INTERNAL PARASITES

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

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

INTERNAL ORGANS (Canine & Feline)

30-31

UNDER THE MICROSCOPE

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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*
WHIPWORMS
Trichuris vulpis

Length of Life Cycle = 3 Months

WHIPWORM

Infective eggs hatch to larvae and mature to adult worms in 74 to 87 days in the cecum.

The dog ingests infective eggs found in soil.

Mature worms pass eggs in the feces.

Infected larvae develop in 2 to 4 weeks within the egg.
WHIPWORMS

Trichuris vulpis

WHIPWORM INFECTION

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

Infected cecum with numerous whipworms embedded in the mucosa
ROUNDWORMS
Toxocara canis*, Toxocara cati*, and Toxascaris leonina*

Length of Life Cycle = T. canis, approximately 4 to 5 Weeks; T. cati and T. leonina, ≈55 Days

ROUNDWORMS

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.

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

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

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

* 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.
ROUNDWORMS
Toxocara canis, Toxocara cati, and Toxascaris leonina

ROUNDWORM INFECTION

Normal small intestine

Small intestine infected with roundworms
DIPYLDIUM TAPEWORMS
Dipylidium caninum

Length of Life Cycle = Approximately 3 Weeks

DIPYLDIUM TAPEWORM

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

Fleas are ingested as the pet grooms.

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

Tapeworm eggs develop to infective larvae within the developing flea.

Eggs are ingested by flea larvae.

Dipylidium caninum egg packets contain individual eggs.
DIPYLIDIIUM TAPEWORMS
Dipylidium caninum

DIPYLIDIIUM TAPEWORM INFECTION

Normal small intestine

Small intestine infected with tapeworms
**TAENIA TAPEWORMS**

*Taenia spp.*

**Length of Life Cycle = 7 to 8 Weeks**

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**Internal Parasites**

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**Taenia Tapeworm**

- Adult tapeworms develop in the small intestine.
- The host becomes infected by eating the intermediate host.
- The eggs develop to larvae in the tissues of the intermediate host.
- An intermediate host ingests the eggs.
- Tapeworm segments containing infective eggs are passed in the feces. Occasionally, eggs are present in feces.
- Eggs are released from the segments into the environment.
TAENIA TAPEWORMS
Taenia spp.

TAENIA TAPEWORM INFECTION

Normal small intestine

Small intestine infected with tapeworms
GIARDIA

Giardia spp.

Length of Life Cycle = 1 Week

GIARDIA

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

Trophozoites emerge from the ingested cyst.

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

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

Infective cysts are present in the environment.
EXTERNAL PARASITES

20–21 Fleas
22 American Dog Ticks
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25 Common Ticks Compared
26 Ear Mites
27 Demodex Mites
28 Cheyletiella Mites
29 Sarcopes Mites
**FLEAS**
*Ctenocephalides felis*

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

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

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).

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

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.).
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.
AMERICAN DOG TICKS
Dermacentor variabilis

Length of Life Cycle = 1 to 2 Years

AMERICAN DOG TICK

Engorged female feeding

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

Adult ticks attach to and feed on dogs and wildlife such as raccoons.

Both larvae and nymphs feed on small mammals.

Nymphs feed and develop to adults.

Eggs hatch to larvae.

Larvae feed, and develop to nymphs.
BROWN DOG TICKS
Rhipicephalus sanguineus

Length of Life Cycle = 3 Months to 1 Year

BROWN DOG TICK

Engorged female feeding.

Adult ticks attach to and feed on dogs.

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

Nymphs feed and develop to adults.

Larvae and nymphs feed on dogs and other small mammals.

Eggs hatch to larvae.

Larvae feed and develop to nymphs.

EXTERNAL PARASITES

FLEAS

TICKS

mites

23
DEER TICKS
Ixodes scapularis (Syn. dammini)

Length of Life Cycle = 1 to 2 Years

DEER TICK

Engorged female feeding

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

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

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

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

 Eggs hatch to larvae.

Larvae feed and develop to nymphs.
COMMON TICKS COMPARED

AMERICAN DOG TICK*
- Adult
- Nymph
- Larva
- Engorged adult

BROWN DOG TICK*
- Adult
- Nymph
- Larva
- Engorged adult

DEER TICK*
- Adult
- Nymph
- Larva
- Engorged adult

* These ticks are found infrequently on cats and humans, but they do occur.
**EAR MITES**
*Otodectes cynotis*

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

**Ear Mite**
- Adult *Otodectes cynotis* mite
- Cat displays effects of ear mite infestation in the ear canal—{inflammation, redness, and swelling 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.
DEMODEX MITES
Demodex canis

Length of Life Cycle = 20 to 35 Days

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.

Adult Demodex mite
All developmental stages occur on the same host.

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

Length of Life Cycle = 3 to 5 Weeks

CHEYLETIELLA MITES*

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 may cause papular eruptions in humans. They do not reproduce on humans.
SARCOPTES MITES
Sarcoptes scabiei

Length of Life Cycle = 17 to 21 Days

SARCOPTES MITE*

- Adult Sarcoptes mite
  All developmental stages occur on the same host.

- Sarcoptes mites tunnel in the skin causing intense itching.

- Normal canine skin

- 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.
UNDER THE MICROSCOPE

Parasites Found in Blood
34 Dirofilaria immitis

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 mansonoides
41 Strongoloides 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

**UNDER THE MICROSCOPE**

*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)

Microfilaria of *D. immitis* (Difil® Filter Test)

Anterior ends of microfilaria of *Dipetalonema reconditum* (left) and *D. immitis* (Modified Knott Test)
PARASITES FOUND IN FECES

**Alaria canis**

Egg of *Alaria canis*

**Aleurostrongylus abstrusus**

Close-up of tail of *A. abstrusus*

First-stage larva of *Aleurostrongylus abstrusus*

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

Ancylostoma spp.

The egg of Ancylostoma caninum

The egg of Uncinaria stenocephala

The egg of A. caninum; oocysts of Isospora canis

The egg of Ancylostoma braziliense

The egg of Ancylostoma tubaeforme

Eggs of A. caninum and T. vulpis

Fecal flotation preparation containing eggs of A. caninum, T. vulpis, U. stenocephala, and Eucoleus (Capillaria) spp.

A. caninum

T. vulpis

U. stenocephala

Eucoleus (Capillaria) boehmi

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

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

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

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

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

Isospora felis
Oocysts of *Isospora felis*

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

Oocysts of *Isospora felis* (smaller), and egg of *Toxocara cati*

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.
Canine Heartworms

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.

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.

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

** Adult worm is sometimes found at ectopic sites, e.g., eye, skin, or body cavity.
PARASITES FOUND IN FECES

**Physaloptera spp.**

Egg of *Physaloptera spp.*

**Sarcocystis spp.**

Sporocytes of *Sarcocystis spp.*

**Spirometra mansonoides**

Egg of the tapeworm *Spirometra mansonoides*

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

**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

**Toxascaris leonina**

Egg of *Toxascaris leonina*

**Toxocara canis**

Eggs of *Toxocara canis*

**Toxocara cati**

Egg of *Toxocara cati*

Surface of egg of *Toxocara cati*

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

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

**Toxoplasma gondii**

Oocysts of *Toxoplasma gondii*

**Trichuris vulpis**

Egg of *Trichuris vulpis*

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

- **Soil fungus**—Common fecal pseudoparasite
- **Hair, air bubble, and flea egg**—Fecal pseudoparasites
- **Tree pollen**—Fecal pseudoparasite
- **Egg of rodent tapeworm**—Appears in feces as result of predation
- **Mite egg**—Fecal pseudoparasite
- **Grain mite and air bubble**—Fecal pseudoparasites
- **Sporocysts of Monocystis or Rhyncocystis (earthworm parasites)**—Appears in feces as result of ingestion
- **Pine pollen**—Fecal pseudoparasite
- **Yeast**—Fecal pseudoparasite

**Plant hair**—Fecal pseudoparasite
HEARTWORMS—CANINE
Dirofilaria immitis

CANINE HEARTWORM INFECTION

Normal dog heart

Dog heart infected with adult heartworms
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.

A mosquito deposits heartworm larvae via saliva puddle into bloodstream.

Fertile 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.

Feline 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*

Length of Life Cycle = 3 to 4 Weeks

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

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

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

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

Eggs hatch and larvae develop to infective stage.

* 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.
HOOKWORMS
Ancylostoma caninum, Ancylostoma braziliense, and Ancylostoma tubaeforme

HOOKWORM INFECTION

Normal small intestine

Small intestine infected with hookworms