

The Dog

Its Behavior, Nutrition,
and Health

SECOND EDITION



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Linda P. Case

Illustrated by Kerry Helms

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The Dog

Its Behavior,

Nutrition,

and Health

Second Edition

Linda P. Case



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In memory of...

Those who are no longer with us in life, but who are forever in our hearts—Fauna, Stepper, Roxie, Gusto, and Sparks. We love and miss you all.

Dedicated to...

Nike, Cadie, and Vinny Binny Vanilla Bean, who continue to bring laughter, joy, and love to our lives.

Preface

TODAY, about 40 percent of households in the United States share their homes with at least one dog, comprising a total of more than 61 million dogs. The multibillion dollar pet food industry and the more than seven billion dollars that pet guardians spend on veterinary care each year provide tangible evidence of the increasing importance that dogs have in our society. This devotion is further illustrated by the continued growth of the pet supply industry, which includes increasing numbers of pet “super-stores”, play-parks, training centers, and doggie day care centers in many communities. The bond that human caretakers have with their dogs and the many health benefits that are afforded by this bond have been the topic of numerous research studies in the past 30 years. The dog as a cherished companion and family member is here to stay, and many caretakers, students, and companion animal professionals are eager to learn more about man’s best friend, *Canis familiaris*.

The Dog: Its Behavior, Nutrition and Health is a comprehensive study of the domestic dog. This book is written for people who are either pursuing or are currently engaged in a profession or avocation that involves dogs. Dog trainers, breeders, kennel owners, veterinary technicians, veterinarians, and other companion animal professionals will find this book to be an indispensable resource. In addition, *The Dog: Its Behavior, Nutrition and Health* is an essential text for college students who are studying the physiology, care, behavior and nutrition of companion animals. The book is divided into four topical sections. Part 1, Man’s Best Friend: The Animal within the Companion, examines the origin of the relationship between humans and dogs and follows the development of the dog from the first stages of domestication through present day.

This section also includes basic information about the dog's physiology, structure, reproduction, and genetics. The status of the dog today and the importance of proper pet selection and responsible guardianship are discussed in the final chapter of this section. Part 2, Behavior: Communicating with Man's Best Friend, examines the developmental behavior of the dog from birth to adulthood. Species-specific behavior patterns are examined, followed by a discussion of breed specific behaviors. Learning process and principles of training are the topic of Chapter 8. Basic tenets of learning are first reviewed, followed by an examination of successful training methodologies. Various training principles are compared and contrasted, and practical examples are provided throughout the chapter. The final chapter in this section identifies several common behavior problems and their solutions. Part 3 concerns Health and Disease: Taking Care and Keeping Fit. Infectious and non-infectious diseases and common internal and external parasitic diseases are included. Types of vaccines, procedures for their use, and new information regarding recommended vaccination schedules are discussed. The final chapter in the section reviews emergency care and first aid procedures that are essential skills for all pet care professionals and dog caretakers. Part 4, Nutrition: Feeding for Health and Longevity, provides an overview of the dog's nutrient requirements and examines available pet foods and methods of feeding. Detailed instructions for feeding throughout the dog's life cycle and criteria for the selection of optimal pet foods are included. The final chapter of the book reviews common medical disorders that can be treated or managed through diet.

The first edition of this book was completed by the author in 1998 and was published by Iowa State University Press in 1999. In the six-plus years since its completion, numerous research studies and academic journal articles have been

published on the topics of companion animal domestication, breeding, behavior, training, health care, and nutrition. All four sections and most chapters of this second edition have been updated with new information from recently published journal papers and books. These revisions will serve to provide college professors and companion animal professionals with the most up-to-date information possible in the field of companion animal science.

This new edition of *The Dog: Its Behavior, Nutrition and Health* offers the reader extensive information and technical depth in a readable and “user-friendly” format. The book is intended not only as a helpful resource, but also as an enjoyable and interesting exploration of the domestic dog, our relationship with him, and the best methods of caring for him. The knowledge gained can only strengthen the well-established and enduring bond that exists between dogs and their human caretakers in our culture today.

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Linda P. Case

Mahomet, Illinois

Part 1

Man's Best Friend: The Animal within the Companion

1

Man and Wolf: The Process of Domestication

TODAY, more than one-third of households in the United States own at least one dog, comprising a total of more than 61 million dogs.¹ In the year 2001, pet owners spent more than 8 billion dollars on food for their animals, and dog owners alone spend more than 10 billion dollars on veterinary care. It is undeniable that the dog is a valued and important member of our society. Unlike any other nonhuman species, the dog has become fully integrated into our lives, and it appears that he is here to stay. So what exactly was it that brought man and dog together so many years ago? And more important, what characteristics of these two very different species enabled them to forge the strong and ongoing partnership that is still so important to us today?

The Dog's Phylogeny (Evolutionary History)

The dog, like the cat, is a member of the order Carnivora, which includes a diverse group of animals that are all predatory in nature. Carnivores are so named because of their enlarged carnassial teeth. These include the enlarged upper fourth premolar and the lower first molar on each side of the mouth. These adaptations make the teeth efficient at

shearing and tearing prey. All carnivores also have small, sharp incisors for holding prey, and they often have elongated canine teeth for stabbing and tearing.

During the time when dinosaurs dominated the earth, a group of animals called the miacids were evolving. The Miacidae family included a very diverse group of predatory mammals, many of whom were small, tree-dwelling animals. This group existed about 62 million years ago and formed the ancestral family for all members of the order Carnivora. The miacids all walked on the palms/soles of their feet (plantigrade), were long bodied and slim, and were the first animals with carnassial teeth—an indication of their predatory nature.

Over time, a group called the viveravines branched off from the miacids. The viveravines are now known to be the oldest ancestor of the domestic cat. A second branch that evolved from the miacids was the miacines. Animals in this group were the ancestors of all extant canid species, as well as the bear, raccoon, and weasel. The miacines existed about 60 million years ago and eventually gave rise to *Hesperocyon* (meaning western dog), who is designated as the oldest member of the Canidae family. Remains of *Hesperocyon* have been found in South Dakota, Nebraska, Colorado, and Wyoming and are estimated to have existed about 36–38 million years ago. Interestingly, current evidence indicates that the Canidae family evolved completely in North America and did not migrate into Eurasia until much later in its development. *Hesperocyon* was a digitigrade mammal (walking on its toes) and was long bodied and long legged, obviously adapted for speed. Its dentition (including the presence of carnassial teeth) and body structure showed it to be an agile predator. By the end of the Oligocene period, about 23 million years ago, *Hesperocyon* had evolved into *Leptocyon*. *Leptocyon* is thought to be the most recent common ancestor of all of

today's canids, although there is some controversy over this mammal's eventual fate.² Some accounts claim that *Leptocyon* gave rise to *Tomarctus*, who became the wolf's and our dog's primary ancestor. Other records depict *Tomarctus* and *Leptocyon* as two separate branches of *Hesperocyon*. Regardless, it appears that *Leptocyon*, and probably *Tomarctus*, gave rise to the dominant group of canids in North America, who were destined to become all of our modern-day canid species.

The Dog's Taxonomy (Naming the Dog)

Today, the domestic dog is classified as a member of the Canidae family ([Table 1.1](#)). This family also includes the wolf, coyote, dingo, fox, jackal, and Cape hunting dog. The dog's genus is *Canis*, and its species is *familiaris*. Other members of *Canis* are the coyote (*Canis latrans*), two species of wolf (the grey or timber wolf, *Canis lupus*, and the red wolf, *Canis rufus*), and four species of jackal. The extreme regional variations that are observed in wolves all represent varieties (subspecies) of *Canis lupus*, rather than separate species. Twenty to thirty subspecies have been identified, a number of which have become extinct in the last century. The genetic plasticity of the wolf as a species is illustrated by the great variation in physical and behavioral attributes in various subspecies. For example, Alaskan timber wolves (*Canis lupus pambasileus*) typically weigh more than 100 pounds at maturity and live in well-organized packs consisting of an average of five to eight adults. In contrast, the small Asian wolf (*Canis lupus pallipes*) weighs only about 45–50 lbs and travels alone or in very small packs. There is much dispute over whether or not the red

wolf (*Canis rufus*) should continue to be classified as a separate species of wolf or be classified as a subspecies.

TABLE 1.1 Taxonomy of the Dog

Phyla	Animalia
Class	Mammalia
Order	Carnivora
Family	Canidae
Genus	<i>Canis</i>
Species	<i>familiaris</i>

There is similar dispute regarding the domestic dog. The immediate common wild ancestor of *Canis familiaris* continues to be the subject of some debate. At one time, it was believed that the dog was descended from the interbreeding of ancestral wolves, coyotes, jackals, and possibly other wild canids.³ During the 1940s, the Nobel prize-winning ethologist Konrad Lorenz wrote that some breeds of dogs were descended from the golden jackal, whereas others, those that he called “lupus” breeds, were directly descended from the wolf.⁴ This theory has been largely discarded, however. During the 1970s, wolf and dog expert Michael Fox developed a “missing link” theory. He believed that the dog is descended from a now-extinct, European, dingo-like dog. However, little fossil evidence of this ancestor has been found. Another theory suggests that our present-day domestic dog arose from a type of semiwild dog similar to the Australian dingo (classified as either *Canis lupus dingo* or as *Canis familiaris dingo*) and the New Guinea singing dog (classified as *Canis familiaris hallstromi*).

Current behavioral, morphological, and molecular biological (genetics) evidence supports the theory that today’s gray wolf, *Canis lupus*, is the domestic dog’s closest relative. Although it is often stated that the wild wolf is our domestic dog’s immediate wild ancestor, in evolutionary terms this is impossible. More correctly, the present-day

wolf and the present-day dog share their most recent ancestor, which was probably very wolflike in appearance and behavior. This distinction is important because the wolf that is extant today has been evolving for the same period of time that today's domestic dog has been evolving. Therefore, the present-day wolf is actually the present-day domestic dog's closest relative.

Overall, the most compelling evidence in recent years about how to accurately classify the domestic dog comes from relatively new methods of analyzing genetic information. Mitochondrial DNA (mDNA) is genetic material that is passed from mothers to their offspring (in the ovum), with no genetic recombination. Analysis of mDNA allows the reconstruction of matrilineal histories and also can provide an estimate of evolutionary history. These studies have shown that although there are morphological and behavioral differences between wolves and dogs, from a genetic standpoint, the domestic dog is virtually identical to the other members of the *Canis* genus. In fact, there are greater mitochondrial DNA differences between some breeds of dogs than are found between dogs and wolves! This knowledge, coupled with the fact that dogs, wolves, coyotes, and jackals are still reproductively interfertile, provides strong evidence that there is very little phylogenetic distance between these groups of canids.

Both dogs and wolves have 39 pairs of chromosomes (78 total), as is true for the four species of jackal and the coyote. Because of this very close genetic relatedness, some argue that the domestic dog should not be classified as a new species but, rather, as a subspecies of wolf (i.e., *Canis lupus familiaris*).⁵ Conversely, another criterion for species classification is adaptation to different ecological niches. Some biologists and ecologists, although accepting the close genetic relationship between the dog and the wolf, maintain that because dogs, wolves, coyotes, and jackals

all adapted to occupy and thrive in very different ecological niches, they should each represent a separate species.⁶

Additional evidence for the dog's close relationship to the wolf lies in the existence of physical, genetic, and behavioral similarities between the two species. One of the most basic is the social nature of dogs and wolves. Both species establish social groups. In contrast, jackals are known to live and hunt alone, while coyotes hunt in pairs or, at the most, as a threesome. The typical wolf pack consists of closely related individuals who are each independent yet voluntarily work together to obtain food, raise young, and protect the pack from other predators. For the wolf, this means survival in a harsh environment in which food is scarce and the primary food source is often large ungulates (hooved mammals). Hunting such large prey would be impossible for one wolf hunting alone. As individuals, both dogs and wolves seek out contact and interactions with conspecifics (other pack members), and social activity is an important component of their daily life. Common examples include the elaborate greeting rituals, play, and exploratory behaviors of both species.

A second important similarity between the domestic dog and the wolf involves methods of communication. Natural selection has resulted in the establishment of complex communication patterns in all species that are required to work cooperatively for survival. In wolves, primary communication patterns involve body postures, facial expressions, and vocalizations. The domestic dog has inherited some of these communication tools in their complete form, differing little from their expression in *Canis lupus*. Other patterns have been modified through domestication, but vestigial portions are still observed. The wolf and the dog exhibit similar postures that signal aggression, dominance, submission and fear. However, the level of stimulus that is necessary to evoke these

expressions, along with their intensity and completeness, have been modified significantly through domestication. The development of different breeds of dogs for specific purposes has further exaggerated or attenuated both physical and behavioral characteristics of the wolf (see Chapter 2). Finally, recent studies comparing dogs with socialized wolves have shown that dogs are significantly better at responding to various types of human social cues, such as gesturing, pointing, and gazing, compared with wolves.⁷ The ability to engage in this type of social communication and learning appears to be an important aspect of domestication in the dog (see Chapter 7 for a more complete discussion).

The Process of Domestication

Domestication of a species occurs when the breeding and containment of large groups of animals are under the control of humans. Over a period of many generations, this results in the development of a group of animals who are genetically distinct from members of the original species. Although members of domesticated species can often still mate and produce viable offspring with members of the progenitor species, the domestication process still involves changes in genetically determined morphology and behavior. The process of domestication can be contrasted to “taming,” which refers to simply decreasing fear of humans in an individual animal. A tame animal is merely a wild animal who has been habituated to his human caretakers. Such an animal usually easily reverts back to the wild state, most often when sexual maturity occurs. In contrast, domestication must be viewed as a process that affects an entire subgroup of a species over many generations and

that involves the geographic, reproductive, and behavioral isolation of the selected group from its wild population.

At present, there are two predominant theories that attempt to explain the morphological and behavioral changes that occurred during domestication of the dog from the ancestral wolf. The first of these develops a model of the dog as a pedomorphic (or neotenized) wolf.^{8,9} Pedomorphosis refers to the retention of juvenile body shapes (morphology) and features into maturity and occurs as a result of changes in the onset, rate, or completion of development in the individual. These changes may affect the individual as a whole (i.e., final body size), or they may be restricted to certain body structures. The term *neoteny* is commonly used to describe the persistence of physical or behavioral infantile characteristics into adulthood. However, neoteny is actually one of several forms of pedomorphosis and refers to a reduced rate of development. Regardless of the terminology that is used, a pedomorphic (neotogenic) animal remains permanently immature with respect to the characteristic in question. Physical attributes that are commonly observed in domestic species that are pedomorphic include decreased body size, altered jaw size and strength, decreased number and size of teeth, development of a prominent forehead, shortened limbs, and diminished secondary sexual characteristics in males.

Neotenized behavioral characteristics are of equal significance in the domestic dog. An examination of the normal wolf pup demonstrates a number of behavior patterns that have been selected to persist into adulthood in the domesticated dog. Wolf pups are highly curious about their environments and will readily explore and investigate new animals and objects without showing the characteristic wariness that is seen in adult wolves. It is only after a certain age that wolf pups begin to show fear of unfamiliar stimuli. This is called *xenophobia* or *neophobia*, meaning

fear of the foreign or fear of the new, respectively. Xenophobia has survival value for any species that is living in a harsh environment. However, this trait is not desirable in a domesticated animal. Adaptability to new environments is a key characteristic in domesticated species. For example, an adult dog who is fearful of new situations, people, or animals is not well adapted to living and working with man. Therefore, the selection for dogs with a puppylike trust of new stimuli was of distinct advantage. Moreover, once the evolving dog began to live near human settlements there was less selective pressure to maintain xenophobia, as the wolf's normal predators were less of a threat and, more important, animals who were less nervous would have more opportunities to feed.

A second important neotenized characteristic that is seen in the dog is the presence of enhanced and easily elicited subordinate behavior patterns. Wolf pups are naturally subordinate to elder members of their pack and are also more sociable with animals of other species. However, as pups mature into adult wolves, subordinate behaviors are not as readily elicited, and a collection of dominant behavior patterns develop that are necessary and vital for the adult wolf's integration into the pack. In the domestic dog, both dominant and subordinate behavior patterns are present, but there is an intensification of subordinate behaviors in the adult dog, compared with the expression of these behaviors in the wolf. Although there are great variations between breeds in both dominant and subordinate behaviors, in general, the display of dominant behaviors has been attenuated.

A second, related theory challenges the premise that pedomorphosis or neoteny can explain all of the morphological and behavioral changes that have occurred in the dog. The "mesomorphic remodeling theory" proposes that there are traits present in the domestic dog that are not

to be found in either wolf pups or wolf adults.¹⁰⁻¹² This theory proposes that the dog may be looked on more as being arrested at some point during its adolescence or metamorphic period, rather than being strictly neotenic. The mesomorphic period refers to a period during which the young animal is rapidly changing into an adult form. In mammals such as the dog this period is typically referred to as the period of adolescence or the juvenile period. The various stages of life through which an individual progresses (i.e., fertilized egg, fetus, neonate, infant, juvenile, and adult) can be viewed as specialized stages in which the animal is behaviorally and morphologically adapted to the environment in which it exists at that time. Behaviors that are present in the infant slowly recede to give way to behaviors that are adaptive for the juvenile, and so on. In wolves, the mesomorphic juvenile exhibits some characteristics of the pup (which are decreasing with time), some traits of the adults (which are increasing with time), and some traits that are present only in the juvenile stage.

An interesting and important aspect of the mesomorphic period is that it represents a period of behavioral flexibility or plasticity. Proponents of this model believe that the mesomorphic period represents a period in which a multitude of new and different behaviors can evolve, and also a period in which the animal is highly responsive to learning. This theory maintains that a better model to use for the domesticated dog is one in which the dog represents a wolf whose development has been arrested or halted during the highly unstable mesomorphic period. The juvenile period in the wolf is relatively long in duration, and there are a number of changes that occur during this period. It is theorized that natural or artificial selection for traits that occur during different points of the juvenile period may be one source of the wide variation in size, morphology, and behavior seen in different breeds of domestic dog. This

hypothesis of metamorphic remodeling is relatively new but, although it has not yet been thoroughly tested or examined by behaviorists, does represent another possible explanation for many of the behaviors and structural differences that are seen in the domesticated dog.

In the Beginning: Man Meets Dog

Domestication of the dog is believed to have begun late in the Mesolithic period, 12,000–15,000 years ago, as humans were changing from being completely nomadic hunter-gatherers to living in semipermanent settlements. Although archeological (fossil) evidence of a domestic dog existing from this period of time is very scant, there is some evidence that a dog or “proto-dog” was living in close proximity to some human settlements about 12,000–14,000 years ago. By the Neolithic period, when agriculture was becoming the predominant way of life, the dog was fully domesticated, and various types of working dogs were beginning to emerge.¹³

Fossil evidence has shown that the dog was distributed across both Eurasia and the Americas before transoceanic travel during the fifteenth century. For some time, this fact, along with morphological data, seemed to show that the dog was domesticated separately in the Old and New worlds. However, a set of recent studies supports the theory that domestication occurred at one time only, in Eurasia, from the Old World gray wolf.¹⁴ It now appears that when the first humans traveled to the New World across the Bering Strait approximately 12,000–14,000 years ago, they brought the newly domesticated (or semidomesticated) dog with them. Subsequently, semidomestic dogs, wolves, and