 90 tons

11 elephants of 8 tons apiece

IS THE LENGTH OF TIME THEY CAN SPEND UNDERWATER WITHOUT BREATHING.

mouth open and capture prey. They feed on squid

They have 18 to 20

conical teeth, weighing up

to 2 pounds (1 kg) apiece,

oxygen into its body on the top of its head.

Sperm whales can allocate

oxygen to certain vital organs, such as the lungs and heart, directing it away from the

**Making Use** 

Sperm whales can dive deeper and stay submerged longer than

can function anaerobically, and

the inducement of bradycardia

any other mammal, because

of Oxygen

During a dive, the heart

**Adaptation in Respiration** 

When they dive to great depths, sperm whales activate

use of their oxygen reserves. This produces what is called a

thoracic and pulmonary collapse, causing air to pass from the lungs to the trachea, reducing the absorption of the toxin

nitrogen. They also rapidly transmit nitrogen from the blood to

the lungs at the end of the dive, thus reducing the circulation of blood to the muscles. Sperm whales' muscles contain a large

amount of myoglobin, a protein that stores oxygen, allowing the

WHEN THEY DIVE

powerful muscles

tightly close the

opening of the blowhole, keeping

water from entering

whales to stay underwater much longer.

ON THE SURFACE

open, allowing the

can before diving.

whales to breathe as

an entire physiological mechanism that makes maximum

rate drops (a condition which lowers oxygen

#### **BLOWHOLE**

Upon submerging, it fills with water, which cools the spermaceti oil and

The heart rate slows

An ample blood flow, rich in hemoglobin, transports elevated levels of oxygen to the body and brain.

The retia is a network of entering the brain

## Dive

True diving champions, sperm whales can dive to depths of 9,800 feet (3,000 m), descending up to 10 feet (3 m) per second in search of squid. As a general rule, their dives last about 50 minutes, but they can remain underwater up to two hours. Before beginning a deep dive, they lift their caudal fin completely out of the water. They do not have a dorsal fin, but they do have a few triangular humps on the posterior part of their body.

# ON THE SURFACE

through the blowhole located at the top of

#### + 3,300 FEET (1,000 M) **90 MINUTES**

They store 90 percent of their oxygen in their muscles, so they can be submerged for a long time.

#### O FEET (O M) **ON THE SURFACE** They exhale all the

air from their lungs; this is called spouting, or blowing.

Sperm whales' ability to dive to great depths could be due in part to their spermaceti organ, located in their heads. It consists of a large mass of waxy oil that helps them both float and take deep dives. Its density changes with temperature and pressure change. It, like the melon of a dolphin, directs sound, focusing clicks, since its eyes are of

## COMPOSITION

**90% Spermaceti Oil**It is made up of esters and

they have various ways of saving oxygen: an ability to store it in their muscles, a metabolism that

**REPLACED IN ONE** 

**REPLACED IN ONE BREATH** 

**68 DIVERSITY MAMMALS 69** 

The "Accelerator" The cat folds its front

legs in to its axis to

increase the speed of

rotation of this part.

It rotates 180°

The "Brake

of this part

It extends its hind

legs perpendicular to

the axis and reduces

**AXIS** 

# Aerial Acrobatics

ats have a surprising ability to land upright. The secret lies in their skeleton, which is more flexible and has more bones than that of any other mammal. Cats' reflexes allow them to twist using the physical principle of the conservation of angular momentum. The principle, first formulated by Isaac Newton, states that all bodies in circular movement tend to a constant amount of energy. Thus, the more the animal extends its legs to its axis of rotation, the slower it rotates, redistributing the total energy of the system. If the animal tucks in its legs, it rotates more rapidly.

Domestic cat Name Family Felidae Species Felis catus **Adult Weight** 4 to 15 pounds (2-7 kg) Longevity 15 years Dimensions 10 inches (25 cm) (30 cm)

It draws its hind

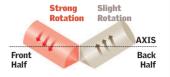
legs in to the axis of the body.

## **STARTS UPSIDE DOWN**

The cat begins to fall upside down and will turn  $180^{\mbox{\tiny 0}}$ upon its axis (in two stages), landing upright.

# **FIRST TWIST**

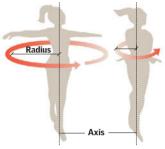
In this maneuver, the cat rotates the front half of its body 180º on its body's axis. The other half rotates only slightly as a result.



## WITH **INDEPENDENCE**

Like a skater who extends or folds the arms to control the speed of rotation, the cat moves its hind legs—but independently of each other.

#### **LIKE A SKATER**

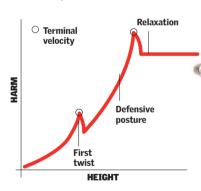


To reduce opens arms to increase the radius of rotation.

To increase closes arms to reduce the radius of the rotation.

# Time of the Fall

A fall from a short distance usually causes more harm than one from a considerable height, because the cat adopts a defensive posture only when it senses acceleration in the fall. Upon reaching terminal velocity, it can accelerate no faster, and the cat relaxes stretches out, and offers resistance to the fall.



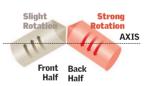
The extended legs reduce the speed of rotation of this part. It rotates 180°.

It extends its front legs at right angles to the axis.

> Now the folded legs increase the speed of rotation

#### **SECOND TWIST** The cat lowers its hind legs

and completes a full rotation on its axis. It again carries out two more rotations, one tighter than the other:



stabilizes the weight of the body during the descent.

hind legs to

the height of

the front legs.

#### **FOUR FEET PLACED UNDER THE BODY**

With four feet positioned under the body, the cat bends its spine like a parachute and then merely corrects its posture for landing.

# 11% ELONGATION CAPACITY

Extreme Flexibility Cats do not have a clavicle, and the articulations of their vertebrae are more flexible They can travel five times the length of their body in one leap.

1/8 of a second

TIME IT TAKES TO ROTATE AND **LAND ON ITS FEET 1/2 SECOND LATER** 



## **LANDING**

Its front legs make the first contact with the ground. Then it lands on its hind legs, and, finally, it relaxes its tail.

# **Equilibrium**

Cross section of

The inner ear in the temporal bone is divided into the cochlea, the vestibule, and three semicircular canals. Inside there is a system of cilia (sense receptors) and a viscous substance (endolymph) that generates the sense of balance when the two come in contact with each other.

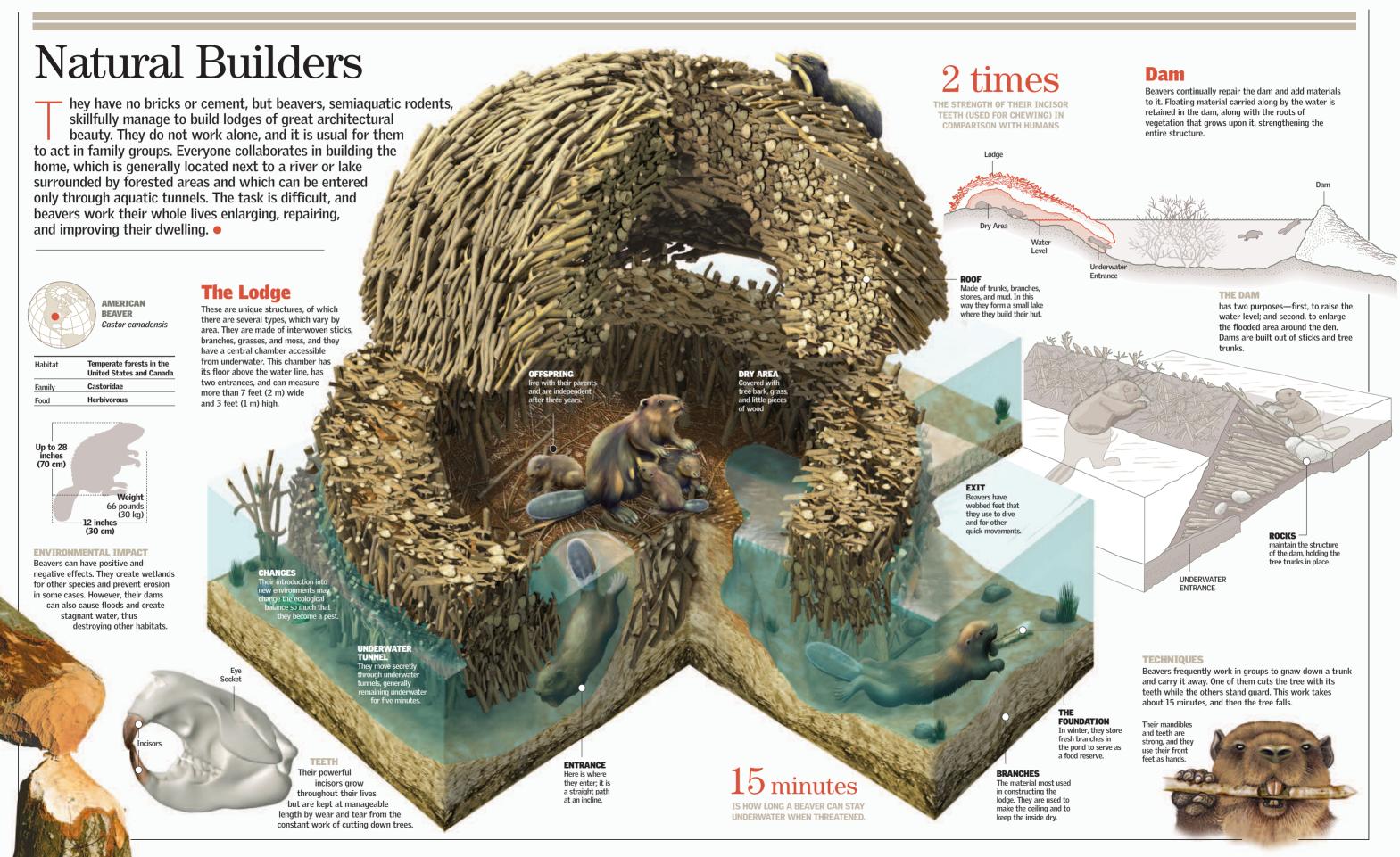
a semicircular It holds the cilia, which are equilibrium receptors. During a rotation, endolymph moves

the cilia in the direction opposite the body's motion.

**QUICK AND PRECISE SHAKE** During the rotation, endolymph can splash into the semicircular canals. To return the liquid to its place, the cat gives a quick shake of its head.



70 DIVERSITY



# Nocturnal Flight

ats are the only mammals that can fly. Scientists call them Chiroptera, a term derived from Greek words meaning "winged hands." Their forelimbs have been transformed into hands with very long fingers joined together by a membrane (called the patagium) that forms the surface of the wing. These mammals' senses are so sensitive that they can move and hunt quickly and accurately in the dark.

60 miles per hour (97 km) THE SPEED SOME BATS MAY REACH DURING FLIGHT

PATAGIUM

# Hibernation

These bats spend the winter in a lethargic state hanging by their feet, faces down, in caves and other dark places. Bats are warmblooded animals while they are active and become similar to cold-blooded creatures when they are asleep. They enter into a state of hibernation more rapidly and easily than any other mammal, and they can survive in cold temperatures for many months—even inside refrigerators—without needing to feed.



Forests of Ghana and Congo Pteropodae Length of wingspan 14 inches (36 cm)

FINGER

FINGER

Moved by their chest and back muscles, bats' wings push downward and backward, generating both thrust and lift. Then the wings spread sideways and upward. Finally they move forward until the tips almost rub the bat's head. Many of these flying mammals can drift through the air, gliding without flapping and maneuvering by folding their wings.

# **Their Radar**

Most of the time bats fly at night in near-total darkness. Instead of light, they use a natural system similar to sonar or radar to guide themselves. This system makes use of acoustical signals the bats themselves emit while flying. This system allows them to recognize the location of any object in front of them or of prey, along with its direction, size, or speed. It is as if they were seeing without light.

- The animal emits an acoustical vibration imperceptible to the human ear because of its high frequency (about 18 kHz). The signal strikes the objects
- When the signals bounce back, the bat perceives their intensity and phase difference—the faster and more intense the return signal, the nearer the object or prey.





HAND OR WING

membrane and is used as a claw.

SECOND FINGER

**ELASTIC FIBERS** The texture of the wing is soft and flexible. It is

# **Flexible Winas**

The patagium is formed by the membranes between the digits. In some species, the wings are also extended by an additional membrane (uropatagium), which joins the hind limbs to the tail. Their wings are not only used for flying (pushing the air as if they were oars in water) but also help to maintain a constant body temperature and to trap insects, upon which bats feed.



# The Language of Water

he ways in which cetaceans communicate with others of their kind are among the most sophisticated in the animal kingdom. Dolphins, for example, click with their mandibles when in trouble and whistle repeatedly when afraid or excited. During courtship and mating, they touch and caress. They also communicate through visual signals—such as leaping—to show that food is close by. They have a wide variety of ways to transmit important information.

#### **HAVING FUN**

Play for dolphins, as with other mammals, fulfills an essential role in social strata.

INHALATION The spiracle opens so

sounds to the inner ear.

# **Reception and** Interpretation

from 100 Hz up to 150 kHz (the human ear can hear only up to 15 kHz). Low-frequency signals (whistles, snores, grunts, clinking) are key in the social life of dolphins cetaceans that cannot live alone.

## 3 pounds 4 pounds (1.4 kg)HUMAN BRAIN







A dolphin's brain. which processes the signals, has at least double the convolutions of those of humans, as well as nearly 50 percent more neurons.





30 to 40 years



#### **MELON**

is an organ filled with lowdensity lipids that concentrate and direct the pulses emitted, sending waves forward. The shape of the melon can be varied to better focus the sounds.

Air to

They can go 12 minutes without

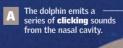
NASAL AIR SAC

Low-frequency signals are used for communication with other dolphins, and high-frequency signals are used as sonar.

mile per **⊥** second (1.5 km/s)

**SOUND WAVES TRAVEL** 4.5 TIMES FASTER IN WATER THAN IN AIR.

# **Echolocation**



The melon concentrates

WITH ECHO Echo 6 s

**SIGNAL** 

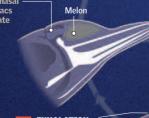
#### CAUDAL FIN has a horizontal axis (unlike that of fish), which serves to propel dolphins forward

**DORSAL FIN** allows dolphins to maintain their equilibrium in the water.

PECTORAL

Sounds are generated by air passing through the respiratory chambers. But it is in the melon that resonance is generated and amplified. Greater frequencies and intensities are achieved in

LARYNX



**HOW THE** 

SOUND IS **PRODUCED** 

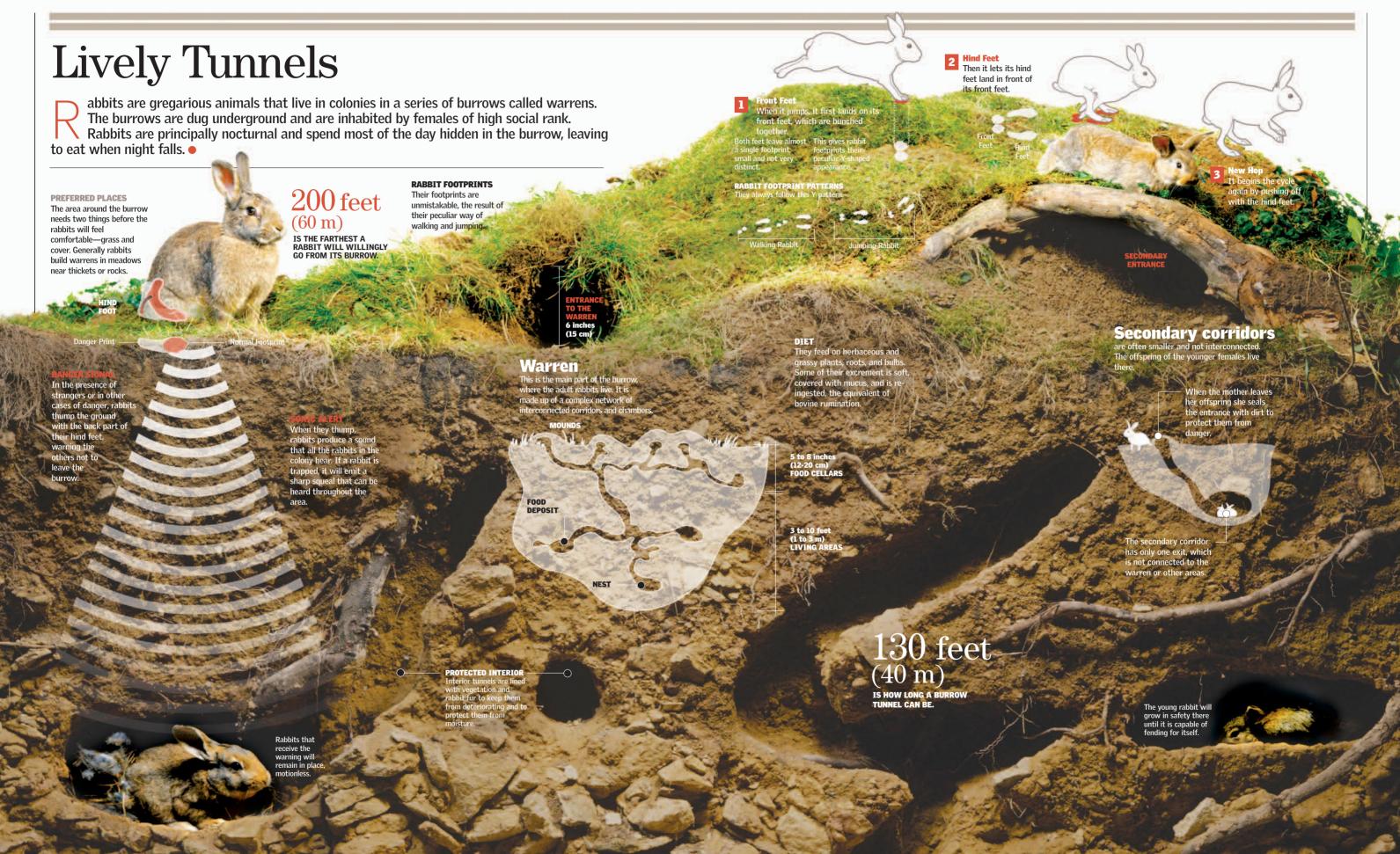
EXHALATION Air resonates in the nasal sacs and is emitted under



indicate the size, position, and direction of the obstacle.

These waves bounce

bounces back and returns to the dolphin in the form of an echo.



# Relationship with People

LTKABLE AND PLAYED

Cats are excellent companion animals and are known for their great independence and MYTHS AND LEGENDS 82-83
EACH IN ITS PLACE 84-85
RAISING HOGS 86-87
MILK PRODUCTION 88-89



he history of cats goes back 12 million years to the time when felines began to populate the Earth. However, their domestication began 4,000

years ago. The Egyptians decided to incorporate them into their home life, thus keeping rats away. Then the Phoenicians took them to Italy and the rest of Europe. One of the subjects

discussed in this chapter has to do with the things that threaten the existence of many animal species, including the loss of natural habitats, poaching, pollution, and illegal pet trafficking. Within the next 30 years, almost one fourth of the Earth's mammals could disappear.

**82** RELATIONSHIP WITH PEOPLE MAMMALS 83

# Myths and Legends

uman history has always been intimately linked with the various mammals—after all, people are mammals, too! Numerous myths and legends have arisen from this relationship, such as that of the wolf goddess Luperca, who saved Romulus and Remus from death—or the story of the birth of the Minotaur, in which a queen was caused to fall hopelessly in love with a bull and give birth to a monster with a bull's head and man's body. The origin of each myth springs from a particular tradition and means something different in each culture.



In Greek mythology, this was a creature born with the body of a man and the head of a bull that ate human flesh. It was born on the island of Crete of a forced sexual relationship of King Minos, and a white bull that Poseidon gave the king to use as



In Eastern culture, animals, especially mammals, have played a leading role in myths and legends. Sometimes one animal has various meanings in various cultures. To Egyptians, cats represent harmony and happiness, but the Buddhist world disapproves of cats because they, along with snakes, were the only ones who did not cry at Buddha's death.

This stone seal depicting a unicorn is found in the **National Museum of** Pakistan in Karachi and dates from the

Winged horse, son of Medusa, who flew to Olympus and was received Thereafter, he transported thunderbolts for the king of the his figure in the

THEIR ORIGIN STEMS FROM THE **OBSERVATION OF NATURE.** 

AND REMUS

These two brothers were

abandoned on the shores of the Tiber, but they were found by a female wolf, Luperca, who

adults, they returned to the place where they had been abandoned and there founded Rome.

The Manjusri Buddha, seated on the mythical lion who is the guardian of **Buddhist doctrine** 

#### **TROJAN HORSE**

Unable to capture the city of Troy during a siege that lasted 10 years, the Greeks built a hollow wooden horse, concealed warriors inside it, and left it on the beach. The Trojans, thinking it a gift from Poseidon, brought it into the city. At night, the warriors left their hiding place and opened the city's gates to the remainder of the Greek army, burning and seizing the city.

In Western culture, the Greeks and Romans have been the great producers of myths and legends relating animals to humans. Human or the limbs of horses are some of many examples.

This was the monstrous three-headed hound of Hades, or hellhound, which guarded the kingdom of the dead, preventing the dead from leaving and the living from entering.

84 RELATIONSHIP WITH PEOPLE MAMMALS 85

The Great Fence

was designed to keep dingoes out of the southeastern part of Australia, protecting flocks of sheep. It ran for thousands of miles and was largely successful in its objective. The number of dingoes in the area declined, and, although the loss of sheep to predators was reduced, this decline led to an ecological imbalance by increasing the competition for pastureland among rabbits and kangaroos.

3,300 miles (5,320 km)

THE LENGTH OF THE GREAT FENCE.

ORIGINAL COURSE

**CURRENT COURSE** 

# Each in Its Place

ature takes care of maintaining its equilibrium, providing each animal its own role within the food chain. When one of the roles is removed, equilibrium in the region is lost. In Australia, dingoes were a big problem for sheep farmers, who built a great fence to protect their flocks. This barrier left the wild dogs without prey and other species able to move about more freely in search of food. Dingoes are classified as pests both for farm animals as well as for rabies control.

# The Introduction of the Dingo

It is thought that dingoes were domesticated animals of the Australian Aborigines who lived in the region. These mammals originated in Asia and were brought to Australia by humans. They are medium-sized wild dogs with thick tails and are notable for having a very distinctive howl instead of a bark. When European pioneers arrived in Australia, dingoes were accepted, but this rapidly changed when sheep became an important part of the economy. Dingoes were soon trapped, hunted, and poisoned.

#### CHAIN

Because of the building of the barrier, herbivorous animals have more space to graze, safe from the presence of dingoes.

#### DING

The leading predators of sheep, dingoes wer isolated from the area

#### SHEE

Their population increased with the absence of the di

#### became scarce, making it difficult for herbivor such as kangaroos and

# The state of the s

AREA FREE OF DINGOES

**AUSTRALIA** 

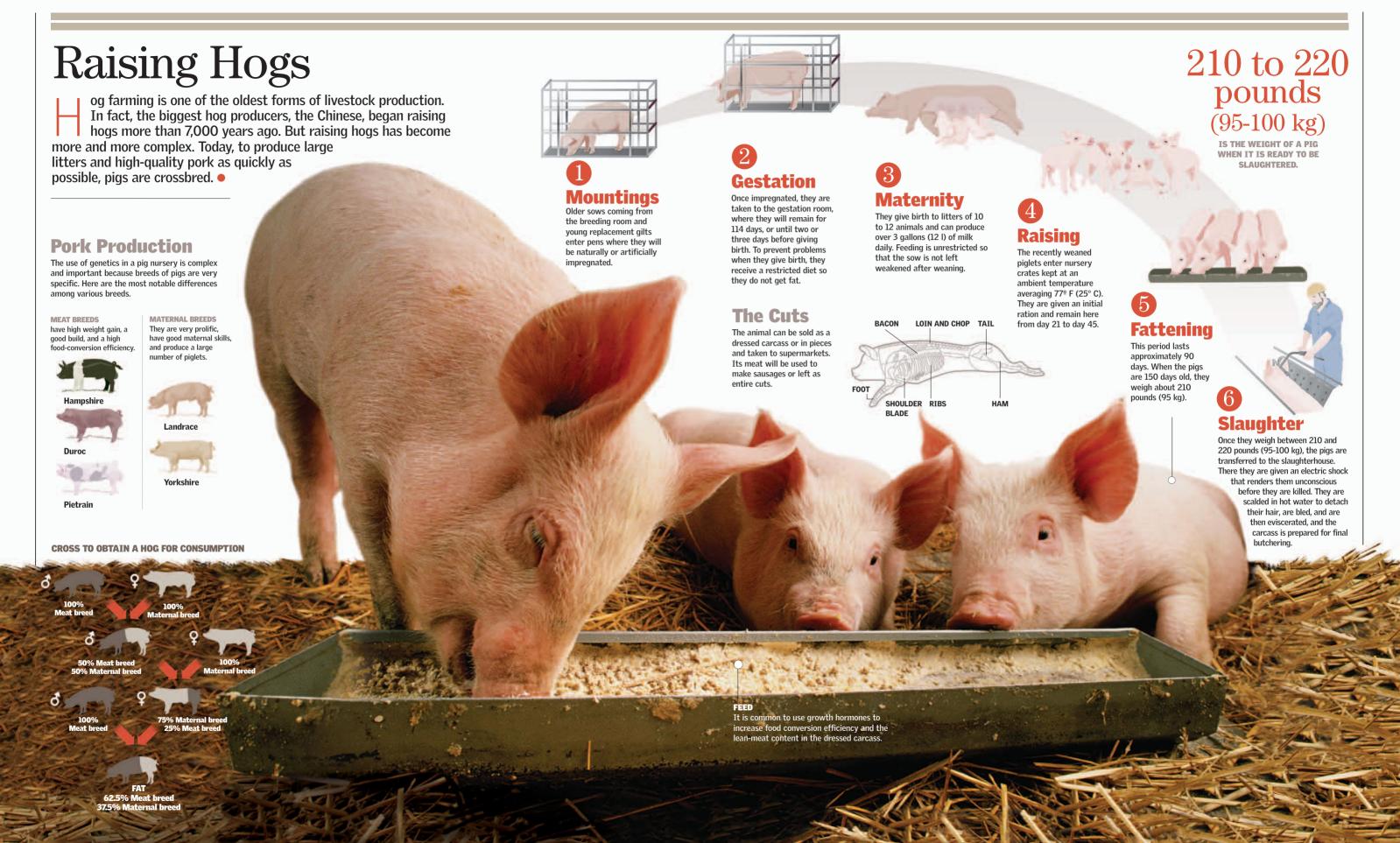
ndertaking, but sheep

# **Wool Industry**

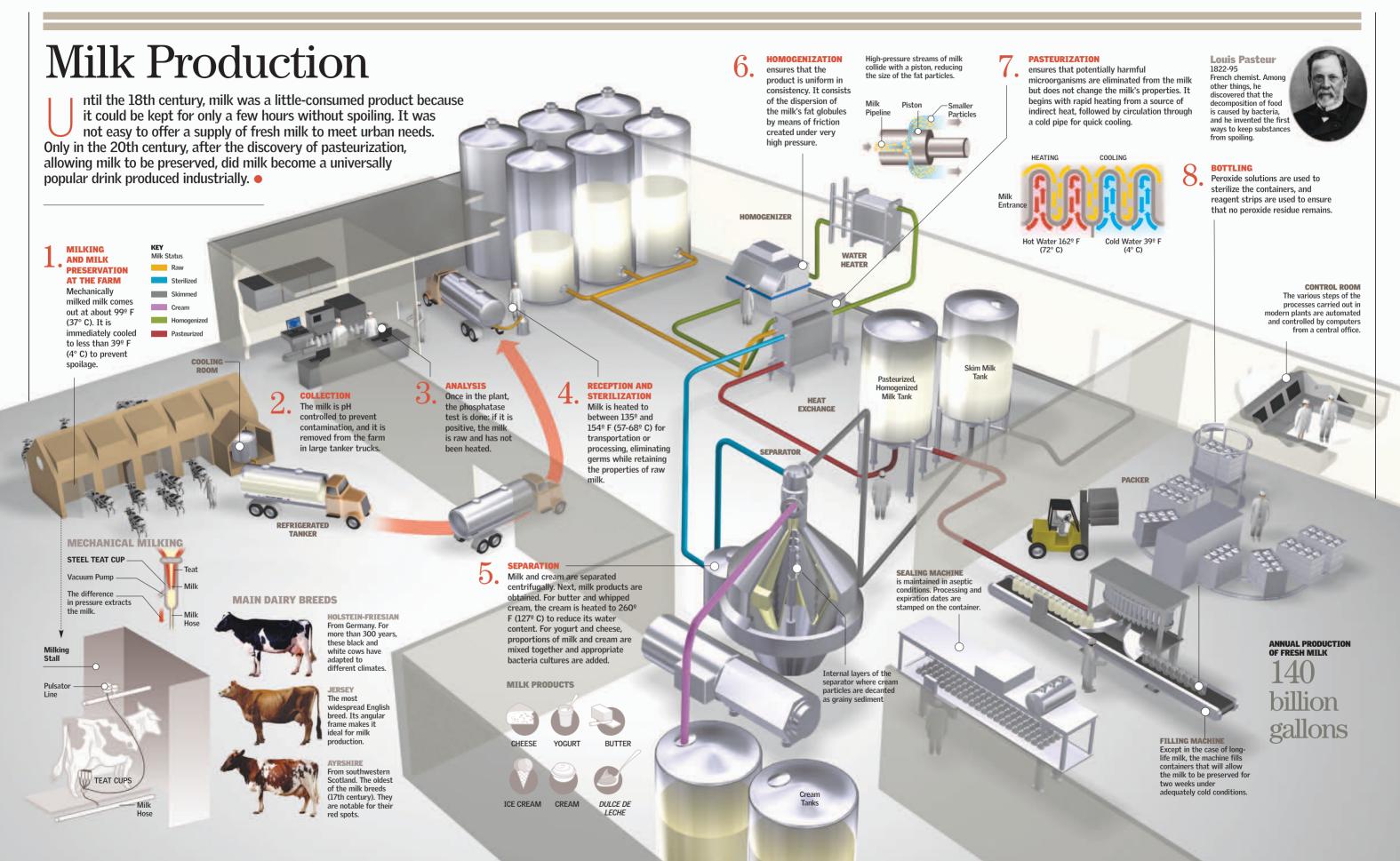
Australia is second in the world in wool oroduction. It has 110 million sheep within its porders, constituting 10 percent of world wool production. In 1989, when part of the famous fence collapsed, about 20,000 sheep were lost to dingoes.

DINGO Canis dingo 86 RELATIONSHIP WITH PEOPLE

MAMMALS 87



88 RELATIONSHIP WITH PEOPLE



# The Human Threat

ver the next 30 years, almost a guarter of the mammals could disappear from the face of the Earth, according to the United Nations. The eminent collapse reflects an unequivocally human stamp: hunting, deforestation, pollution, urbanization, and massive tourism. Experts calculate that more than 1,000 mammals are

endangered or vulnerable, and 20 areas of the planet have been identified where probabilities of extinction may exist in the near future.

# **Affected Regions**

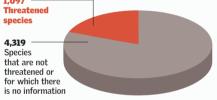
There are 781 threatened species in the region of sub-Saharan Africa, and in South Asia there are 726. South America contains another 346 endangered species, and Central and North America have 63 endangered mammals.

#### **MAMMALS OF THE WORLD**

Critical

Endangered

More than one out of every five species of mammals is endangered: 20 to 25 percent of existing mammalian species.



Chinchilla brevicaudata

They live in the Andes

Mountains of Chile and Peru.

Indiscriminate hunting has

decreased the species, and it **ENDANGERED BY COUNTRY** 140 ¬ Indonesia has the most endangered species, followed by the "country of 120 tigers." India. In Latin America. Brazil is first and Mexico second. 100 -EXISTING MAMMAL

# Sea Otter

#### Enhydra lutris

Once a continuous line of sea otter colonies stretched from the Kuril Islands of Japan to California. Today only a few colonies remain in Alaska and in the lower United States.

Dama Gazelle The degradation of their habitat, as well as unregulated hunting, threaten their existence. In the Sahara, their population fell by 80 percent in only 10 years.

# Southern **Right Whale**

#### Eubalaena australis

inhabits a broad band extending from 20° S to 60° S. They are sought for their high quantities of body oils, and they are relatively easy to capture. It is estimated that only 3,000 exist today.

EUROPE

# Cetaceans

Gray whales, which inhabit the waters of the northern Pacific and the Arctic, are protected. In 1970, sperm whales were declared endangered, and today hunting them is prohibited. The Indian Ocean has been declared a whale sanctuary in an effort to curb hunting, but 7 out of 13 great whales remain in danger of extinction, as do a similar number of dolphin species.

#### **DEGREE OF THREAT**

| Extinct               | Has not been seen for 30 year<br>Survives in captivity |  |  |
|-----------------------|--|--|--|
| In the Wild           |  |  |  |
| Critically Endangered | 500 individuals  |  |  |
| Endangered            | 1,000 to 2,000 individuals                             |  |  |
| Vulnerable            | Up to 5.000 individuals                                |  |  |

- MAMMALS AT CRITICAL RISK
- O UP TO 10 SPECIES ALREADY EXTINCT
- MORE THAN 10 SPECIES ALREADY EXTINCT

Twenty-five percent of the 625 species and subspecies of primates are in danger of extinction. The principal causes are deforestation, indiscriminate commercial hunting. and illegal trafficking of animals. In the countries of Gabon and Congo, where the majority of chimpanzees and gorillas live, the population decreased by more than half between

## **Families of Primates**



#### **FAMILY PONGIDAE**







The World Conservation Union was created in 1948, bringing together 81 nations and nearly 10,000 specialists.

#### Hippopotamus

These are among the most vulnerable animals. From 1994 until today, their population in Zambia and the Democratic Republic of Congo has fallen by 95 percent.

Hainan Black-crested Gibbon Nomascus nasutus sp. hainanus These primates are among the five species in most danger of extinction. Only 30 black-crested gibbons are known to exist

# **Orangutans**

Pongo pygmaeuspygmaeus (Borneo) Pongo pygmaeus abelii (Sumatra)

Found in the tropical forests of the islands of Borneo and Sumatra. Indiscriminate logging, mining, and forest fires isolate them from nature, as does the illegal capture of their young, which are then sold



# **Giant Panda**

#### Ailuropoda melanoleuca

One thousand bears survive in reserves created in China. The disappearance of their habitat—caused by the felling of bamboo, their natural food—as well as the extreme difficulty they have reproducing in captivity (because of their timidity) are the principal reasons for the decrease in this species.

92 GLOSSARY

# Glossary

#### Abomasum

Last of the four chambers into which ruminants' stomachs are divided. It secretes strong acids and many digestive enzymes.

## Agouti

Rodent mammal of South America measuring approximately 20 inches (50 cm) and having large feet, a short tail, and small ears.

### Albumin

Protein found in abundance in blood plasma. It is the principal protein in the blood and is synthesized in the liver. It is also found in egg whites and in milk.

## Alveolar Gland

Functional production unit in which a single layer of milk-secreting cells is spherically grouped, having a central depression called a lumen.

### Biome

Land or water ecosystem with a certain type of predominant vegetation and fauna.

# Biped

Adjective applied to species of mammals that walk on two feet.

# Bradychardia

Lowering of cardiac frequency to below 60 beats per minute in humans.

# Bunny

This is a young or growing rabbit.

## Carnassial

A typical sharp premolar present in carnivorous animals that helps them cut and tear the flesh of their prey more efficiently.

# Carpus

Bone structure of the wrist, located between

the bones of the forearm and the metacarpus. It is made up of two rows of bones.

### Chiridium

A muscular limb in tetrapods. It is a long bone whose anterior end articulates with the scapular belt. The posterior end articulates with two bones that connect to the joints of the digits.

#### Cloaca

The open chamber into which the ducts of the urinary and reproductive systems empty.

### Cochlea

A structure shaped like a coiled spiral tube, located in the inner ear of mammals.

### Concha

The arched, osseous plate found in each of the nostrils.

#### Cones

The photoreceptor cells in the retina of vertebrates. They are essential for distinguishing colors.

#### Convolution

Each of the slight elevations or folds that mark the surface of the cerebral cortex.

## Cortex

The outer tissue of some organs, such as the brain and kidney.

# **Counter Shading**

The characteristic of protective coloration in the hair or fur of certain mammals that are dorsally dark and ventrally lighter.

# Cynodonts

Animals that, beginning in the Triassic Period, start to exhibit characteristics essential to the lives of warm-blooded animals, making them

relatives of true mammals. They include the Mammaliaformes.

#### Dendrite

The branched elongation of a nerve cell by means of which it receives external stimuli.

#### Dermis

The inner layer of the skin, located under the epidermis.

### Dichromatic

Refers to mammals, such as mice and dogs, that have two types of cones in their retinas and can only distinguish certain colors.

# Digitigrade

Refers to animals that use only their digits to walk. One example is dogs.

# Dimorphism

Two anatomical forms in the same species. Sexual dimorphism is common between males and females of the same species.

## Domestication

The process by which an animal population adapts to human beings and captivity through a series of genetic changes that occur over time, as well as by means of adaptation processes brought about and repeated over generations.

## **Echolocation**

The ability to orient and maneuver by emitting sounds and interpreting their echoes.

# Ecosystem

A dynamic system formed by a group of interrelated living beings and their environment.

# Embryo

A living being in the first stages of its development, from fertilization until it acquires the characteristic appearance of its species.

### **Endemism**

The characteristic of a specific area where animal or plant species are natively and exclusively found.

## **Endothermy**

The ability to regulate metabolism to maintain a constant body temperature independent of the ambient temperature.

# **Epidermis**

The outer layer of the skin formed by epithelial tissue covering the bodies of animals.

# Erythrocyte

A spherical blood cell containing hemoglobin, which gives blood its characteristic red color and transports oxygen throughout the body. It is also known as a red blood cell.

## Estrus

The period of heat, or greatest sexual receptivity, of the female.

# Ethology

The science that studies animal behavior.

## Eumelanin

One of the types of melanin, a darkish brown color pigment.

# Eutheria

One of the infraclasses into which the Theria subclass is divided, applied to animals that complete their development in the placenta.

# Fetlock Joint

In quadrupeds, the limb joint between the cannon bone and the pastern.

# Follicle

A small organ in the form of a sac located in the skin or mucous membranes.

#### Gestation

The state of an embryo inside a woman or female mammal from conception until birth.

### Glomerulus

A ball-shaped structure such as the renal glomeruli, which are formed by a tiny ball of capillaries and which filter the blood.

### Habitat

The set of geophysical conditions in which an individual species or a community of animals or plants lives.

## Hibernation

The physiological state that occurs in certain mammals as an adaptation to extreme winter conditions, exhibited as a drop in body temperature and a general decrease in metabolic function.

#### Hock

The joint located between the metatarsal and tarsal bones of the hind limbs of a quadruped.

## Homeostasis

The set of self-regulating phenomena that keeps the composition and properties of an organism's internal environment constant.

# Homeothermy

Thermoregulation characteristic of animals that maintain a constant internal temperature, regardless of external conditions. Body temperature is usually higher than that of the immediate environment.

## Hoof

Horny, or cornified, covering that completely envelops the distal extremity of horses' feet.

## **Iris**

The membranous disk of the eye between the cornea and the lens that can take on different

coloration. In its center is the pupil, which is dilated and contracted by the muscle fibers of the iris.

#### Keratin

A protein rich in sulfur, it constitutes the chief element of the outermost layers of mammals' epidermises, including hair, horns, nails, and hooves. It is the source of their strength and hardness.

### Lactation

The period in mammals' lives when they feed solely on maternal milk.

#### Litter

All the offspring of a mammal born at one time

## Mammaliaformes

See Cynodonts.

# Mammalogy

The science of studying mammals.

# Mammary Gland

One of a pair of external secretion organs characteristic of mammals. It provides milk to the young during lactation.

# Marsupial

Mammals whose females give birth to unviable infants, which are then incubated in the ventral pouch, where the mammary glands are located. They belong to the Metatheria infraclass.

# Marsupium

The pouch, characteristic of female marsupials, that functions as an incubation chamber. It is formed by a fold of the skin and is attached to the outer ventral wall. The mammary glands are found there, and the offspring complete the gestation period there.

94 GLOSSARY

#### Melanin

The black or blackish-brown pigment found in the protoplasm of certain cells. It gives coloration to the skin, hair, choroid membranes, and so on.

## Metacarpus

The set of elongated bones that make up the skeleton of the anterior limbs of certain animals and of the human hand. They are articulated to the bones of the carpus, or wrist, and the phalanges.

#### Metatheria

The infraclass of the Theria subclass, it contains species that reproduce partially inside the mother and then continue their development inside the marsupium.

#### Molt

The process by which certain animals shed their skin or feathers; or, when plants shed their foliage.

## Monotremata

The only order of the Prototheria subclass, it consists of egg-laying mammals with a marsupium in which they incubate their eggs. The mammary glands are tubular and similar to sweat glands. They are distributed in four families, half of which are now extinct.

#### Multituberculate

A group of mammals that lived predominantly during the Mesozoic Era and that became extinct during the early part of the Cenozoic Era.

#### Neuron

A differentiated cell of the nervous system capable of transmitting nerve impulses among other neurons. It is composed of a receptor site, dendrites, and a transmission (or release) site—the axon, or neurite.

### Nostril

Each of the openings of the nasal cavities that lead to the outside of the body.

### **Omasum**

A ruminant's third stomach chamber. It is a small organ with a high absorptive capacity. It permits the recycling of water and minerals such as sodium and phosphorus, which may return to the rumen through the saliva.

### Oviduct

The duct through which the ova leave the ovary to be fertilized.

# Oviparous

Refers to animals that lay eggs outside the mother's body, where they complete their development before hatching.

# Papilla

Each of the small, conical elevations on skin or mucous membranes, especially those on the tongue, by means of which the sense of taste functions.

# Pasteur, Louis

(1822-95) The French chemist who developed pasteurization and other scientific advances.

### **Pasteurization**

The process that ensures the destruction of pathogenic bacteria and the reduction of benign flora in milk without significantly affecting its physicochemical properties.

# Patagium

The very fine membrane that joins the fingers and anterior limbs with the body, feet, and tail of bats.

# Pheomelanin

One of the types of melanin, a yellowish-red pigment.

### Pheromone

A volatile chemical substance produced by the sexual glands and used to attract an individual for reproductive purposes.

# Phylogeny

The origin and evolutionary development of species and, generally, genealogies of living beings.

#### Placenta

The spongy tissue that completely surrounds the embryo and whose function is to allow the exchange of substances through the blood. It also protects the fetus from infections and controls physiological processes during gestation and birth.

## Placentalia

The name by which the species in the Eutheria infraclass orders are also known.

# Plantigrade

Refers to mammals that use the entire foot in walking. Humans are plantigrade.

# Polyandry

Refers to the relationship in which a female copulates with various males during one breeding period.

# Polyestrous

Refers to an animal that has multiple annual breeding, or reproductive, periods.

# Polygyny

The social system of certain animals, in which the male gathers a harem of females.

# Prototheria

A subclass of the mammal class, it has a single order, Monotremata.

# Quadruped

Refers to a four-legged animal.

### Rabbit Warren

A burrow that rabbits make to protect themselves and their offspring.

#### Reticulum

The second chamber of a ruminant's stomach. It is a crossroad where the particles that enter and leave the rumen are separated. Only small particles of less than a 12th of an inch (2 mm) or dense ones greater than 1 ounce per inch (1.2 g per mm) can go on to the third chamber.

### Retina

The inner membrane of the eyes of mammals and other animals, where light sensations are transformed into nerve impulses.

## Rod

Along with cones, rods form the photoreceptor cells of the retina of vertebrates. They are responsible for peripheral and night vision, though they perceive colors poorly.

## Rumen

The first chamber of a ruminant's stomach. It is a large fermentation vessel that can hold up to 220-265 pounds (100-120 kg) of matter in the process of being digested. Fiber particles remain there between 20 and 48 hours.

# Ruminate

The process of chewing food a second time, returning food to the mouth that was already in the chamber that certain animals (ruminants) have.

# Scapula

Triangular bone, also called the shoulder blade. With the clavicle, it forms the scapular belt.

# Scavenger

Animals that eat organic forms of life that have died. They help maintain the equilibrium of the ecosystem by feeding upon dead animals, breaking them down.

## Spermaceti

A waxy substance contained in the organ that bears the same name, located in the head of the sperm whale. It is believed that it aids deep dives, although some specialists believe that it may assist echolocation.

## Spinal Cord

An extension of the central nervous system. Often protected by vertebrae, this soft, fatty material is the major nerve pathway that carries information to and from the brain and muscles.

# Synapsids

These are also known as therapsids and are described as mammal-like reptiles. They are a class of amniotes that were characterized by a single opening in the cranium (fenestra) behind each eye in the temple. They lived 320 million years ago, during the late Carboniferous Period. It is believed that modern mammals evolved from them.

# **Tapetum Lucidum**

A layer of cells located behind the retina of some vertebrates that reflects light toward the retina, increasing the intensity of the light it receives. It heightens the perception of light in near-darkness.

## **Trichromatic**

Refers to mammals whose eyes have three classes of cones—sensitive to red, green, or blue.

## Trophic Chain

System formed by a group of living beings that successively feed on each other.

#### Udder

Saclike organ containing the mammary glands of certain female mammals.

# Ungulate

A mammal that supports itself and walks on the tips of its digits, which are covered by a hoof.

# Uropatagium

The membrane that bats have between their feet. It also encloses the tail.

# Viviparous

Refers to animals in which the embryonic development of offspring occurs inside the mother's body and the offspring emerge as viable young at birth.

# Vomeronasal Organ

An auxiliary organ of the sense of smell located in the vomer bone between the nose and the mouth. Sensory neurons detect different chemical compounds, usually consisting of large molecules.

## Warren

A burrow where certain animals raise their young.

# Weaning

The process by which a mammal ceases to receive maternal milk as its subsistence.

### Whiskers

Very sensitive hairs of many mammals. They are often located near the mouth, like a mustache.

96 INDEX

# Index

| ٨  | See also homeothermy                                 | cheetah, 24-25, 55            | diving, whales, 67                      | erythrocyte (red blood cell), 64   | functions, 19, 30, 75           |
|--|--|-------------------------------|---|------------------------------------|---------------------------------|
| A  | bonding phenomenon, 45                               | chimpanzee, 22-23, 48-49, 91  | dog                                     | Europe, endangered species, 90     | hair types, 31                  |
|  | bone: See skeleton                                   | chinchilla, 30, 90            | developmental stages, 44-45             | Eutheria: See placental mammal     | mimicry, 75                     |
| acoustical guidance system               | Borneo, 91   | <b>chipmunk,</b> 14, 75       | dingoes, 84-85                          | evolution, 74                      | polar bear, 15, 16, 17          |
| bats, 72                                 | bottlenose dolphin, 14, 76-77                        | Chiroptera (bat), 23, 72-73   | field of vision, 27                     | extinction, 90-91                  |                                 |
| See also echolocation                    | bradycardia, 67                                      | circulatory system, 14        | greyhound, 24                           | causes, 81                         |                                 |
| <b>Africa,</b> endangered species, 90-91 | brain, 15, 77  | claw, 23, 25                  | mythological, 82                        | polar bears, 7                     |                                 |
| aggressive mimicry, 74, 75               | breathing, 66-67                                     | coati, 31                     | nose, 29                                | See also endangered species        |                                 |
| American beaver, 70-71                   | breeding, 86   | <b>cochlea,</b> 28, 69        | paw, 22                                 | extremity, 22-23                   | G                               |
| antler, 36-37                            | brown bear (grizzly bear), 15                        | coloration, 74-75             | sense of hearing, 28                    | fins, 23                           |                                 |
| Arabian camel (dromedary camel), 64-65   | buffalo, 55  | colostrum, 44                 | sense of smell, 28-29                   | opposable thumbs, 49               | game                            |
| Arctic fox, 30                           | burrow, rabbits, 78-79                               | communication                 | sense of taste, 29                      | wings, 23                          | chimpanzees, 48                 |
| artificial insemination, 86-87           |  | bats, 72                      | dolphin, 14, 76-77                      | <b>eye,</b> 26-27                  | wolves, 59                      |
| Asia, endangered species, 91             |  | chimpanzees, 48, 49           | domestic cat, 68-69                     |                                    | <b>gazelle,</b> 55, 90          |
| Australia, 10-11, 84-85, 91              |  | deer, 37                      | dormouse, 60-61, 62-63                  |                                    | genet, 54                       |
| Ayrshire (breed of cattle), 88           |  | dolphins, 76-77               | dorsal fin, 76                          |                                    | genetics, 86                    |
| Tyrsine (breed or eache), oo             |  | meerkats, 57                  | dromedary camel (Arabian camel), 64-65  | F                                  | Geoffroy's cat, 55              |
|  |  | playing, 48-49                |   | $\Gamma$                           | gestation, 11, 35, 42           |
|  | call, 72   | rabbits, 78                   |   |                                    | giant panda, 91                 |
| D  | See also communication                               | underwater, 76-77             |   | falling, feline equilibrium, 68-69 | gibbon, 91                      |
| В  | camel, 15, 61, 64-65                                 | wolves, 58                    | R                                       | family, 59                         | giraffe, 13, 32-33, 74          |
|  | camouflage, 30, 74-75                                | companion animal, 80-81       | <u>L</u>                                | farming, 86                        | gland                           |
| bacteria, ruminants, 53                  | carnivore, 50-51, 54                                 | consumer, trophic pyramid, 54 |   | fat reserve, 17                    | milk-producing, 46-47           |
| Bastet, 83                               | cat (feline)   | continent, 11                 | eagle, 57                               | fat storage, 62-63, 65             | sebaceous, 31                   |
| bat, 23, 31, 60, 72-73                   | balance, 68-69                                       | corpuscle, 31                 | ear                                     | fatty tissue, 30                   | sweat, 14, 30                   |
| bear                                     | camouflage, 74-75                                    | cottontail rabbit, 34         | anatomy, 8, 28                          | feline: See cat                    | goat, 22                        |
| brown, 15                                | cheetahs, 24-25, 55                                  | cow, 46-47, 52-53, 88         | bones, 15                               | ferret, 55                         | Gondwana (continent), 11        |
| grizzly, 15                              | companion to humans, 80-81                           | cranium (head), 15            | cats, 69                                | fin, 23, 76                        | gorilla, 14-15, 91              |
| polar, 6-7, 16-17, 31                    | domestic, 68-69                                      | Cretaceous Period, 8, 12      | cochlea, 69                             | finger, 49                         | gray whale, 90-91               |
| beaver, 12, 70-71                        | equilibrium, 69                                      |                               | dogs, 28                                | flexibility, 68-69                 | greyhound, 24                   |
| bellow, 37                               | flexibility, 69                                      |                               | eastern cottontail rabbit, 34           | flight, 24-25, 72-73               | grizzly bear (brown bear), 15   |
| See also communication                   | Geoffroy's cat, 55                                   |                               | eating                                  | flying squirrel, 24-25             | growth hormone, 87              |
| Bengal tiger, 18-19                      | history, 80  |                               | giraffes, 32-33                         | food                               |                                 |
| binocular vision, 14, 26, 51, 57         | lions, 50-51, 55                                     | $\mathcal{D}$                 | ruminants, 52                           | dormice, 62                        |                                 |
| biomass, 54                              | mythological, 83                                     |                               | echidna, 10, 35, 38-39                  | lions, 51                          |                                 |
| birth, 44                                | paws, 23   | dairy farm, 88-89             | echolocation, dolphins, 77              | pork, 86-87                        | LT                              |
| blood, 67                                | skeleton, 68   | dam, 70-71                    | ecology, 54-55                          | food chain, 54-55, 84-85           | 11                              |
| blowhole, 67                             | small-spotted genet, 54                              | Dama gazelle, 90              | ecosystem, 54-55                        | foot, 9, 20                        |                                 |
| blue whale, 5                            | tigers, 19, 26-27, 74-75                             | deer, 36, 52-53               | egg, 32, 35, 38                         | fossil, 11                         | habitat, 15, 90-91              |
| body temperature, 14, 16-17              | vision, 26-27  | defense mechanism, 74-75      | elephant seal, 13, 15                   | fox, 30                            | Hainan black-crested gibbon, 91 |
| balling up, 62-63                        | caudal fin, 76                                       | dentition: See teeth          | endangered species, 5, 90-91            | fruit bat, 73                      | hair                            |
| camel, 64                                | Cerberus, 82   | dermis, 30-31                 | endolymph, 69                           | fur, 30-31                         | body temperature, 14            |
| dormice, 62                              | <b>cetacean</b> (aquatic mammal), 15, 23, 66-67, 76- | digestion, 52-53              | energy, trophic pyramid, 54             | body temperature, 14               | camel, 64                       |
| fur, 8                                   | 77, 90-91  | digitigrade (foot), 22        | epidermis (skin), 30-31                 | camel, 64                          | camouflage, 30                  |
| hibernation, 15, 62                      | See also dolphin; sea lion; seal; whale              | dingo, 84-85                  | equilibrium, 69, 84-85                  | camouflage, 30, 74-75              | functions, 19, 30, 75           |
| HIDCHIAUOH, IJ, UL                       | •              | <del>- '</del>                | • | <b>3</b> · · ·                     |                                 |

98 INDEX

|                                |                                     |   | extinction, 7, 81, 90-91              |                                 |                                       |
|--------------------------------|-------------------------------------|---|---------------------------------------|---------------------------------|---------------------------------------|
| mimicry, 75                    | hyena, 55                           | monkeys, 49                                 | extremities. 22                       | tail, 9, 21, 25, 51             | multituberculate, 9                   |
| polar bear, 15, 16, 17         |                                     | underwater, 76-77                           | family, 59                            | types, 9                        | muscle, 20                            |
| types, 31                      |                                     | See also communication                      | fastest. 24                           | ungulates, 20                   | myoglobin (protein), 67               |
| hand, 9                        | •                                   | legend, 82-83                               | ,                                     | vertebrate, 21                  | myth, 82-83                           |
| hare, 27, 30                   |                                     | life cycle, 34-35, 40                       | features, 8-9                         | vision, 14, 18                  |                                       |
| hazel dormouse, 62             | 1                                   | life span, 34                               | feeding, 34: See also lactation       | water conservation, 64-65       |                                       |
| hearing, 28                    |                                     | ligament, 20                                | flying, 24-25, 72-73                  | Mammaliaformes, 8               | 3.7                                   |
| See also ear                   | Indonesia, 91                       | limb  | food chain, 54-55, 84                 | mammary gland, 15, 46-47        |                                       |
| herbivore, 52-53, 54           | insulation, 31                      | fins, 23                                    | foot, 9                               | mandrill, 13                    |                                       |
| hibernation                    | IUCN (World Conservation Union), 91 | functions, 15, 22                           | fur: See fur                          | marsupial, 9, 10                |                                       |
| bats, 73                       |                                     | wings, 23                                   | habitat, 15                           | defining characteristics, 11    | nest, 63, 78-79                       |
| body temperature, 5, 15        |                                     | lion, 50-51, 55, 83                         | hair: <i>See</i> <b>hair</b>          | gestation, 35                   | Newton, Isaac, 68                     |
| dormice, 62                    | _                                   | livestock                                   | hand, 9                               | kangaroo, 40, 84-85             | night vision, 18, 26-27               |
| polar bear, 17                 | T                                   | cows, 88                                    | herbivores, 52-53, 54                 | koala bear, 35                  | North America, endangered species, 90 |
| weight loss, 63                |                                     | hogs, 86-87                                 | hierarchy, 58-59                      | opossum, 11                     | nose                                  |
| hierarchy, social, 58-59       |                                     | sheep, 84-85                                | humans: See human                     | pouch, 40-41                    | camel, 64                             |
| hippopotamus, 91               | jackal, 56                          | locomotion, 22, 79                          | insulation, 31                        | Tasmanian devil, 11             | dog, 28-29                            |
| hog (pig), 86-87               | jaw, 15                             | longevity, 35                               | lactation: See lactation              | wallaby, 35                     | •                                     |
| Holstein (breed of cattle), 88 | Jersey (breed of cattle), 88        | loop of Henle, 64                           | life cycle, 34                        | marsupium, 40-41                |                                       |
| homeostasis, 16                | Jurassic Period, 8, 12              | Luperca, 82-83                              | life span, 34, 35                     | mating, 36-37                   |                                       |
| homeothermy (body temperature) |                                     | •   | marsupials: See marsupial             | meerkat, 56-57                  |                                       |
| balling up, 62-63              |                                     |   | mimicry, 74-75                        | melon, dolphins, 76, 77         |                                       |
| dormice, 62                    |                                     |   | monotremes: See monotreme             | Merkil's disk, 31               |                                       |
| hibernation, 5, 15             | <b>T</b> /                          | <b>1</b> / I                                | movement, 20-21, 22, 79               | metabolism, 17, 25              | <b>O</b> ceania, 10-11                |
| polar bears, 16-17             | N                                   | M   | mythological, 82-83                   | Metatheria: See marsupial       | offspring, 34-35                      |
| See also body temperature      |                                     |   | nocturnal, 72-73                      | migration, polar bears, 17      | omnivore, 13, 55                      |
| hominid, 15                    | kangaroo, 40-41, 84-85              | macaque monkey, 30                          | number of species, 5, 14, 90          | milk, 15, 34, 40, 46-47, 88-89  | opossum, 11                           |
| homogenization, 89             | kidney, 64                          | mammal                                      | omnivores, 13, 55                     | See also lactation              | opposable thumb, 49                   |
| hoof, 20, 22                   | koala bear, 35                      | aquatic: See cetacean                       | origins, 4-5, 7, 8                    | milk production, 88-89          | orangutan, 91                         |
| horn, 36-37                    | rodia scary 33                      | Australian, 84-85                           | placental: See placental mammal       | mimicry, 30, 74                 | organ, 64                             |
| horse, 20-21, 22, 24, 82, 83   |                                     | beginnings, 4-5, 7, 8                       | playing, 48-49, 59, 76                | Minotaur, 82, 83                | otter, 90                             |
| human                          |                                     | body temperature: See body temperature;     | posture, 9                            | monkey                          | oxygen, 66, 67                        |
| adaptation, 15                 | T                                   | homeothermy                                 | prominence, 12                        | chimpanzee, 22-23, 48-49        | oxygen, oo, or                        |
| animal relationships, 80-91    |                                     | bone structure, 8-9                         | reproduction: See reproductive cycle; | endangered, 91                  |                                       |
| brain, 77                      |                                     | camouflage, 30, 74-75                       | sexual reproduction                   | gibbon, 91                      |                                       |
| classification, 15             | lactation                           | carnivores, 50-51, 54                       | running, 20, 24-25, 51                | hanging, 49                     | D                                     |
| destructiveness, 5             | cows, 46-47                         | circulatory system, 14                      | sense of smell, 28-29                 | macaque, 30                     | P                                     |
| feet, 22-23                    | distinguishing feature, 46          | classifying, 22                             | senses, 19, 28-29                     | mandrill, 13                    | 1                                     |
| field of vision, 27            | kangaroo, 40                        | coloration, 74-75                           | skeletal structure, 20-21             | monocular vision, 14            | pack, 58-59                           |
|                                | marsupials, 40                      | common characteristics, 14-15, 16-17, 46-47 | skin, 30-31                           | monotreme, 9, 10, 32, 35, 38-39 | panda bear, 91                        |
| survival, 4-5, 15              | placental mammals, 44               | communication: See communication            | slowest, 74                           |                                 | panda bear, 91<br>pant-hoot, 48       |
| hunting                        | •                                   |   | social groups, 56-57, 58-59           | morganucodon, 8-9               | Pasteur, Louis, 89                    |
| cheetahs, 24                   | platypus, 39<br>rabbits, 34         | dentition: See teeth                        | socializing, 48-49                    | mouth, 15                       |                                       |
| lions, 50-51                   |                                     | diversity, 5, 60-79                         | species, 5, 14, 91                    | movement, 22                    | pasteurization, 88-89                 |
| tigers, 26                     | weaning, 34                         | education, 48-49                            | subclasses, 10                        |                                 | pastureland, 84-85                    |
| wolves, 59                     | language                            | endangered, 5, 90-91                        | SUNCIUSSUS, IV                        |                                 | patagium, bats, 73                    |

**100** INDEX MAMMALS 101

| paw, 23, 25                            |                               | running, 20, 24-25, 51                | endangered, 5, 90-91               | camouflage, 74-75                 |
|--|-------------------------------|---------------------------------------|------------------------------------|-----------------------------------|
| pectoral fin, 76                       |                               | ruilling, 20, 24-23, 31               | number, 5, 14, 91                  | vision, 26-27                     |
|  |                               |                                       | sperm whale, 66-67, 90             |                                   |
| Pegasus, 82                            |                               |                                       | •                                  | titi monkey, 91                   |
| pet, 80-81                             | quill, 31                     |                                       | spermaceti organ, sperm whales, 66 | tongue, 29                        |
| photosynthesis, 54                     |                               | S                                     | spiracle, 66, 76                   | tool, chimpanzees, 49             |
| physiology, 15                         | _                             |                                       | squirrel, 24-25                    | tooth: See teeth                  |
| pig (hog), 86-87                       | R                             |                                       | stereoscopic vision, 18            | Triassic Period, 8                |
| placenta, 42, 43                       | 10                            | scavenger, 55                         | sternum, 20                        | Trojan horse, 82                  |
| placental mammal, 9, 10, 11            |                               | sea lion, 31                          | stomach, ruminants, 52-53          | trophic pyramid, 54-55            |
| branches, 12                           | rabbit, 34, 78-79, 85         | sea otter, 90                         | Sumatra, 91                        | tunnel, 78-79                     |
| defining characteristics, 12-13, 42-43 | raccoon, 12                   | seal, 13, 15                          | sweat gland, 14, 30                |                                   |
| development, 42-43                     | rat, 42-43                    | sexual reproduction, 32               |                                    |                                   |
| lactation, 44                          | red deer, 36-37               | echidna, 38-39                        |                                    |                                   |
| life cycle, 34                         | red kangaroo, 40              | marsupial, 35                         |                                    |                                   |
| plantigrade (foot), 22                 | regurgitation                 | mating, 36-37                         |                                    |                                   |
| <b>platypus,</b> 10, 35, 38-39         | ruminants, 52                 | monotremes, 38-39                     | 1                                  |                                   |
| playing, 48-49, 59, 76                 | weaning, 45                   | pigs, 86-87                           |                                    | udder, 46                         |
| polar bear, 6-7, 16-17, 31             | reproductive cycle            | platypus, 38-39                       | tail                               | ungulate, 20, 22                  |
| porcupine, 31                          | echidnas, 35, 38-39           | red deer, 36                          | cheetah, 25                        | unicorn, 83                       |
| pork, 86-87                            | kangaroo, 40                  | sheep, 52-53, 84                      | lion, 51                           | uropatagium, 73                   |
| pouch, 40-41                           | koala, 35                     | shelter                               | rodent, 9                          | UV radiation, 30                  |
| predator, 54                           | length, 35                    | beaver dam, 70-71                     | structure, 21                      |                                   |
| prehensile digit, 22                   | marsupial, 40                 | rabbit burrow, 78-79                  | Tasmania, 11                       |                                   |
| primate                                | monotremes, 35, 38-39         | short-beaked echidna, 35              | Tasmanian devil, 11                |                                   |
| characteristics, 15                    | placental mammals, 12, 42-43  | shrew, 5                              | taste, 29                          | <b>T</b> 7                        |
| chimpanzee, 22-23, 48-49               | •                             | siamang, 91                           | teat, 46                           | V                                 |
| endangered, 91                         | platypus, 38-39<br>rabbit, 34 | Siberian flying squirrel, 24-25       | teeth                              |                                   |
| feet, 22-23                            |                               | sight: See vision                     | beavers, 70, 71                    | vertebra, 21                      |
| gibbon, 91                             | rat, 42-43                    | sign language, chimpanzees, 49        | carnivores, 50                     | vision                            |
| gorilla, 14-15                         | reptile, 8                    | skeleton                              | growth, 14                         | binocular, 14, 26, 51, 57         |
| hanging, 49                            | respiration                   | cats, 68                              | herbivores, 52                     | lions, 50-51                      |
| hominid, 15                            | cheetah, 24                   | horses, 20-21                         | horses, 20                         | monocular, 14                     |
| human: See human                       | underwater, 66-67             | skin, 15, 30-31                       | Mammaliaformes, 8                  | night, 18, 26-27                  |
| mandrill, 13                           | retina, 27                    | slaughterhouse, 87                    | types, 14                          | stereoscopic, 18                  |
| producer, trophic pyramid, 54          | rodent                        | sloth, 25, 74                         | whales, 66                         | tigers, 26-27                     |
| protective mimicry, 74                 | beaver, 70-71                 | small-spotted genet, 54               | temporal bone, 69                  | tigers, 20-27                     |
| ,                                      | chipmunk, 14                  | smell, sense of, 28-29                | ·                                  |                                   |
| protein, 67                            | dormice, 60-61, 62-63         |                                       | tendon, 20                         |                                   |
| Prototheria: See monotreme             | flying squirrel, 24-25        | social structure                      | territory, 57                      | ***                               |
| pulmonary collapse, 67                 | gestation, 42-43              | meerkats, 56                          | Tertiary Period, 8                 | W                                 |
| pupil, 26                              | multituberculates, 9          | wolves, 58-59                         | Theria (mammal subclass), 10       | ▼ ▼                               |
| puppy, 44-45                           | rat, 42-43                    | socialization, chimpanzees, 48-49     | thoracic collapse, 67              | Mala d                            |
|  | semi-aquatic, 70-71           | sound wave, 77                        | three-toed sloth, 25               | Wales, 4                          |
|  | squirrel, 24-25               | South America, endangered species, 90 | thumb, 49                          | wallaby, 35                       |
|  | ruminant, 52-53               | southern right whale, 90-91           | tiger                              | warren, rabbits, 78               |
|  | rumination, 52-53             | species                               | Bengal, 18-19                      | water conservation, camels, 64-65 |
| I .                                    |                               |                                       |                                    |                                   |

weaning, 45 whale blue, 5 fins, 23 gray, 90-91 life span, 34 southern right, 90-91 sperm, 66-67, 90 wing, 23, 72-73 wolf, 30, 55, 58-59, 82-83 wool, 31, 85 World Conservation Union (IUCN), 91

zebra, 51, 55, 60-61, 74



MAMMALS
Britannica Illustrates
Science Library



Britannica