

**SEMESTER ONE 2007**  
**INFECTION and IMMUNITY**  
**GRADUATE ENTRY PROGRAMME**  
**PARASITOLOGY PRACTICAL 9 – Dr TW Jones**  
**NEMATODES**

**Objectives**

After this class I expect you to be able to:

1. Describe and recognise the range of morphological features used for the identification of nematodes.
2. Identify with reasons the following nematodes according to host and morphological features :
  - Ruminants
    - *Cooperia*
    - *Haemonchus*
    - *Trichuris*
  - Horses
    - *Oxyuris*
    - *Parascaris*
    - *Strongylus*
  - Dogs and cats
    - *Toxascaris*
    - *Toxocara canis*
    - *Toxocara cati*
  - Pigs
    - *Ascaris*
  - *Trichinella spiralis* – as encysted larvae in a stained section of host muscle

Please **do not** remove the specimens from the flasks. You can see all the necessary details either by eye or using the stereo microscope. Report any leaks or spills from flasks\* **immediately** to the person in charge of the class. Do not attempt to clear up spills.

**\*Health & Safety information:** Chemical hazard – Formaldehyde solution about 2% v/v. Formaldehyde is a carcinogen and toxic by skin contact and swallowing. 2% solution presents a low risk unless ingested in large quantities. Wash off any spills on the skin immediately with cold water

Note: The range of nematodes included in this practical under each host types is not meant to cover all the nematodes that infect that particular host type. The parasites featured here are representative of the major groups of nematodes affecting livestock and companion animals.

**Activities**

**Video presentation**

Watch the video on roundworms of dogs and cats and answer the following questions

1. Which group of nematodes are featured in this video?
  - Ascarids
2. What percentage of stray cats are estimated to be infected with roundworms?

- 86%
3. How many eggs are claimed to be laid by a single female worm in one day?
    - 100,000
  4. How do ingested larvae behave in:
    - Adult dogs? – hypobiotic larvae in the muscles which are reactivated just before birth
    - Puppies? – hepato-tracheal migration with adults in the gut
  5. How can puppies acquire infection with roundworms?
    - Usually Transplacental (endogenous) by reactivated larvae just before birth
    - Unusually via the mother’s milk (transmammary)
    - Ingestion of eggs from the environment
    - Ingestion of paratenic hosts
  6. What is the difference between infection routes for kittens and puppies?
    - Kittens are not infected transplacental – usual route is transmammary
  7. What is the name given to rodents who can act as a source of infection for cats?
    - Paratenic host
  8. Which other helminths of dogs and cats are mentioned in the video?
    - Tapeworms, whipworms, lungworms.....
  9. What control measures are mentioned in the video?
    - Good hygiene
    - Treatment of bitch and puppies at regular intervals
  10. Taking into account the presentation style and language used, who do you think this video is aimed at?
    - Possibly pet owners but a mix of popular e.g. “motions” and specialist e.g. “hypobiosis”
  11. How might you use this video if you were in veterinary practice?
    - Show to owners/clients to raise awareness
    - Staff training eg veterinary nurses and receptionists

**Morphological features of nematodes that you need to be able to recognise and use for the identification of nematodes**

Most of these features can be seen either by eye or at low magnification using the stereo microscope. Some features such as spicules, vesicles, vulval flaps and cervical papillae can only be seen using the higher magnification and better resolution of the compound microscope

1. **Size** – Most nematodes can be seen by eye but some are very large – look at *Ascaris* and *Parascaris* as examples of nematodes that can be identified based on their size and host.
2. **Shape** – Most nematodes are linear but some take on a particular shape which can be used in their identification. Look at the following:
  - a. *Cooperia* – the tightly coiled appearance is diagnostic for this nematode
  - b. *Trichuris* – the long thin “neck” section with a thick “body” gives this a whip-like appearance, commonly referred to as a whipworm.
  - c. *Oxyuris* – the thin pointed posterior end gives this worm a pin shape, commonly referred to as a pinworm
  - d. *Nematodirus* – often found as large loose clumps resembling cotton wool
3. **Features associated with feeding**
  - a. Tissue feeders such as *Strongylus*, *Chabertia* and *Bunostomum* have a buccal capsule around the mouth which appears as a balloon-shaped structure at the anterior end of the body (**but don’t confuse it with a bursa** – see below)
  - b. Some browsing nematodes such as *Ascaris*, *Parascaris*, *Toxocara* and *Toxascaris* have three fleshy lips around the mouth.

#### 4. Features associated with reproduction

- a. *Bursa* - The males of many nematodes have a copulatory bursa at the posterior end of the body which is used to grasp the female during copulation. The bursa consists of an expanded section of cuticle supported by a number of fleshy structures called rays – the layout of these rays BUT **make sure that you can distinguish between a bursa and a buccal capsule** (above). Look at:
  - i. *Haemonchus* and *Strongylus* as examples of bursate nematodes (but remember that it is only present in the male)
  - ii. Look at *Parascaris* as an examples of a non-bursate nematode
- b. *Spicules* – these are usually associated with the bursa and used during copulation – the size, shape and colour of the spicules can be used to identify the nematode but we don't do that in this class. Look at
  - i. *Haemonchus* as an example of a bursate nematode with internal spicules which are extended during copulation
  - ii. *Nematodirus* as an example of a bursate nematode with fixed spicules which are permanently extended and fused into a single structure
- c. *Vulval flap* – an extension of the cuticle which covers the reproductive pore on the female. Look at *Haemonchus* to see an example of a large vulval flap
- d. *Uterus* – the uterus of some nematodes is very distinct when full of eggs. Look at
  - i. The photograph of *Haemonchus* on the surface of the abomasums to see the characteristically double-twisted gut and uterus which gives it the common name of “barber’s-pole.
  - ii. Look at *Nematodirus* in a flask to see the large eggs contained in the uterus

#### 5. Other cuticular extensions

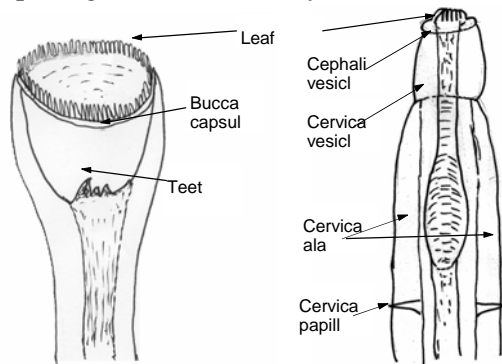
- a. *Alae* are fin-like outgrowths of the cuticle, usually at the anterior end of the nematode – known as *cervical alae*. Look at the following:
    - i. *Toxocara cati* is an example of a nematode with short wide alae which are sometimes described as “arrow-shaped”
    - ii. *Toxascaris* is an example of a nematodes with long narrow alae which are sometimes described as “lanceolate”
    - iii. What kind of alae can you see on *Toxocara canis*?
    - iv. How would you distinguish between the following based on their alae
      1. *Toxocara cati* and *Toxascaris* in the cat
        - Based on the shape of the alae – lance-shaped in *Toxascaris*, arrow-shaped in *Toxocara*
      2. *Toxocara canis* and *Toxascaris* in the dog?
        - Impossible based on the information presented at this class as they both have lance-like alae. They can be differentiated based on the presence of a difficult to find finger-like process on the tip of the *Toxocara* male.
  - b. *Vesicles* – these are thin-walled, fluid-filled balloon-like extensions of the cuticle usually at the anterior end of the body these can be very difficult to see in preserved specimens so they will be shown as a demonstration
  - c. *Cervical papillae* – very small and can be difficult to find as they often relax back to the cuticle during preparation. Look for them on the prepared slides using the compound microscope at the anterior end of *Haemonchus*
6. **Nematodes in tissue sections** – most of the time you will be identifying whole nematodes from the host or passed in the faeces but in the case of *Trichinella* you might need to identify hypobiotic larval stages in muscle. Look at the tissue section from polar bear muscle showing encysted L<sub>1</sub> larvae to find the encapsulated larvae between the muscle fibres of this

preparation – what is the name given to this structure and where would you expect to find the adult nematodes?

**Find that worm**

From the nematodes featured in this class, find examples of nematodes that meet with the following descriptions

1. Nematodes with a buccal capsule and a bursa
  - *Strongylus, Chabertia & Bunostomum* (males)
2. Nematodes with a buccal capsule but without a bursa
  - Female equivalents of the above
3. Nematodes without a buccal capsule but with a bursa
  - *Haemonchus, Cooperia, Nematodirus*.....
4. Nematodes without a buccal capsule or a bursa
  - *Ascaris, Parascaris, Toxocara, Toxascaris*
5. Blood-feeding nematodes
  - *Haemonchus*
6. Zoonotic nematodes
  - *Trichinella, Ascaris, Toxocara canis*
7. Nematodes with ensheathed L<sub>3</sub> as their infective form
  - Most of these – *Haemonchus, Nematodirus, Cooperia, Strongylus*.....
8. Nematodes that retain the larval stage in the egg as their infective form
  - *Ascaris, Parascaris, Toxocara, Toxascaris, Nematodirus*
9. Nematodes that are transmitted transplacentally
  - *Toxocara canis*
10. Nematodes that have hypobiotic stages in the life cycle
  - *Trichinella, Toxocara*
11. Which morphological features that you have seen today could you use as group



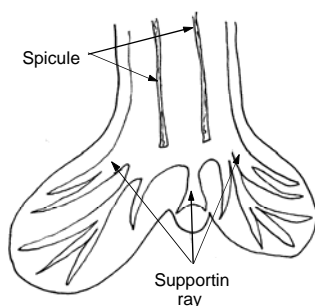
characteristics for the Ascarid nematodes – *Ascaris, Parascaris, Toxocara & Toxascaris*

- Simple mouth surrounded by fleshy lips, large, no buccal capsule or bursa

**Larval**

they  
larvae which appear

inner

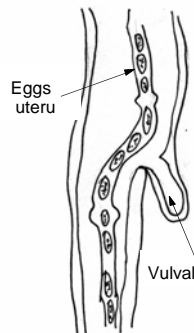


**Mal bursa**

Anterior ornamentation

**stages (Demo)**

Examine this preparation noting how move. Also look for the presence of L<sub>3</sub> to have a “double skin” - the outer layer being cuticle from the L<sub>2</sub> stage and the one the cuticle from the L<sub>3</sub> stage.



**Female flap**

These are the principal morphological features used to identify different nematode species.

You won't find them all on every specimen and some of them might be more difficult to see than others