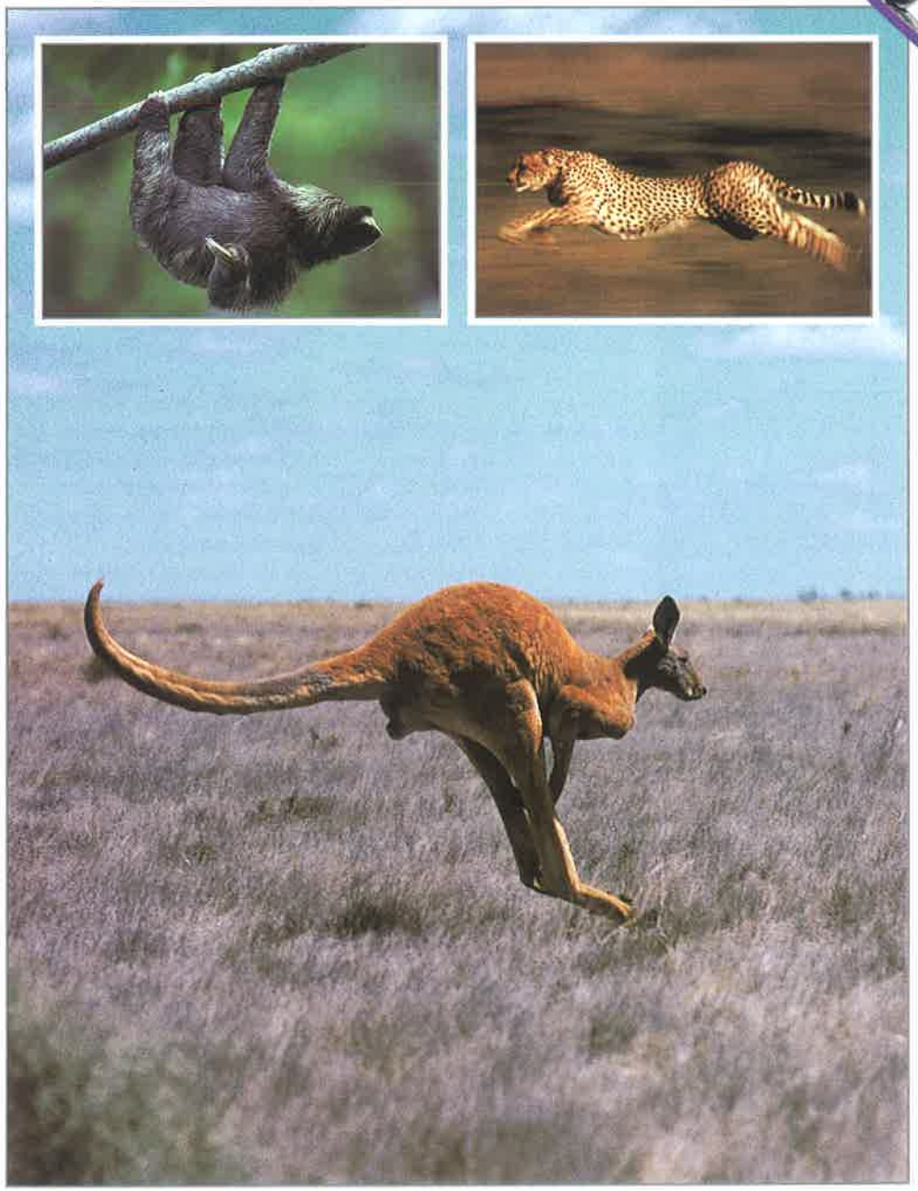
CARD 30

HOW MAMMALS MOVE

GROUP 8: ANIMAL BEHAVIOR



From the super-swift cheetah to the ponderously slow sloth, different mammals move in their own distinctive ways. The design of an animal's body determines its characteristic way of moving.

KEY FACTS

AIRBORNE MAMMALS

GLIDERS

A few animals, such as flying squirrels, flying phalangers, and sugar gliders, move by gliding. These animals have a membrane of skin stretching from their forelegs to their hind legs. When the sugar glider leaps from a tree branch, it spreads its limbs so that the membrane acts like a parachute. In this way it is able to glide almost 150 feet.

Left: *When the sugar glider stretches the membrane between its legs, it can glide from tree to tree.*

MAMMALS IN FLIGHT

The bat is the only mammal that uses true flight to move. Its body is designed for flying. The skeleton is delicate, but the forelimbs are well developed, with powerful shoulder joints to bear the weight of the body. The long forearm is webbed by a thin double layer of skin that forms the wing membrane and the bat's flying mechanism.

With the wing membrane extended, the bat flies just like a bird, using a series of beating wing movements. But since it can use tendons in its arm muscles to flex all its joints, the bat has perfect control of its wings and is better able to maneuver in flight than other flying creatures. When the bat is not in flight, its wings can be folded over so they do not interfere with walking.

Below: *The bat's complex flying mechanism enables it to maneuver in the air.*

The bat's hind legs are also used in flight. When they are extended the bat can kick downward, adding power to its wingbeat. The arrangement of bones and tendons in the bat's leg allows it to rest hanging upside down by its claws.

DID YOU KNOW?

- The cheetah can reach a speed of over 60 miles an hour, but can sustain this for only about a quarter-mile. Then it has to stop and catch its breath before it is ready for another chase.
- Pumas and leopards can jump 16 feet into a tree; a red kangaroo can jump over obstacles about 10 feet high.
- The slowest mammal, the three-toed sloth, moves at an average of 6 feet a minute. But it can speed up to 12 feet a minute in response to a distress call from its young.
- The gibbon can move between trees at 10 miles per hour, faster than a human can run across the ground.

Movement is essential to an animal's survival, enabling it to search for food and to escape from enemies. Mammals are among the animal world's most versatile movers, with species adapted to a full range of motion, from swimming through water to gliding or flying through the air.

Left: *Like other members of the gibbon family, the siamang has powerful arms with mobile joints that enable it to move quickly through the treetops.*

Left: *Trotting, a horse has moments with only two feet on the ground. Galloping at full speed, as shown here, it may even have all four feet in the air at the same time.*

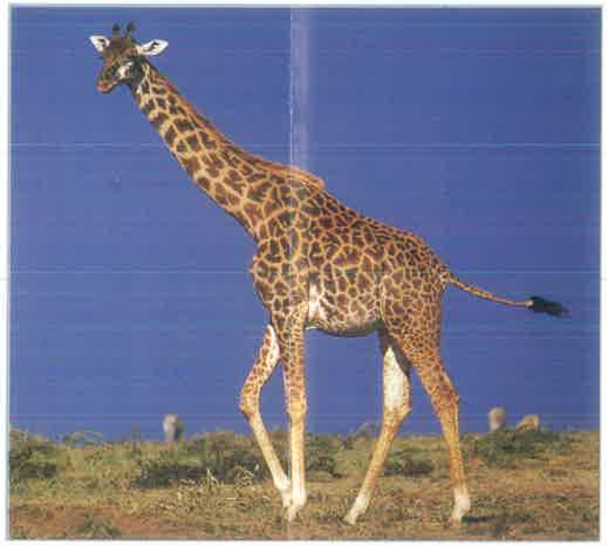
LIMB MOVEMENTS

Most mammals walk using the same limb movement as a crawling baby. First the right forelimb is raised, then the left hind leg, next the left forelimb, and finally the right hind leg. In this way the animal is supported by three limbs and can stop short without falling.

When trotting, one limb is lifted before the previous one touches the ground, leaving a moment when only the two feet diagonally opposite each other are on the ground. The animal stays stable by replacing its feet rapidly.

A few mammals, such as the horse, can sustain swift movement like galloping when only one foot is on the ground at any time and when all feet are in midair at given moments.

The horse's movement stems from its legs, and its back muscles play little part. The cheetah arches and stretches its flexible spine so its hind legs land in front of its forelimbs, increasing the force and length of its stride. In this way it reaches speeds of over 60 miles an hour for fairly short distances.



Right: *The giraffe, like most four-legged mammals, uses the diagonal limb sequence to walk.*

JUMPING, CLIMBING & SWINGING

The kangaroo moves by hopping and jumping, using its long, thick tail as a support and a counterweight. Like other leaping mammals such as the jerboa and kangaroo rat, it propels itself with its large hind legs. The kangaroo can travel up to 30 feet in one bound, keeping its tail raised for balance. When it hops, its bent tail acts as a third leg.

Climbing and leaping are movements characteristic of leaf-eating monkeys like the colobus and proboscis. These mammals use their hind legs to propel themselves into a leap, and they grasp vegetation with their forelimbs as they land on their hind legs. Moving along a branch they use their hands and feet in the diagonal limb sequence.

The gibbon grasps branches with alternate hands, hurling itself along with each grasp. Its long arms and mobile wrists and shoulders even let it cross gaps between trees.

South American monkeys and most tree-climbing marsupials have a *prehensile* (gripping) tail, which they can wrap around branches, leaving the body suspended while feeding.

Right: *Otters are more agile in water than on land.*

Front cover: *The red kangaroo uses its powerful legs and tail to leap along.*

Front insets: *The hanging sloth (left) is the slowest-moving mammal, and the cheetah (right) is the fastest.*

SWIMMING

Aquatic mammals like whales, dolphins, and porpoises swim as skillfully as fish. The bottlenose dolphin, for example, has a streamlined body that enables it to move underwater at almost 20 miles an hour. It uses its muscular tail as a propeller and its fin-shaped front flippers for steering and balance. By leaping out of the water as it surfaces to breathe, the dolphin avoids turbulence and maintains its speed.

Semiaquatic otters move easily in water. Using their backs and tails when swimming, they can reach speeds of 15 miles an hour. But otters usually paddle underwater by using hind-leg movements, interspersed with bursts of fast swimming and gliding. To see and breathe, they raise their heads and chests above the surface while treading water. They also float stomach down, with their eyes, ears, and nostrils above water. On land, otters move awkwardly, with neck and head held low, hips and lower back arched, and muscular tail extended behind.

Right: *The torpedo-shaped body and muscular tail of the bottlenose dolphin help it swim.*

CARD 29

HOW REPTILES SEE

GROUP 8: ANIMAL BEHAVIOR

The eyes of reptiles are specially adapted to their habits. These vital sense organs are protected in various ways. Some species shed tears, some have eyelids, and some even have "eyeglasses."

KEY FACTS

MONOCULAR AND BINOCULAR VISION

A reptile's vision depends on the position of its eyes. A reptile with *monocular* vision has eyes on either side of the head. The area that one eye can see does not overlap the area the other eye can see. Land tortoises, crocodiles, and many lizards have monocular vision.

A reptile with *binocular* vision has both eyes facing forward. The area that each eye can see overlaps. Reptiles with binocular vision, like the snapping turtle, focus both eyes on their prey and can accurately judge its distance.

A chameleon's eyes swivel independently—back and forward through 180 degrees—and also up and down. This allows it to scan a wide area for prey. When it finds a victim close enough to kill, it focuses both eyes on its prey.

Right: The chameleon uses both monocular and binocular vision.

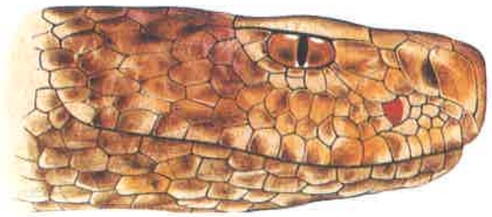
HEAT DETECTION IN SNAKES

Some snakes detect prey by sensing their body heat. *Boids* (members of the boa family), including boa constrictors and pythons, have a row of up to 12 heat-sensitive organs.

Pit vipers, including rattlesnakes and moccasins, are named for the heat-sensitive pit organ between the eye and the nostril on either side of the head. The tiny pit detects infrared heat radiated by its potential prey. This information is focused onto a surface of several thousand nerve endings and passed to the brain, where it is "seen" like signals coming from the eyes. The result is a "heat picture" that reveals the location of any warm-blooded creature nearby. A pit viper can detect temperature changes as small as half a degree.

Pythons and pit vipers also use heat sensors in the mouth to guide them when prey is near enough to kill.

HEAT SENSORS IN PIT VIPER



The North American water moccasin is a pit viper. Its well-defined, highly sophisticated pit organ (shown in red) enables it to detect the presence of warm-blooded animals and sense minute temperature changes.

HEAT SENSORS IN BOID SPECIES

The reticulate python is more primitive than a pit viper, having evolved from a different origin. It has a row of several heat-sensitive organs (shown in red), but they are less sophisticated than those of the pit viper.

Not all reptiles see their surroundings in the same ways. The position of the eyes, the shape of the pupils, and the number and type of light-sensitive cells determine the range, depth, and color of a reptile's view. Some snakes can even "see" an image of warm-blooded prey by detecting the heat that the animal gives off.

REPTILES' EYESIGHT

The class *Reptilia* includes crocodiles, alligators, snakes, lizards, worm lizards, tortoises, turtles, and tuataras.

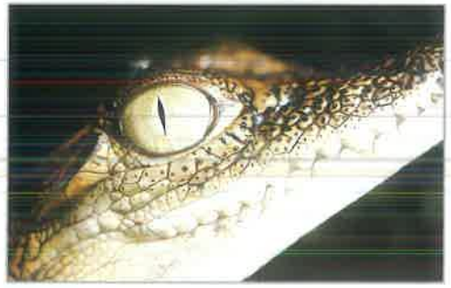
A reptile needs to recognize the shape, and sometimes the color, of prey. It also needs to monitor the movements of mates, offspring, and predators.

Reptiles that live primarily underground or in muddy water have very small eyes. Day-active reptiles that live aboveground often rely on sight more than on their other senses.

A reptile's eye works much like the human eye. Light waves that are reflected from objects pass through a "window" in the eye called the *cornea* and enter a slot in the *iris* (the colored part) called the *pupil.* The light waves then pass through the *lens,* which focuses the image. They finally reach the back of the eye, or *retina,* which is made up of two types of cells that send messages to the brain: rod-shaped cells that convey objects' shapes and cone-shaped cells that convey their colors. The brain interprets these messages as an image, which is what the reptile sees.

Right: *A tree snake focuses by aligning its pupils with the grooves on its snout.*

Front cover: *The caiman's eyes are high on its head.*



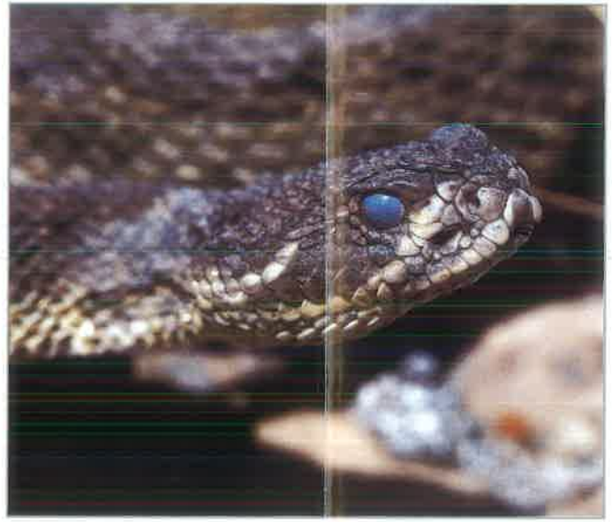
Front cover insets: *The snapping turtle (left) has binocular vision. The tuatara (right) has a tiny "third eye" on its head.*

COLOR VISION

Many lizards seem able to distinguish between colors. For example, some can recognize the red and black markings on insects that are harmful to eat. Giant tortoises can see in color, and some terrapins seem sensitive to red light. They also appear to see infrared rays, which are invisible to humans.

Crocodiles and snakes, however, are color-blind. In low light, American night lizards see shape rather than color. Their retinas contain more shape-sensitive rod cells than color-sensitive cone cells.

Right: *In poor light the granite night lizard's eyes distinguish shapes rather than color.*



EYE PROTECTION

Certain reptiles have eyelids to protect their eyes. But the eyelids differ from those of mammals as the reptile's lower eyelid is usually larger and more movable than its upper one.

Snakes do not blink because they keep dust out of their eyes with fixed, transparent "eyeglasses" that are called *brilles.* Geckos also have brilles, which they sometimes lick clean with their tongues.

Other reptiles have a third eyelid called a *nictitating* (winking) membrane. This transparent fold of thin skin is regularly drawn across the cornea to clean and lubricate its surface. Crocodiles draw this membrane over their eyes when they swim underwater.

Some reptiles use tear glands for protection, but sea turtles use their tears to get rid of excess salt. The tears are most noticeable when a sea turtle comes ashore to dig a nest on a sandy beach. The tears cause grains of sand to stick to the turtle's eyes and face.

Left: *A snake cannot see when shedding its skin, as its transparent eye-covering turns opaque.*

PUPIL SHAPE

Some reptiles, including crocodiles, pythons, vipers, tuataras, and geckos, are active at night but also spend time basking in the sun. Their pupils are usually vertical slits, which can be closed more completely in bright light than round pupils.

The gecko's pupils close in daylight, leaving four tiny pinholes in each one. Only a small amount of light enters through these holes, but the gecko's view is sharpened because it is composed of four superimposed images.

Right: *In sunlight the tokay gecko's pupils become thin slits, each with four small pinholes.*

Below: *The green turtle sheds salty tears, causing sand to stick to its face.*

Left: *The pupils of a crocodile close to narrow openings in bright sunlight.*

HOW MIMICRY PROTECTS ANIMALS

CARD 28

GROUP 8: ANIMAL BEHAVIOR

Mimicry is an important survival tactic for many animals. Some animals have even evolved to look like toxic or unpleasant species that predators have learned to avoid.

KEY FACTS

BATESIAN MIMICRY

The edible viceroy is protected from predators because its appearance mimics that of the inedible monarch butterfly. This form of mimicry is called Batesian mimicry, after the nineteenth-century English naturalist Henry Walter Bates, who proposed that a harmless species could gain protection by imitating a toxic species or a distasteful one.

Certain monarch butterflies can also benefit from Batesian mimicry as not all monarchs are poisonous. As caterpillars, monarchs may feed on either poisonous or nonpoisonous milkweed. If a bird eats a butterfly reared on toxic milkweed the bird vomits, and it learns to avoid any butterfly with the same markings. So monarchs that eat nonpoisonous milkweed are mimics of their toxic relatives. Mimicry within one species is called *automimicry*.

Left: ***All monarchs may look alike, but not all are toxic.***

Right: ***The viceroy mimics the monarch for protection.***

MÜLLERIAN MIMICRY

The hoverfly provides an example of Batesian mimicry. It looks like a yellow jacket, so predators assume it can sting and avoid it.

Some wasps, including the yellow jacket, benefit from another form of mimicry. They have black and yellow markings like those of the cinnabar moth caterpillar and taste just as unpleasant to predators. A bird that learns to avoid the distasteful caterpillar will also avoid the wasp. A bird that is stung while eating a wasp will avoid the caterpillar. This kind of imitation—where appearance is shared by different but equally unpalatable species—is called Müllerian mimicry.

Left: ***The hoverfly does not sting, but predators avoid it.***

Right: ***The yellow jacket's sting deters predators.***

DID YOU KNOW?

- Worker termites feeding under leaf debris collectively make a snakelike "hiss" to scare away predators.
- If threatened, a dormouse in a dark hole will hiss like a snake to scare off an attacker.
- One orb-weaver spider spins two blobs of gossamer on its web that look like the spider itself. A bird is likely to attack the wrong "spider."

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There are three forms of mimicry that animals use to defend themselves against predators. Some animals protect themselves by looking like harmful or inedible animals. Other species mimic their background with appropriate colors and body shapes. Still others pretend to be injured or dead to confuse potential attackers.

WHAT IS MIMICRY?

Mimicry—looking, acting, or sounding like something else—is a form of deception practiced by a variety of animals. For many animals, a key problem is how to eat without being eaten. By mimicking something else, they increase their chances of survival.

There are three strategies for fooling predators. One is to use *camouflage,* blending into the background. Another is to resemble a species that is distasteful or threatening to the predator. The third is to use deceptive behavior whenever a predator is about to attack.

Animals that are protected by their likeness to a dangerous species are the most successful mimics. They do not have to change their behavior or stay against a safe background to disguise themselves. Because their appearance says "keep away," they can go about their daily business with little danger.

Front cover: *The grass snake pretends to be dead to fool potential attackers.*

Front inset left: *Birds avoid preying on the hornet moth because it looks like a yellow jacket.*

Front inset right: *The hornet's sting protects it and its nonstinging mimics from predators.*

Left: *The drongo tastes unpleasant to predators, who avoid it.*

Right: *The edible black flycatcher fools its enemies by resembling the drongo.*

LOOKING DANGEROUS

Harmless insects often mimic stinging insects. The hornet moth looks like a hornet, the bumble bee moth resembles a bumble bee, and the buprestid beetle mimics a wasp.

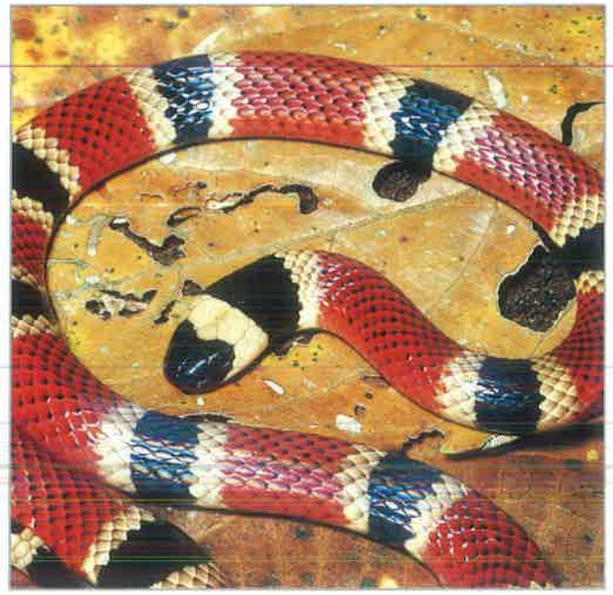
Other insects survive by looking like a distasteful species that predators avoid. Female mocker swallowtails mimic poisonous butterflies like the friar and the African monarch. The males do not mimic and are at risk.

Some birds and reptiles also practice this type of mimicry. The black flycatcher is a bird that resembles the unpalatable drongo. The African rufous flycatcher looks like the ant thrush, which tastes of formic acid from its diet of ants. Among reptiles, the king snake has markings that resemble those of the poisonous coral snake.

This type of mimicry is not a conscious action. Over time evolution has produced animals that resemble harmful species. The resemblance offers protection, so these animals survive and produce young that look like their parents.

Left: *The harmless king snake bears a convincing resemblance to the deadly coral snake.*

Right: *Predators avoid the poisonous coral snake and its similarly marked mimics.*



CONFUSING PREDATORS

If discovered by a predator, some animals try to convince their attacker that they are dangerous. The hawk moth caterpillar waves its body like a snake. Its two eyelike markings add to the illusion.

Other animals like the grass snake pretend to be dead. The Virginia opossum rolls over and lies still with its mouth open and a glassy look in its eyes. This behavior deters predators such as cats, that need to kill before they feed.

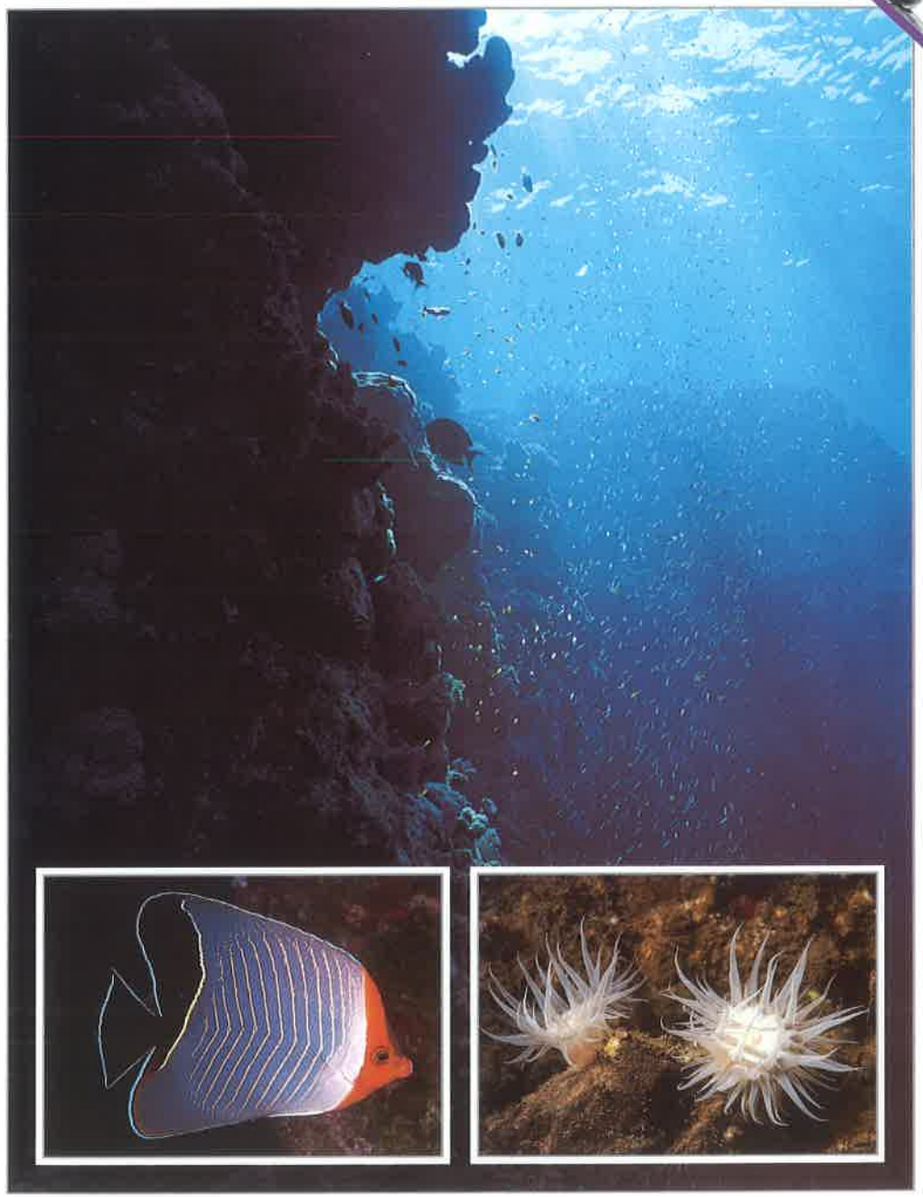
When the pale prominent moth plays dead, it resembles an inedible wood shaving, so it is doubly protected. The hog-nosed snake also pretends to be dead and may even give off a rotting smell. Before it resorts to this, however, it mimics a rattlesnake, raising its head as if about to strike and making a rattling sound.

Left: *"Playing possum" saves the opossum from predators that take only live prey.*

CARD 26

OCEAN TERRITORIES

GROUP 8: ANIMAL BEHAVIOR



The oceans of the world are not as uniform as they seem. They conceal a patchwork of habitats, teeming with animals that must defend their own space.

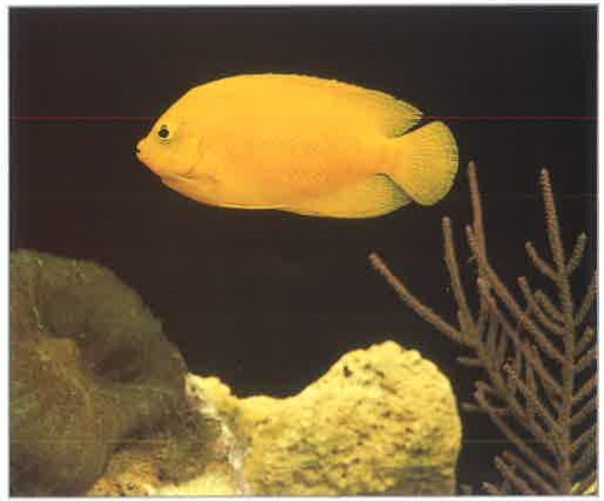
KEY FACTS

DEFENDING A TERRITORY FOR BREEDING

The defense of a food supply may be linked to breeding, as illustrated by the dwarf angelfish, an inhabitant of coral reefs. A group of four to seven fish sets up a territory in an area with abundant seaweed. The male defends this area, while his harem of females feeds and produces young.

A strong male defends a territory large enough to support a group of females and their offspring. Weaker males, less effective at defense, attract fewer females.

This pattern may be important as a way of controlling populations. When numbers are high, weaker fish are forced into less suitable areas, where they are more susceptible to disease and predators and less successful at breeding.



Above: ***The stronger a male angelfish is, the better the territory he establishes.***

SEA LION TERRITORIES

During the breeding season, from May to August, male California sea lions establish *rookeries* (breeding territories) on isolated beaches. Female sea lions come ashore to the rookery to give birth. The newborn pups benefit from the protection of the male, who also protects his harem of females from other males. Shortly after they give birth, the females are ready to breed again and mate with the male whose territory they occupy.

The male sea lion patrols the edge of his rookery both in and out of the water, threatening potential intruders. The threats are usually for show, with much barking, head shaking, staring, and lunging. But occasionally males are seriously injured and are left scarred from fights.

The male is so concerned with defending his territory that he usually stops feeding for several weeks, relying on his stored-up fat deposits. Outside the breeding season, the sea lion is sociable and much less aggressive.

Left: ***The combat of two male sea lions may look and sound dangerous, but it rarely is.***

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Ocean animals establish territories in all but the most inhospitable waters. All of these animals defend their territories against individuals from their own or different species. But territorial behavior is especially widespread in inshore areas, where the competition for food and a mate is intense.

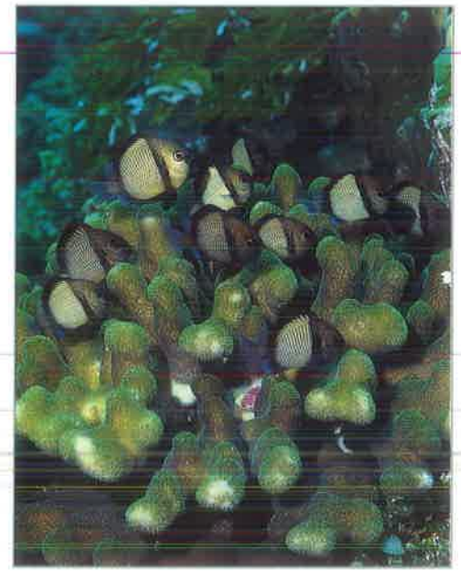
OCEAN HABITATS

Nearly three-quarters of the earth is covered by water, and more than 93 percent of this water is in the oceans. Within the oceans, there are distinct areas, each with different types of marine life and habitats.

Shallow inshore waters are home to the greatest variety of habitats because they contain the greatest water movement, variations in temperature, and *salinity* (saltiness). In some locations, twice-daily tides temporarily expose the area between high and low tide to the air.

The surface layers of the open ocean are well lit and teem with life. Tiny floating plants use energy from the sun to grow and reproduce. They are eaten by plankton, which in turn is eaten by fish and whales.

Since light cannot penetrate below about 650 feet, there is far less life in the ocean depths. Below 3,300 feet, the ocean environment is characterized by low temperature, great pressure, and total darkness.



Front cover: ***Inshore waters such as those of the coral reef provide the highest density of territories.***

Front inset left: ***The bright colors of many coral reef fish act as a "no trespassing" sign to other fish.***

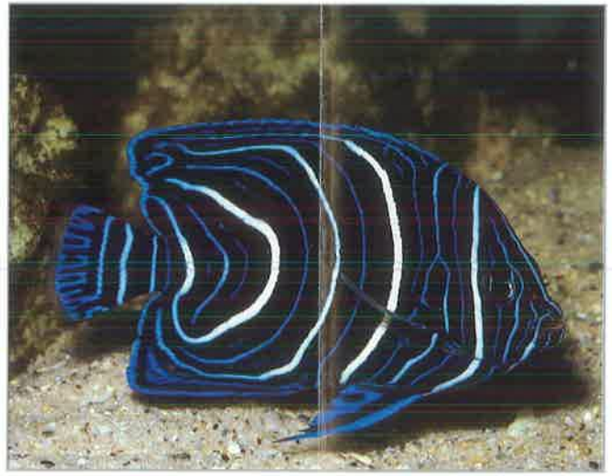
Front inset right: ***If two sea anemones meet, a battle over territory may result.***

TERRITORIAL FISH

Damselfish are very territorial fish that live on tropical coral reefs. They create seaweed gardens by killing a patch of coral and keeping other seaweed-eating animals away. Soon a patch of seaweed grows and attracts tiny shrimp and crabs, which the damselfish eats.

Many damselfish defend their territories from plant-eating fish that are larger than themselves. But they often ignore noncompetitive species that feed on plankton.

Other fish, like the threadfin butterfly, are aggressive only about their nighttime resting spots. The threadfin is not territorial in daytime.



Left: ***The damselfish is one of the most aggressively territorial inhabitants of the coral reef.***

DEFENDING A HOME, SPACE & FOOD

Many ocean animals defend a home, the space around them, or a food supply. An aggressive display may actually reduce fighting. It usually consists of posturing that warns other animals away.

The mantis shrimp is a well-armored crustacean that lives in small burrows or crevices on coral reefs. If another shrimp or a fish ventures into its home, the mantis shrimp drives the intruder away by snapping its pincers shut. The loud noise that results intimidates the potential competitor into fleeing.

Stuck to a rock with tentacles waving, the sea anemone does not seem very aggressive. But it must compete with other anemones for a space where plankton and small fish are borne by the current. If the poison-tipped tentacles of two anemones come into contact, a battle may follow. The fight continues until one combatant concedes by slowly creeping out of its opponent's range.

Right: ***The mantis shrimp uses both a visual threat and a warning sound to deter intruders.***

Left: ***The threadfin butterfly fish uses selective territorial behavior. Only if disturbed at night does it chase intruders away by threatening them with its spiny fins.***

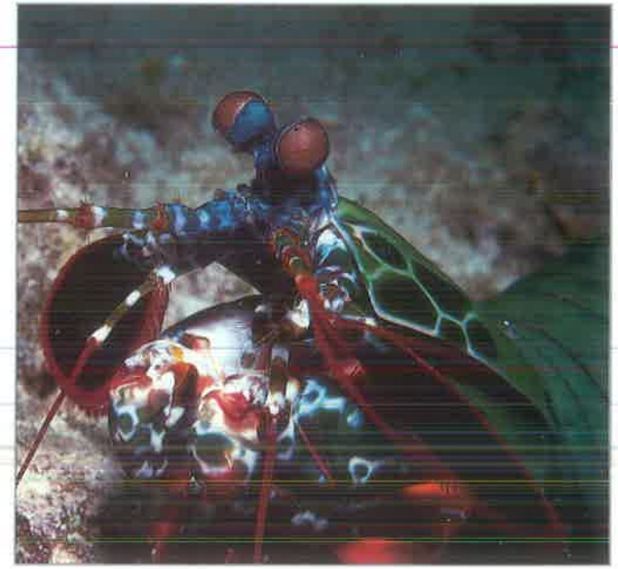
MARKING A TERRITORY

Aquatic animals use sound and color instead of scent to mark territorial boundaries. Fish, sea lions, shrimp, and crabs use sound to help maintain their territories. Sea lions bark (even below water) and shrimp and crabs rub their legs together to produce a sound that warns trespassers away. Some fish produce sounds by using bony structures in their heads or even in their swim bladders.

Other fish, such as the marine angelfish and the butterfly fish, have bright colors that warn off similarly marked competitors of the same or related species. The bright colors can be seen from great distances in the clear waters of a coral reef.

Juvenile reef fish may have completely different color patterns from adults of the same species. In this way they avoid conflict with their elders until they reach maturity.

Left: ***Markings that differ from the adult's protect young semicircle angelfish.***



CARD 23

ANIMAL ARCHITECTS

GROUP 8: ANIMAL BEHAVIOR

Humans are not the only builders of architectural wonders. Elaborate and impressive constructions are also found throughout the animal kingdom.

KEY FACTS

EXTRAORDINARY CONSTRUCTIONS

MASTER SPINNERS

Many spiders make webs to catch prey. The most skilled spinners are orb web spiders. *Spinnerets* (special organs in the abdomen) produce a sticky silk thread that the spider attaches to a twig and throws to another point. The web's frame is completed in this way. Radial threads, like a wheel's spokes, are added next, followed by the spirals. The completed web traps flies, which the spider eats.

Right: ***The garden spider uses its elaborate web to trap prey.***

Left: ***The beaver dams a lake before building its lodge. This behavior ensures that the lodge is always underwater and that the water is deep enough to swim in.***

BUILDING BIG

Termites construct different kinds of nests: small pillars of hardened mud, pockets of earth hanging from tree branches, or extensive underground chambers. Their building materials include earth, clay, soil mixed with wood, and rock-hard mud.

The chambers of a pillar nest reach into the ground. Some chambers are nurseries, while others contain fungus "gardens" where food is grown. The nest built by the genus *Apicotermes* is divided into several stories that are connected by ramps.

Termite nests are designed for efficiency. Many have ventilation systems. The nests of the genus *Cubitermes* have roofs to keep out rain.

Left: ***The magnetic termite of Australia always builds its nest facing north–south.***

Although most animals build some sort of nest or burrow, their structures are unremarkable compared with the creations of the few great animal builders. Among spiders, insects, birds, and mammals, there are architects whose work displays amazing organization and a sophisticated sense of design.

MAMMALS

The harvest mouse is the only mammal that weaves a nest like a bird's. It raises its young in the ball-shaped structure made of leaves and grass.

Many mammals dig simple burrows, but the mole builds a complicated network with chambers for nesting and food storage. The black-tailed prairie dog ventilates its burrow by building two entrances in a mound. The two entrances let air move through the mound.

The beaver is the best-known builder among mammals. It uses logs cut with its large, sharp front teeth to build dams across lakes. The beaver makes its lodge in the middle of the lake. Underwater tunnels leading into the lodge let the beaver enter without being seen by predators on land.

Right: *The harvest mouse weaves a nest that is light enough to be held by a few stalks.*

Front inset left: *The nautilus makes a beautiful but complex shell.*

Front inset center: *Weaver ants can construct a home out of a single leaf.*

Front inset right: *The paper wasp's nest is made from chewed wood fibers.*

MOLLUSKS

Mollusks are *invertebrates* (animals without backbones) that usually have shells to enclose and protect their soft bodies. The hard shells are made from the secretions of special glands. The many species of mollusk, including the snail, produce a variety of elaborate structures.

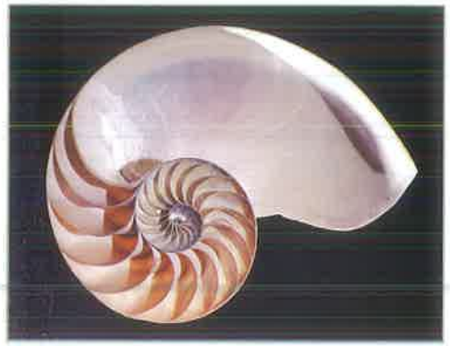
One of the most elegant shells is formed by the nautilus. Its perfectly coiled shell consists of chambers of increasing size. These chambers contain gas that keeps the animal afloat. The last, largest chamber holds the nautilus itself, which builds new chambers as it grows.

INSECTS

The larvae of the caddisfly construct hard cases to protect their soft bodies. The larvae can be found under stones in streams. Some species make their cases from grains of sand, pebbles, twigs, and leaves, which they glue together with a sticky substance they secrete. Camouflaged to look like moving twigs, their constructions help them catch prey.

The structures made by the social insects—ants, bees, wasps, and termites—house thousands of individuals. The weaver ant makes "tents" of leaves, which may be held together by the ants themselves or sewn together with grass or plant fibers. Wasps make nests from wood fibers, which they chew to produce a substance like paper pulp. Some species make small, spherical nests, but others make larger structures. The hornet's nest is the size of a football. Solitary wasps build a variety of nests, from the tiny mud pots of the potter wasp to the chimney-shaped nests of the mason wasp.

The honeybee's comb is a collection of perfect six-sided cells. The cells are made by worker bees from wax, and each is slightly tilted to keep honey from running out. The queen bee lays eggs in some cells, and nectar and pollen are stored in others.



Left: *A cross section of a nautilus shell shows the increasing size of the chambers. By adjusting gas in the chambers, the nautilus can float or sink.*

BIRDS

Some birds dig nesting chambers in sandy banks. But most birds construct nests, which can be very elaborate.

African weaver birds make roofed baskets with strips of vegetation. They weave in pieces of grass and even tie knots to make the nests secure. Each species makes a basket with a distinctive shape.

Bowerbirds get their name from the tentlike structures, or bowers, made by the male. In front of the bower a male displays berries and other colorful objects to attract a mate. The golden bowerbird builds a spectacular pair of columnar structures about 10 feet high. They are built around two saplings and connected by a threshold of moss and lichens.

Above left: *The South American ovenbird is a constant nest builder. Its unique nest is made from damp earth, clay, or grass coated with manure.*

Left: *The caddisfly larva builds a case for itself that blends in with debris on the riverbed. For greater camouflage, the larva may stick pebbles, twigs, and leaves to the case.*

HOW PREDATORS DISGUISE THEMSELVES

CARD 22

GROUP 8: ANIMAL BEHAVIOR

All animals that hunt need to catch their prey before it flees. Some adopt remarkable disguises either to remain undetected or to fool their victims into believing they are harmless.

KEY FACTS

REASONS FOR DISGUISE

A predator must be able to get close enough to its victim to catch and eat it. Some animals, such as foxes, move stealthily as they stalk their prey. Other animals, such as cheetahs, rely on their speed to attack their prey.

Still other animals take a different approach. They blend in with their background and wait until their prey comes close enough to be attacked, using a minimum of effort. Some of these hunters actually mimic the background environment, changing colors and body shapes to enhance their resemblance. Their deception is so good that the victim usually does not realize the danger until it is too late.

Right: *The crab spider closely resembles the flower it sits on and simply waits to catch insects that fly onto the plant to feed.*

Below: *The lacewing larva does not naturally resemble the woolly alder aphids it feeds on, but it plucks the woollike substance from their backs to disguise itself.*

Other predators mimic a harmless creature that does not frighten the desired prey. They may enhance a natural resemblance by imitating the other animal's movements and behavior, or they may, like the lacewing larva, disguise their own appearance. This tactic allows small predators to approach animals that are larger than themselves.

DID YOU KNOW?

- The ray is a sea fish that hangs in water and arches its broad "wings" to form a cave. Small fish swim into this seemingly safe refuge and are quickly eaten.
- To catch birds, the African vine snake wraps its tail around a small tree branch and holds its body out rigidly to look like a twig. It then sticks out its orange tongue, which resembles an insect, to attract birds.
- Male fireflies can identify a female of their species by her pattern of light flashes. The *Photuris* firefly mimics the signals of the female *Photinus* to attract the male *Photinus*, which it eats.

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MATCHING THE BACKGROUND

Many animals try to blend in with their background. They can then sit still and wait for prey to come within reach. At the same time, their disguise protects them from larger predators.

Instead of spinning a web, the crab spider, which has a pink body and legs, sits on the petals of a pink flower. Butterflies, hover flies, and bees fly in to feed on the flower's nectar. There they are seized by the waiting crab spider.

Left: ***The Borneo flower mantis closely resembles the ginger plant that it sits on.***

Flower mantises use the same method. Some are green to match green petals and others are pink to blend with pink flowers. The color markings and projections on their bodies enhance their resemblance to a flower.

The spotted scorpionfish is well protected by poisonous spines as it hides on the seabed. Fleshy projections on its body make it look like a harmless, algae-covered rock, until prey get too close. The anglerfish also blends in well with the sea bottom. A spine on top of its mouth looks edible. The anglerfish dangles the spine in front of its jaws and waits for fish to take the bait.

The barracuda is light underneath and dark on top. It has light and dark stripes on its sides that resemble rays of sunlight filtered through the water. These colors make it difficult to see from any direction. It hangs motionless in the water until a fish swims by; then it darts out to catch it.

As the slender trumpetfish swims vertically among the branches of soft corals, it changes its color to match its background. It is almost invisible to the small animals that it hunts.

Camouflage and mimicry allow prey to hide from their predators, but these techniques can also benefit predators. By blending into their surroundings or taking on the appearance of more harmless animals, predators can avoid detection by their victims and in this way get close enough to attack them.

Left: ***The flower mantis is hard to distinguish from surrounding vegetation.***

Right: ***The vine snake resembles a vine and has a tongue that birds mistake for an insect.***

WOLVES IN SHEEP'S CLOTHING

Some predators disguise themselves as harmless animals. An example is the green lacewing larva. It feeds on woolly alder aphids, but it first has to get past the ants that protect the aphid. When it can, it plucks white, woollike wax from the aphid's back and attaches this to its own back. The larva can then deceive the ants and get to the aphids more readily.

The zone-tailed hawk feeds on live prey, but it mimics the flight of a vulture, which eats only dead animals. The hawk deceives small mammals with its gliding flight and vulture-like outline.

The harmless cleaner fish eats parasites from the skin of larger fish and swims into their mouths to remove food particles from between their teeth. The saber-toothed blenny has blue and black markings like the cleaner and imitates its swimming pattern. In this disguise, it can swim close enough to bite a chunk of flesh from its prey.

Cheilinus is a flesh-eating fish that takes on the colors of several different plant-eating fish. It may swim with grazing goatfish and dart out when prey comes within range.

Front cover: ***A tropical mantis and a sargassum anglerfish (inset) blend into their surroundings so that they can hide themselves from their prey.***

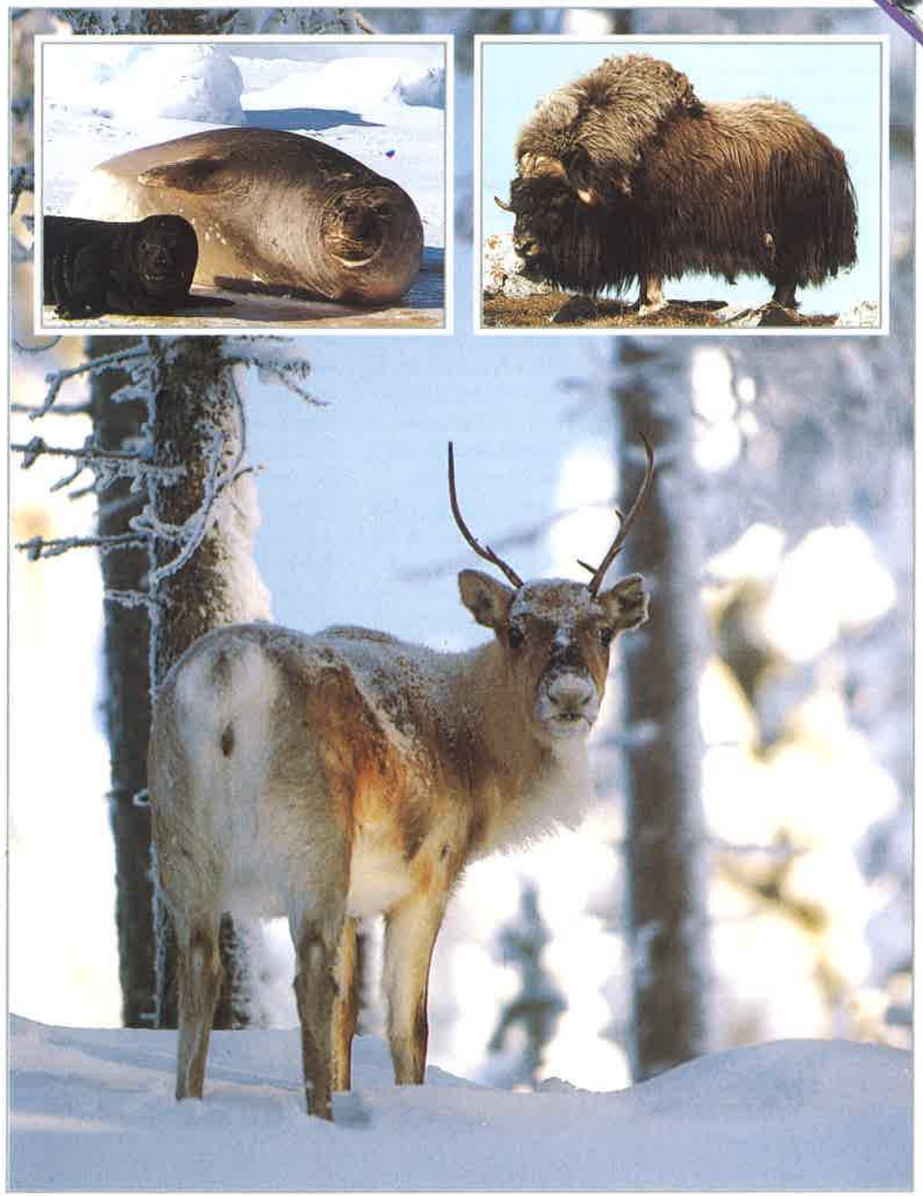
Above: ***The predatory blenny mimics the swimming pattern and markings of the cleaner fish.***

Left: ***The cleaner fish is harmless. It feeds itself by cleaning the teeth of larger fish.***

HOW MAMMALS KEEP WARM

CARD 21

GROUP 8: ANIMAL BEHAVIOR



Keeping warm is essential to a mammal's survival, especially in very cold areas. Animals have adapted both their habits and their bodies in the struggle to conserve heat.

KEY FACTS

CHANGING BODY SHAPE

Animals living in very cold climates often differ in body shape and size from similar species in warm areas. Two general rules are that rounder is warmer and shorter is warmer. These adaptations are especially noticeable in small animals.

ROUNDER IS WARMER

Bergmann's Rule states that an animal becomes bulkier and rounder when living in cold surroundings. Arctic hares living in the northern part of their range have skulls about an inch shorter than those of hares in northern Scotland. Lemmings in Siberia are an inch or so longer than those living nearer the Arctic Circle. The rounder the animal's shape the more efficiently it can conserve heat. This rule is also illustrated by the rounded bodies of seals and whales—mammals that thrive in icy waters.

Left: *Small animals lose heat quickly because their body volume is low compared with their surface area. The snowshoe hare has short legs and its ears are about the same size as a rabbit's. As a result its surface area is reduced, and heat loss is minimized.*

SHORTER IS WARMER

Allen's Rule states that the farther north an animal lives, the shorter its limbs, ears, and tail will be to help prevent heat loss. The Arctic and the snowshoe hares have shorter ears than hares in warmer climates, and both have short, stocky legs. The snowshoe hare also has enlarged hind feet that give it extra support in soft snow, much as snowshoes do for humans.

Left: *The Arctic fox differs from temperate fox species. It has a rounder and bulkier body, and its muzzle and ears are shorter. It also has fur-covered feet and thick fur that turns white in the winter. These adaptations help it survive intense cold.*

DID YOU KNOW?

- A chinchilla's fur is so dense that up to 60 hairs may grow out of a single hair follicle.
- If a musk-ox is drenched by rain during a warm spell in winter, its fur may freeze solid.
- There are up to 368,000 fibers in a square inch of a fur seal's coat.
- Deer may travel long distances to find shelter from cold winds. They sometimes huddle together for warmth.

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In cold climates land mammals are kept warm by their fur coats, which insulate their bodies by trapping air. Many marine mammals protect themselves from cold with extra layers of fat beneath their skin. Some mammal species have even adapted their body shape and their size to help conserve heat.

ARCTIC LAND MAMMALS

The Arctic is the coldest place inhabited by land mammals. Polar bears may actually live near the North Pole, but most Arctic mammals have a range spreading south to more temperate climates.

Many Arctic mammals have thick white fur made up of hollow hairs. This fur traps and warms air. It may be replaced by a thinner coat in summer.

Polar bears have white fur year-round. The white hairs funnel ultraviolet light from the sun to the bear's black skin, converting it to warmth. The polar bear's dense undercoat is covered by long guard hairs that form a waterproof layer to keep the bear warm and dry when it swims.

Wolverines also keep their thick brown fur year-round. The Inuit, or Eskimos, use wolverine fur to line parka hoods because it does not collect ice crystals.

The musk-ox has a dense, furry undercoat covered by a long, fleecy coat of 20- to 30-inch hairs. This overcoat almost reaches the ground. The two coats provide excellent insulation. In fact the musk-ox sheds its outer coat in spring to avoid getting too hot.

Right: *A layer of blubber and a coat that channels heat to the skin warm the polar bear.*

Right: *The gray wolf has thick fur, but it seeks shelter in extremely cold weather.*

Front cover: *In winter the reindeer uses its fat reserves. The elephant seal (left inset) has blubber for warmth, while the musk-ox (right inset) has a fat coat.*

WARMTH AT HIGH ALTITUDES

In the mountains animals must adapt to temperatures that are high during the day and low at night, as well as to seasonal fluctuations. Many species have thick coats to keep warm.

In the South American Andes, the chinchilla, vicuña, and alpaca are valued for their fur and wool. The coat of the Angora goat from southern Central Asia provides mohair.

Further down the slopes, at the forest fringes, the nightly temperature drop is less extreme. Some mountain sheep and goats spend the winter in these forests and return to the mountains in spring.

Left: *The alpaca's dense coat protects it from the cold on the high plains. Its wool grows year-round to provide constant insulation.*

SHELTER FROM THE COLD

Snow provides insulation in very cold conditions. Small mammals such as the lemming and ermine (white winter stoat) live in underground tunnels that are insulated by the snow on the ground.

Some bear species, such as the Alaskan brown bear, hibernate in a den during winter. But the polar bear seeks shelter only during blizzards and to give birth. To rest, it curls up outside, tucks in its head, and lets the snow drift around its body for insulation.

Wolves, reindeer, moose, and foxes are all well adapted to the cold. In winter they live on fat reserves built up in fall. In very bad weather they take shelter in vegetation or thick leaf debris. Squirrels, badgers, and many other small mammals escape cold by sleeping through the winter.

WARMTH IN WATER

Cold water absorbs heat from warm-blooded animals faster than air. Humans could survive for only a few minutes in the polar seas that are home to some marine mammals.

Several species live around both the North and South Poles. Walruses live only in the Arctic. A few seals, such as the ringed seal in the Arctic and the leopard seal in the Antarctic, live in the cold year-round. Others, like the harp seal, migrate. Narwhal and beluga whales are residents, while gray, humpback, and blue whales are summer visitors.

The bulky, rounded shape of whales and seals minimizes heat loss. They also have a thick layer of *blubber*, or fat, below the skin that keeps body heat in and cold out. The blubber layer varies in thickness from an inch to more than a foot depending on the animal. Fur seals get added insulation from their coats.

Their insulation methods are so efficient that marine mammals may overheat after a strenuous swim. If they get too hot, blood flows through a network of vessels in the blubber, close to the skin, and is cooled by the icy sea.

Below: *The harp seal's rounded shape and layer of blubber keep it warm in icy water.*