CONTENTS

INTERNAL PARASITES

4–5 ............Heartworms, Canine
6–7 ............Heartworms, Feline
8–9 ............Hookworms
10–11 ............Whipworms
12–13 ............Roundworms
14–15 ............Dipylidium Tapeworms
16–17 ............Taenia Tapeworms
18 ............Giardia

EXTERNAL PARASITES

19

20–21 ............Fleas
22 ............American Dog Ticks
23 ............Brown Dog Ticks
24 ............Deer Ticks
25 ............Common Ticks Compared
26 ............Ear Mites
27 ............Demodex Mites
28 ............Cheyletiella Mites
29 ............Sarcoptes Mites

INTERNAL ORGANS (Canine & Feline)

30–31

UNDER THE MICROSCOPE

33

34–45 ............Photographic aids to identifying common parasites and pseudoparasites as seen in blood, feces, and urine

The hosts for each parasite are identified at the top of each page by the following icons representing dog, cat, and/or human hosts.
INTERNAL PARASITES

4–5 Heartworms, Canine
6–7 Heartworms, Feline
8–9 Hookworms
10–11 Whipworms
12–13 Roundworms
14–15 Dipylidium Tapeworms
16–17 Taenia Tapeworms
18 Giardia
HEARTWORMS—CANINE
Dirofilaria immitis

Length of Life Cycle = Approximately 6 Months

Fertilized adult female heartworms release microfilariae into the blood.

Larvae develop in tissues and migrate to the heart where they mature to adult worms.

Adult heartworms live in the right ventricle and pulmonary artery.

A mosquito becomes a heartworm intermediate host by ingesting microfilariae while biting an infected host.

A mosquito deposits heartworm larvae via saliva puddle into bloodstream.

Amosquito deposits heartworm larvae via saliva puddle into bloodstream.**

Normal dog heart

Dog heart infected with adult heartworms

Although rare, humans may develop pulmonary lesions if infected with D. immitis.

** Adult worm is sometimes found at ectopic sites, eg, eye, skin, or body cavity.
HEARTWORMS—FELINE
Dirofilaria immitis

Length of Life Cycle = Approximately 8 Months

FELINE HEARTWORM*

A mosquito becomes a heartworm intermediate host by ingesting microfilariae while biting an infected host.

Fertilized adult female heartworms release microfilariae into the blood. Microfilariae are difficult to detect because they are few in number and are present in blood for a short time.

Larvae develop in tissues and migrate to the heart where they mature to adult worms—however, many of the larvae do not reach maturity in cats.

Larvae then migrate to the lungs and are deposited in the alveolar walls and are ingested by the cat, completing the life cycle.

FELINE HEARTWORM INFECTION

A mosquito deposits heartworm larvae via saliva puddle into bloodstream.

Normal cat heart and lungs

Cat heart and lungs infected with adult heartworms

Although rare, humans may develop pulmonary lesions if infected with D. immitis.**

** Adult worm is sometimes found at ectopic sites, e.g., peripheral arteries, body cavity, or central nervous system.
Hookworms

Ancylostoma caninum, Ancylostoma braziliense, and Ancylostoma tubaeforme

Following ingestion of infective larvae in the mother’s milk, puppies begin passing eggs in the feces in as little as 2 weeks.

Young animals may be infected during nursing via milk, by ingestion of infective larvae in the soil, or by skin penetration.

Eggs hatch and larvae develop to infective stage.

Infective larvae are ingested or penetrate the skin and may migrate extensively.

Larvae mature to adult hookworms that reside in the small intestine, where they can cause significant blood loss.

Following ingestion of infective larvae in the mother’s milk, puppy begins passing eggs in the feces in as little as 2 weeks.

Length of Life Cycle = 3 to 4 Weeks

*The life cycles for A. tubaeforme and A. braziliense are similar to that shown for A. caninum; A. tubaeforme is generally found only in cats, A. caninum and A. braziliense are found in both dogs and cats, larvae of A. braziliense and A. caninum may cause human cutaneous larva migrans and rarely, eosinophilic enteritis.
Infective eggs hatch to larvae and mature to adult worms in 74 to 87 days in the cecum.

Mature worms pass eggs in the feces.

Infective larvae develop in 2 to 4 weeks within the egg.

The dog ingests infective eggs found in soil.

Normal cecum and the ileocecal junction of the small and large intestine

Infected cecum with numerous whipworms embedded in the mucosa

Length of Life Cycle = 3 Months
ROUNDWORMS
Toxocara canis*, Toxocara cati*, and Toxascaris leonina*

Adult roundworms live in the small intestine.

Roundworms may be transmitted to young animals in utero or via milk (except T. leonina).

Eggs are passed in the feces.

Infective eggs develop in the environment: approximately 1 week for Toxascaris sp. and 4 weeks for Toxocara sp.

The transport hosts ingest infective eggs; larvae encyst in tissues.

The hosts ingest the infective eggs or the transport host. Larvae of T. canis or T. cati may migrate extensively within the host's

Length of Life Cycle = T. canis, approximately 4 to 5 weeks; T. cati and T. leonina, 55 days

* Larvae of both T. canis and T. cati may infect many organ systems in humans (visceral larva migrans); Toxascaris leonina is of no zoonotic significance.
DIPYLIDUM TAPEWORMS

Dipylidium caninum

Length of Life Cycle = Approximately 3 Weeks

Dipylidium caninum egg packets contain individual eggs.

Tapeworm larvae within the flea will develop to adult tapeworms in the small intestine.

Eggs are ingested by flea larvae.

Tapeworm segments containing egg packets are passed in the feces. Occasionally, egg packets are present in feces.

Fleas are ingested as the pet grooms.

Tapeworm eggs develop to infective larvae within the developing flea.

Normal small intestine

Small intestine infected with tapeworms

Pfz Parasite Atlas FNL.qxd  5/28/04  11:34 AM  Page 14
Tapeworm segments containing infective eggs are passed in the feces. Occasionally, eggs are present in feces.

The host becomes infected by eating the intermediate host.

Normal small intestine

Eggs are released from the segments into the environment.

Small intestine infected with tapeworms

An intermediate host ingests the eggs.

The eggs develop to larvae in the tissues of the intermediate host.

Tapeworm segments containing infective eggs are passed in the feces. Occasionally, eggs are present in feces.

The host becomes infected by eating the intermediate host.

Normal small intestine

Eggs are released from the segments into the environment.
GIARDIA

Giardia spp.

**GIARDIA**

Trophozoites attach to the mucosa of the small intestine and may cause diarrhea.

Trophozoites usually form cysts that are intermittently passed in the feces.

GIARDIA

Length of Life Cycle = 1 Week

**EXTERNAL PARASITES**

20–21 Fleas
22 American Dog Ticks
23 Brown Dog Ticks
24 Deer Ticks
25 Common Ticks Compared
26 Ear Mites
27 Demodex Mites
28 Cheyletiella Mites
29 Sarcoptes Mites

Infective cysts are present in the environment.

The host ingests cysts from the environment, usually from contaminated food or water.

GIARDIA

Trophozoites emerge from the ingested cyst.

Pfz Parasite Atlas FNL.qxd 5/28/04 11:35 AM Page 18
FLEAS
Ctenocephalides felis

EXTERNAL PARASITES

FLEAS

FLEA

Adult flea remains on the dog or cat host, feeding and producing eggs.

Eggs fall off of the host animal and hatch within 2 to 5 days to larvae.

Larvae feed on adult flea feces which fall off the host and organic debris present in the environment.

Larvae develop into pupae inside a debris-coated, silk-like fiber cocoon (cross section).

For each flea on the host, there are hundreds of eggs, larvae, and newly emerged adults, concentrated in the environment (carpet, bedding, soil, decaying vegetation, etc.).

Length of Life Cycle = 2 Weeks to Many Months

FLEA ALLERGY DERMATITIS

Stage 1
Normal skin

Stage 2
When a flea bites, it injects a small amount of saliva into the skin, causing an inflammatory reaction.

Stage 3
In animals that are allergic to the flea saliva, the reaction is more pronounced, causing intense itching. Scratching may cause increased inflammation and hair loss.

Stage 4
Bacterial infection is a common sequela to skin trauma caused by scratching.

FLEA

Adult fleas emerge from the cocoon in search of a blood meal.

Pfz Parasite Atlas FNL.qxd  5/28/04  11:35 AM  Page 20
AMERICAN DOG TICKS
Dermacentor variabilis

LENGTH OF LIFE CYCLE = 1 TO 2 YEARS

Larvae feed and develop to nymphs.
Nymphs feed and develop to adults.
Adult ticks attach to and feed on dogs and wildlife such as raccoons.
Engorged female ticks fall off the host and lay several thousand eggs.
Eggs hatch to larvae.

BROWN DOG TICKS
Rhipicephalus sanguineus

LENGTH OF LIFE CYCLE = 3 MONTHS TO 1 YEAR

Larvae feed and develop to nymphs.
Nymphs feed and develop to adults.
Adult ticks attach to and feed on dogs.
Engorged female ticks fall off the host and lay several thousand eggs.
Eggs hatch to larvae.

Engorged female feeding

Both larvae and nymphs feed on small mammals.
Engorged female ticks fall off the host and lay several thousand eggs.
Engorged female feeding

AMERICAN DOG TICK

BROWN DOG TICK

Nymphs feed and develop to adults.
Larvae and nymphs feed on dogs and other small mammals.
Larvae feed and develop to nymphs.
Larvae feed, and develop to nymphs.
Eggs hatch to larvae.
DEER TICKS
Ixodes scapularis (Syn. dammini)

Length of Life Cycle = 1 to 2 Years

Engorged female ticks fall off the host and lay several thousand eggs.

Larvae feed on mice, the reservoir for Lyme disease organisms.

Nymphs feed on mice, wildlife, dogs, cats, and humans, and develop to adults.

Larvae feed and develop to nymphs.

Engorged female feeding.

Adult ticks attach to and feed on dogs, white-tailed deer, and other animals.

Larvae

Nymph

Adult

Engorged adult

American Dog Tick*

Engorged adult

Brown Dog Tick*

Engorged adult

Deer Tick*

-engorged adult

* These ticks are found frequently on cats and humans, but they do occur.

EXTERNAL PARASITES

DEER TICKS

FLEAS

mites

TICKS

COMMON TICKS COMPARED

Length of Life Cycle = 1 to 2 Years
**DEMODEX MITES**

**Demodex canis**

**EXTERNAL PARASITES**

**FLEAS**

**MITES**

**EAR MITES**

*Otodectes cynotis*

---

**Length of Life Cycle = 3 to 4 Weeks**

**DEMODEX MITE**

Demodex mites live and reproduce in the hair follicles and sebaceous glands. Increased numbers of mites are seen in animals with a genetic predisposition or disorders of the immune system.

Normal canine skin. Dogs normally have low numbers of mites.

The entire life cycle of the Demodex mite occurs on the host. Mites are acquired by puppies through intimate contact with their infested mother.

---

**Length of Life Cycle = 20 to 35 Days**

**EAR MITE**

Cat displays effects of ear mite infestation in the ear canal—redness, swelling, and inflammation of canal structures.

Cat displays effects of ear mite infestation in the ear canal—redness, swelling, and inflammation of canal structures.

Normal feline ear anatomy

Ear mites may be found on body sites other than the ear canal. Animals become infested by passive contact with infested animals.

---

**Length of Life Cycle = 3 to 4 Weeks**

**EAR MITE**

*Otodectes cynotis* mite

Cat displays effects of ear mite infestation in the ear canal—redness, swelling, and inflammation of canal structures.

Normal feline ear anatomy

Ear mites may be found on body sites other than the ear canal. Animals become infested by passive contact with infested animals.
**SARCOPTES MITES**
Sarcoptes scabiei

- Adult Sarcoptes mite
- Sarcoptes mites tunnel in the skin causing intense itching.
- Sarcoptes lesions often start on the elbows and ear margins. The disease is highly contagious to other dogs, cats, or humans.
- * Sarcoptes may produce severe transient pruritis in humans but disease is usually self-limiting.

**CHEYLETIELLA MITES**
Cheyletiella yasguri, Cheyletiella blakei, and Cheyletiella parasitivorax

- Adult Cheyletiella mite
- Cheyletiella mites live on the surface of the skin where they feed and reproduce. The mites are contagious to other animals and can survive in the environment.
- Cheyletiella mite infestation produces hair loss, dull coat, and dandruff.
- Cheyletiella may cause papular eruptions in humans. They do not reproduce on humans.

- Normal canine skin

**Length of Life Cycle**
- **SARCOPTES MITES**
  - 17 to 21 Days
- **CHEYLETIELLA MITES**
  - 3 to 5 Weeks
### UNDER THE MICRO-

<table>
<thead>
<tr>
<th>Parasites Found in Blood</th>
<th>34</th>
<th>Dirofilaria immitis</th>
</tr>
</thead>
</table>
| **Parasites Found in Feces** | 35 | Alaria canis  
Aleurostrongylus abstrusus |
| 36 | Ancylostoma spp. |
| 37 | Eucoleus (Capillaria) aerophila  
Eucoleus (Capillaria) boehmi  
Dipylidium caninum |
| 38 | Giardia spp. |
| 39 | Isospora canis  
Isospora ohioensis  
Isospora felis  
Isospora rivolta  
Neospora caninum  
Paragonimus kellicotti |
| 40 | Physaloptera spp.  
Sarcocystis spp.  
Spirometra mansonioides |
| 41 | Strongyloides stercoralis  
Taenia spp. |
| 42 | Toxascaris leonina  
Toxocara canis  
Toxocara cati |
| 43 | Toxoplasma gondii  
Trichuris vulpis |
| **Parasites Found in Urine** | 44 | Pearsonema (Capillaria) feliscati  
Pearsonema (Capillaria) plica |
| **Pseudoparasites** | 45 | Pseudoparasites |

The egg of *Toxocara canis* is placed beside each parasite for scale.
**Parasites Found in Blood**

**Dirofilaria immitis**
- Adult male heartworm with corkscrew-like tail is in center; adult female is on outside.
- Single microfilaria of *D. immitis* (Difil® Filter Test)
- Anterior ends of microfilaria of *Dipetalonema reconditum* (left) and *D. immitis* (Modified Knott Test)

**Alaria canis**
- Egg of *Alaria canis*

**Aleurostrongylus abstrusus**
- Close-up of tail of *A. abstrusus*
- First-stage larva of *Aleurostrongylus abstrusus*

**Parasites Found in Feces**

**Aleurostrongylus abstrusus**
- First-stage larva of *Aleurostrongylus abstrusus*

The egg of *Toxocara canis* is placed beside each parasite for scale.
**PARASITES FOUND IN FECES UNDER THE MICROSCOPE**

- *Ancylostoma spp.*
  - The egg of *Ancylostoma caninum*
  - The egg of *Ancylostoma braziliense*
  - Eggs of *A. caninum* and *T. vulpis*

- *Eucoleus (Capillaria) aerophila*
  - Egg of *Eucoleus (Capillaria) aerophila* (respiratory tract)

- *Eucoleus (Capillaria) boehmi*
  - Egg of *Eucoleus (Capillaria) boehmi* (nasopharynx)
  - Surface of egg of *Eucoleus (Capillaria) boehmi*

- *Dipylidium caninum*
  - Dipylidium caninum egg packet containing numerous eggs

- *Toxocara canis*
  - The egg of *Toxocara canis* is placed beside each parasite for scale.

**PARASITES FOUND IN FECES UNDER THE MICROSCOPE**

- *Ancylostoma spp.*
  - The egg of *Ancylostoma caninum*
  - The egg of *Ancylostoma braziliense*
  - Eggs of *A. caninum* and *T. vulpis*

- *Eucoleus (Capillaria) aerophila*
  - Egg of *Eucoleus (Capillaria) aerophila* (respiratory tract)

- *Eucoleus (Capillaria) boehmi*
  - Egg of *Eucoleus (Capillaria) boehmi* (nasopharynx)
  - Surface of egg of *Eucoleus (Capillaria) boehmi*

- *Dipylidium caninum*
  - Dipylidium caninum egg packet containing numerous eggs

- *Toxocara canis*
  - The egg of *Toxocara canis* is placed beside each parasite for scale.
PARASITES FOUND IN FECES UNDER THE MICROSCOPE

**Giardia spp.**
- Cysts of Giardia spp. (zinc sulfate flotation, iodine stain)
- Close-up of cysts of Giardia spp. (zinc sulfate flotation, iodine stain)
- Cyst of Giardia spp. (Sheather’s sucrose flotation)
- Stained trophozoite of Giardia spp. (fecal smear)

**Isospora canis**
- Oocysts of *Isospora canis* (left), *I. ohioensis* (top), and egg of *T. canis*

**Isospora felis**
- Oocysts of *Isospora felis*

**Isospora felis, Isospora rivolta**
- Oocysts of *Isospora felis* (larger) and *Isospora rivolta* (smaller)

**Neospora caninum**
- Oocysts of *Neospora caninum* (arrows)

**Paragonimus kellicotti**
- Egg of the lung fluke *Paragonimus kellicotti*

The egg of *Toxocara canis* is placed beside each parasite for scale.
PARASITES FOUND IN FECES UNDER THE MICROSCOPE

Physaloptera spp.
- Egg of Physaloptera spp.

Sarcocystis spp.
- Sporocytes of Sarcocystis spp.

Spirometra mansoniodes
- Egg of the tapeworm Spirometra mansoniodes

Strongyloides stercoralis
- First-stage larvae of Strongyloides stercoralis
- Anterior end of Strongyloides stercoralis

Taenia spp.
- Egg of Taenia spp. Eggs of Echinococcus spp. are similar, and thus are not easily differentiated from those of Taenia spp.
- Ruptured egg of Taenia spp. Note the exposed hexacanth embryo.

The egg of Toxocara canis is placed beside each parasite for scale.
Parasites Found in Feces under the Microscope

- **Toxoplasma gondii**
- **Toxascaris leonina**
- **Toxocara canis**
- **Toxocara cati**
- **Trichuris vulpis**

**Surface of egg of Toxocara cati**

The egg of *Toxocara canis* is placed beside each parasite for scale.

**Eggs of Toxocara canis, Toxascaris leonina, and Ancylostoma caninum**

The egg of *Toxocara canis* is placed beside each parasite for scale.
PSEUDOPARASITES UNDER THE MICROSCOPE

Soil fungus — Common fecal pseudoparasite
Hair, air bubble, and flea egg — fecal pseudoparasites
Mite egg — fecal pseudoparasite
Grain mite and air bubble — fecal pseudoparasites
Yeast — fecal pseudoparasite
Plant hair — fecal pseudoparasite

PARASITES FOUND IN URINE

Pearsonema (Capillaria) feliscati
Egg of Pearsonema (Capillaria) feliscati
Surface of egg of Pearsonema (Capillaria) feliscati

The egg of Toxocara canis is placed beside each parasite for scale.