The Language of Veterinary Parasitology

OUTLINE

Symbiosis
Parasitism
Life Cycle
The Linnaean Classification Scheme

EDUCATIONAL OBJECTIVES

After studying this course, the reader should be able to do the following:

• Briefly discuss the importance of veterinarians in public health.
• Briefly discuss the importance of veterinary parasitology.
• Describe the important types of symbiotic relationships.
• Become fluent in the language of veterinary parasitology.
• Utilize the Linnaean classification scheme within the discipline of veterinary parasitology.
• Define and describe terms associated with veterinary parasitology and give examples of parasites that exemplify these terms.

Veterinary medicine continues to be one of the most rapidly evolving health care professions of the twenty-first century. Veterinarians are responsible for many aspects of human health promotion and disease prevention, especially in the areas of food safety, environmental health, prevention and control of zoonotic diseases, and the human-animal bond. To accomplish these important missions, successful veterinarians, along with their professional associates, must learn to communicate effectively with a variety of individuals, ranging from health care professionals in other disciplines, to print and electronic journalists, to the day-to-day clients who walk off the street into the veterinary practice.

TECHNICIAN’S NOTE Veterinarians and technicians are responsible for many aspects of human health promotion and disease prevention.
SYMBIOSIS

Planet Earth is home to millions of species of diverse, living organisms that include plants, animals, fungi, algae, and unicellular organisms. Inevitably, there are millions of complex relationships taking place between and among these differing species. Many organisms live together in varied, intricate relationships. The term symbiosis (sym meaning “together” and biosis meaning “living,” thus “living together”) describes any association, either temporary or permanent, between at least two living organisms of different species. Each member of this association is called a symbiont. For example, lichen growing on the side of a tree (Figure 1-1) is actually a very complex symbiotic relationship between a fungus and an alga. Even the act of a human owning a dog and living with that dog is a type of symbiotic relationship. Two different living species cohabitate; the human “owner” and the “pet” dog are members of a very ancient symbiotic relationship.

There are five types of symbiotic relationships: predator-prey, phoresis, mutualism, commensalism, and parasitism. In a predator-prey relationship, there is an extremely short-term relationship in which one symbiont benefits at the expense of the other. For example, the lion (the predator) will kill the zebra (the prey). The prey pays with its life and serves as a food source for the predator.

In phoresis (phore meaning “to carry”), the smaller member of the symbiotic relationship is mechanically carried about by the larger member. The bacterium Moraxella bovis, the etiologic agent of infectious bovine keratoconjunctivitis, or “pinkeye” of cattle, is mechanically carried...
from the eyes of one cow to those of another on
the sticky foot pads of the face fly, *Musca autum-
nalis* (Figure 1-2).

The term **mutualism** describes an association
in which both organisms in the symbiotic rela-
tionship benefit. For example, within the liquid
rumen environment of a cow are millions of
microscopic, swimming, unicellular, ciliated pro-
tozoans. The cow provides these tiny creatures
with a warm, liquid environment in which to live.
In return, the rumen ciliates break down cellulose
for the cow and aid in its digestion processes.

**TECHNICIAN’S NOTE** In mutualistic
symbiosis, both organisms benefit from the
relationship.

The term **commensalism** describes an asso-
ciation in which one symbiont benefits and the
other is neither benefited nor harmed. An exam-
ple is the relationship between the shark and the
remora, its “hitchhiker.” The remora attaches
to the underside of the shark and hitches a ride.
The remora also eats the food scraps, or leftovers,
after the shark’s meal. The remora benefits from
this relationship, whereas the shark is neither
benefited nor harmed.

In **parasitism**, an association exists between
two organisms of different species, in which one
member (the **parasite**) lives on or within the
other member (the **host**), and may cause harm.
The parasite becomes metabolically dependent
on the host.

This course discusses the host-parasite rela-
tionships between domesticated and wild anim-
als and their parasites. **Parasitology** is the study
of such parasitic relationships.

**PARASITISM**

Parasitism can occur in differing degrees. In
**parasitiasis** the parasite is present on or within
the host and is potentially pathogenic (harmful); however, the animal does not exhibit outward clinical signs of disease. For example, healthy cattle
on pasture may harbor bovine trichostrongyles
(roundworms) in their gastrointestinal tracts, but
the cattle do not exhibit outward clinical signs of
parasitism (Figure 1-3). Parasitiasis describes
this type of parasitic relationship.

In **parasitosis**, the parasite is present on or
within the host and does produce obvious injury
or harm to the host animal. The host exhibits
obvious outward signs of clinical parasitism (Fig-
ure 1-4). For example, an emaciated cow on
pasture certainly harbors bovine trichostrongyles
(roundworms) in its gastrointestinal tract. Para-
sitosis describes this type of parasitic relationship.

**FIGURE 1-2**: Moraxella bovis, etiologic agent of infectious bovine keratoconjunctivitis (“pinkeye”), is mechanically carried from eyes of one cow to those of another on sticky foot pads of the face fly *Musca autumnalis*.

**FIGURE 1-3**: Healthy cattle on pasture may harbor bovine trichostrongyles (roundworms) in their gastrointestinal tracts but not exhibit outward clinical signs of parasitism. This condition is known as **parasitiasis**.
In any parasitic relationship, the parasite may live on or within the body of the host. If the parasite lives on the body of the host, it is called an ectoparasite. Cat fleas (Ctenocephalides felis) on a dog are ectoparasites (Figure 1-5). If the parasite lives within the body of the host, it is called an endoparasite. The dog heartworm (Dirofilaria immitis) is an endoparasite (Figure 1-6). Ectoparasitism is parasitism by an external parasite. Endoparasitism is parasitism by an internal parasite. Similarly, an ectoparasite will produce an infestation on the host, and an endoparasite will produce an infection within that host.

Both endoparasitism and ectoparasitism in domestic animals can be treated by administering parasiticides, chemical compounds (both simple and complex) used to treat specific internal and external parasites. The different types of parasiticides include anthelmintics (or anthelmintics, compounds developed to kill roundworms, tapeworms, flukes, and thorny-headed worms), acaricides (compounds developed to kill mites and ticks), insecticides (compounds developed to kill insects), and antiprotozoals (compounds developed to kill protozoan organisms).
Sometimes a parasite will wander from its usual site of infection into an organ or location in which it does not ordinarily live. When this happens, the parasite is called an **erratic parasite**, or **aberrant parasite**. For example, *Cuterebra* species, called “warbles” or “wolves,” found in the skin of dogs or cats may accidentally “wander” or migrate into the cranial vault. When this happens, *Cuterebra* becomes an erratic (aberrant) parasite (Figure 1-7).

A parasite can occur in a host in which it does not usually live. When this occurs, the parasite is called an **incidental parasite**. For example, humans can become infected with larval stages of *Dirofilaria immitis*, the canine heartworm (Figure 1-8). Because humans are not the usual host for the heartworm, the canine heartworm is an incidental parasite in humans.

Organisms that are “free-living” (nonparasitic) can become parasitic in certain hosts. These organisms are called **facultative parasites**. An example is *Helodera strongyloides*, a free-living soil nematode (roundworm). This free-living roundworm usually lives in the superficial layers of the soil as a “non-parasite.” However, this roundworm is capable of penetrating the skin of many domesticated animals, particularly dogs lying in moist dirt and “downer cattle,” and establishing a parasitic skin infection. *P. strongyloides* is therefore a facultative parasite.

An **obligatory parasite**, however, is a parasite that must lead a parasitic existence. These are not capable of leading a free-living existence. *D. immitis*, the canine heartworm, is an obligatory parasite; most of the parasites that affect domesticated and wild animals are obligatory parasites.

**FIGURE 1-7:** A, *Cuterebra* species (“warbles,” “wolves”) in the skin of dogs or cats may migrate into cranial vault; *Cuterebra* is then an erratic (aberrant) parasite. This parasite has become “lost” on its migration path. **B,** Enlargement of parasite in cranial vault.

**FIGURE 1-8:** Humans can become infected with larval stages of *Dirofilaria immitis*, the canine heartworm. Humans are not the usual host for heartworm, so canine heartworm is an incidental parasite in humans. (Courtesy Ronald E. Bowers, MD.)
A parasite does not necessarily have to live on or within a host. It can make frequent short visits to its host to obtain nourishment or other benefits. Such a parasite is called a **periodic parasite**. The best example of a periodic parasite is the female mosquito, which sucks blood from the vertebrate host; the host's blood is required for her egg development. Without a blood meal, the female mosquito will not have sufficient protein to lay her eggs.

Living creatures or objects that are not parasitic may be mistaken for or erroneously identified as parasites. These are referred to as **pseudoparasites**. Sometimes, fecal flotation procedures will reveal pollen grains from trees, such as pine pollen (Figure 1-9), or from flowering plants. A novice veterinary student or veterinary technician may view these pollen grains on fecal flotation and erroneously identify them as parasites; they are pseudoparasites.

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**TECHNICIAN’S NOTE**  
Some parasites can have obligatory stages in their development where they need a host and some life stages can be nonparasitic. In addition, with some parasites, only the female adult is parasitic while the free-living males and females are nonparasitic.

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**LIFE CYCLE**

Each parasite has its own **life cycle** (Figure 1-10). The life cycle is the development of a parasite through its various life stages. Every parasite has at least one definitive host and may have one or more intermediate hosts. The **definitive host** is the host that harbors the adult, sexual, or mature stages of the parasite. For example, the dog is the definitive host for *D. immitis*; mature male and female heartworms (the sexual stages of the parasite) are found in the right ventricle and pulmonary arteries of the dog’s heart (see Figure 1-6). The **intermediate host** is the host that harbors the larval, juvenile, immature, or asexual stages of the parasite. The female mosquito is the intermediate host for *D. immitis*; larval or immature heartworms (the developing stages of the parasite) are found in the Malpighian tubules and proboscis of the mosquito (Figures 1-11 and 1-12). The intermediate host transfers the parasite from one definitive host to another. A parasite may have more than one intermediate host. In the life cycle of *Platynosomum concinum*, the lizard-poisoning fluke of cats, a land snail is the first intermediate host and a lizard is the second intermediate host for the parasite. This liver fluke requires two intermediate hosts to infect the cat.

In a special type of intermediate host, a parasite does not undergo any development, but instead remains arrested, or **encysted** (“in suspended animation”) within the host’s tissues. This host is called the **transport host**, or **paratenic host**. The larvae remain in this suspended state until the definitive host eats the transport host. Once within the definitive host, the larvae “wake up,” establish an infection, migrate to their predilection site, and grow to adult parasites within the definitive host.
A reservoir host is a vertebrate host in which a parasite or disease occurs in nature and is a source of infection for humans and domesticated animals. Heartworms may develop in the right ventricle and pulmonary artery of wild wolves and coyotes. Wolves and coyotes may be reservoir hosts for heartworm; the infection may be spread from the wolf or coyote to the family pet by the mosquito intermediate host.

A homoxenous or monoxenous parasite is a parasite that will infect only one type of host. For example, *Eimeria tenella*, a coccidian, will only infect chickens. Similarly, a stenoxenous parasite is a parasite with a narrow host range. Because *E. tenella* will only infect chickens, it is...
A zoonosis is any disease or parasite that is transmissible from animals to humans. Examples of parasites that are zoonotic are *T. gondii*, *Trichinella spiralis*, *Ancylostoma caninum*, and *Toxocara canis*. Zoonotic parasites are discussed in later courses.

**THE LINNAEAN CLASSIFICATION SCHEME**

In beginning biology, students must learn the classification scheme perfected by Linnaeus, an early Swedish biologist. Every organism can be classified using the following classification scheme: kingdom, phylum, class, order, family, genus, and species (Figure 1-14). Students often remember this classification scheme with the simple mnemonic device, “King Philip came over for good spaghetti,” in which the first letter of each word in the sentence corresponds to the first letter in the Linnaean classification scheme.

The Linnaean classification scheme works in the following manner. Several million species of animals, plants, fungi, protozoa, and algae live on the earth. These creatures may have different common names in different regions of the world. A common name may refer to different organisms in different places. The solution to this problem was to give each organism a scientific name composed of two Latin words, which is commonly written in italics. The first word is capitalized and is the genus name. The genus indicates the group to which a particular type of animal or plant belongs. The second word is not capitalized; it is the specific epithet and indicates the type of animal itself. Examples of common names of animals and their corresponding scientific names are the dog, *Canis familiaris*; the cat, *Felis catus*; the housefly, *Musca domestica*; and a bacterium normally found in the gut, *Escherichia coli*. Similar species are grouped together into the same genus. Similar genera (plural form of genus) are grouped together in the same family. Similar families are grouped together in the same order. Similar orders are grouped together in the same class. Similar classes are grouped together in the same phylum. Similar phyla are grouped
together in the same kingdom. Therefore the classification scheme for the dog is as follows:

- **Kingdom:** Animalia
- **Phylum:** Chordata
- **Subphylum:** Vertebrata
- **Class:** Mammalia
- **Order:** Carnivora
- **Family:** Canidae
- **Genus:** Canis
- **Species:** familiaris

Every living creature has its own unique classification scheme. This text discusses many parasites that affect domesticated animals. It is important to learn the scientific names, the common names, the hosts, and the key identifying features for all these parasites.

The classification scheme contains the following five kingdoms: **Planta** (plants), **Animalia** (animals), **Protista** (unicellular organisms), **Monera** (algae), and **Fungi** (fungi). Veterinary parasitology is concerned with only two of these kingdoms as true parasites of domesticated animals. The first is the kingdom **Animalia**, which contains platyhelminths (flatworms—trematodes [flukes] and cestodes [tapeworms]), nematodes (roundworms), acanthocephalans (thorny-headed worms), annelids (leeches), and arthropods (insects, mites, ticks, spiders, pentastomes, and other creatures with jointed appendages). The second is the kingdom **Protista**, which contains protozoans (unicellular organisms). The following course presents parasites from each of these groups and relate their significance in veterinary parasitology.

Any student of veterinary parasitology must use the terms presented in this course and their definitions as the “framework” on which to build a greater proficiency in this discipline. As with the veterinarians with whom they work, veterinary technicians must be encouraged to embrace the continual improvement of professional knowledge and competence.