



Small laboratory animals

Ferrets (*Mustela putorius furo*)

1

PILA elements

- Principles of care and use
- Biology and husbandry of relevant species.
- Common diseases in the relevant species.
- Recognition of wellbeing, pain, suffering and distress in relevant species.
- Health monitoring and disease prevention and control.
- Handling and restraint of relevant species.
- Conduct of minor procedures.
- Introduction to anaesthesia and analgesia.
- Humane methods of killing

2

LO 3.1.1

3

Introduction

- Primitive carnivore belonging to the family Mustelidae, and are related to stoats, weasels, Otters, badgers and minks.
- Curious and playful animals and are useful models for some types of biomedical research such as respiratory diseases and auditory projects.
- They are domesticated from the European Polecat and are not generally found in the wild.
 - Used for controlling snakes, rabbits and rodents.
 - They make popular pets, used for their fur, showing, racing and research

3

LO 3.1.1

4

Research Ferrets

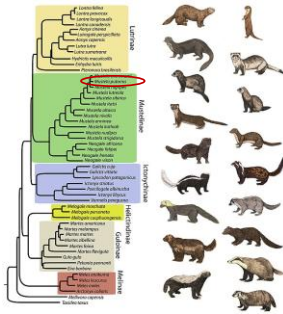
- They are used as a model for human research.
 - Neurology (as an alternative to cats)
 - Influenza research
 - Antibody production
 - Toxicology (as an alternative to dogs and primates)
 - Infectious diseases
 - Hearing research

4

LO: 3.1.1

Classification

- Class: Mammalia
- Order: Carnivora
- Family: Mustelidae
- Genus: *Mustela*
- Species: *M. Furo*
- Domestic ferret (*Mustela Putorius furo*)



5

LO: 3.1.1, 3.1.7

Ferret Types

- Different varieties of ferret can be distinguished based on fur colour. The most common or wild type variety is known as 'fitch' or 'polecat' (black guard hair, cream undercoat, black points, light facial fur with dark mask, dark brown or black eyes).
- Other colours include the albino or English ferret. Albinos have yellow or white fur and pink eyes.



6

LO: 3.1.1

Terminology

- | | |
|---------------------|---------------|
| • Male | hob |
| • Female | jill |
| • Neutered male | gib or hobble |
| • Vasectomised male | hoblet |
| • Spayed female | sprite |
| • Under 1 year | kit |
| • Group | business |

7

LO: 3.1.1

Ferret Types

- There are several variants of ferret which some are associated with genetic defects, and an example is Waardenburg syndrome.
- Minor defects of the neural crest pathways commonly causing deafness. The colour marking associated with Waardenburg syndrome are small white strip on the back of the head or an all-white head from the tip of the nose to the back of the head.
- Also, may have widely set eyes and a flatter skull.



8

LO 3.1.1

9

Ferret Biology

- Lobular lungs which are anatomically similar to humans.
- Typical mustelid characteristics – Sleek, flexible, elongated tubular body, relatively short legs and small rounded ears which makes them ideal for confined spaces.
- Long flexible spine with 15 pairs of ribs.
 - Cervical 7
 - Thoracic 15
 - Lumbar 5
 - Coccyx 18
- Mono-gastric, very flexible stomach and are able to vomit
- Heart located between 6th and 8th rib.
- No caecum
- Musk glands (similar to anal glands)



9

LO 3.1.1

10

4. Only females show seasonal variation in coat colour and weight.

- False
- Both males and females show seasonal variation in coat and weight.
- Natural lighting conditions will cause ferrets to moult in the autumn and may develop seasonal alopecia.
- Coat shorter and darker in summer and longer and lighter in winter.
- Body weight can fluctuate by up to 40% between summer and winter, as they lay down fat when winter approaches.



10

LO 3.1.1

11

Biology & Physiology

Terminology	Data
Adult body weight	M: 1-2Kg F: 500 – 900g
Life span	8-10 years (max 15 years)
Rectal temp	38° - 40°C
Heart rate	200 – 400 bpm
Respiratory rate	33-36 breaths per minute
Average length (including tail)	40 – 50cm

11

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12

Ferret breeding data

Breeding terms	Data
Sexually mature	8 - 12 months in the spring after birth
Age at first mating	M: 12 months F: 9 – 12 Months
Gestation period	40 – 42 days
Average litter size	8
Birth weight	6 – 12g
Weaning age	6 - 8 weeks (200 – 250g)
Oestrus cycle	Weeks if not mated
Mechanism of ovulation	Induced

12

LO: 3.1.1

13

Reproduction and breeding

- Seasonal breeders becoming sexual mature in the spring following birth 8-12 months but can be as early as four months.
- Breeding season is determined by photoperiod which can be manipulated by altering the light cycle.
- Males come into season as the day shortens and females respond to an increase in day length.
- In the northern hemisphere males and females are in season between December and July.
- An appropriate light cycle is essential for breeding ferret or problems will arise.
- Generally, one litter per year generally in late spring or early summer.

13

LO: 3.1.1, 4.10

14

Reproduction and breeding

- Females in oestrus develop vulval swelling and male testes are small during autumn and early winter becoming enlarged as the day length increase around January.
- Induced ovulator's, and jills remain in season until mated. Those that are not mated will remain in season.
- Oestrus females are exposed to high oestrogen levels, which if prolonged can lead to serious health issues.
- Active management of oestrus is needed for non-breeding females.



14

LO: 3.1.1, 4.10

15

Reproduction and breeding

- Ensure Jills are checked to ensure they are in good condition. Parturition is particularly demanding on jills and an unfit jill is more likely to have problems during pregnancy and birth.
- Optimum time for conception is 14 days after vulval swelling. Take jill to hob and leave with him for 2 days. Mating is vigorous, prolonged and noisy. The hob will grasp the Jill by the scruff and drag her around for up to one hour before conception.
- Her skin is sufficiently thick to withstand the biting, but injuries can still occur.
- Ovulation takes place 30-35 hours after mating and vulval swelling reduces within a few days.

15

LO: 3.1.1, 4.10

16

Reproduction and breeding

- After mating, Jills may need to be housed alone to reduce risk of disturbance. Females become more aggressive as gestation progresses.
- Move to littering cage 2-3 weeks prior to parturition.
- Ensure adequate nutrition is provided ad lib (35 – 40% protein & 18 – 20% fat) Increase fat content to 30% during lactation and additional supplements may be required.
- Breeding performance declines after approximately three years in males and 3-4 years in females

16

LO: 3.1.1

17

Kits

- Up to 18 can be born with the average at 8.
- All are born white regardless of the eventual coat colour. They are born altricial which means they are hairless and blind.
- Kits have voracious appetites, and they develop rapidly, doubling their birth weight in 5 days.
- Eyes are closed until around day 34, becoming active and eating solids from 14 – 21 days. Growth is gradual right up until weaning when their body weight reaches at least 200 -250g.
- At this point fed adlib they eat around 30g of solid food and drink about 125ml/day.
- Adult weight reached at around 16 weeks.



17

LO: 3.1.1, 4.10

18

Ferret Kit

- Neonatal mortality can reach between 8 – 10% so good management is essential to reduce problem during the periparturient period.
- Dystocia, mastitis and cannibalism are common issue surrounding ferret breeding.
- Jills need to be left undisturbed for several days post-partum and given adequate nutrition, with increasing quantities of food offered 2 – 3 days after birth.
- Calcium supplements may be needed to prevent hypocalcaemia (can peak around 3 – 4 weeks after birth).
- On very rare occasions mature males are sometimes treated with anti-testosterone drugs to avoid fighting.



18

LO: 3.1.1

19

Behaviour

- Ferrets are highly intelligent, agile, lively, playful and curious.
- They do not develop a fear of humans or human environments and they natural like to explore.
- They vocalise with a range of sounds. When playing they might hiss and chuckle, and when frightened they may scream. They produce a low-pitched grumble when foraging.



19

LO: 3.1.1, 3.1.6

20

Behaviour

- They have an undeserved reputation for being aggressive.
- Young ferrets play constantly, and their play can be rough. Mock aggression, play chasing and pouncing are commonly observed.
- They will nip and may bite when first handled but become more docile if handled frequently.
- They have poor eyesight and may confuse a tentatively approaching hand as food.
- Ferrets do respond well to frequent handling and rapidly become friendly.



20

LO 3.1.1, 3.1.6

21

Behaviour

- Ferrets produce a pungent odour from scent glands near to the anus which can be released when they are frightened or excited.
- also produce a musky odour from scent glands in the skin which is more pronounced in unneutered males.
- Regular bathing and cleaning of their living environment can help manage the smell.



21

LO 3.1.1, 3.1.6

22

Laboratory ferrets

- When awake they are very lively and like to burrow, hide and explore. They are more active at night.
- When given a three-dimensional environment they will make good use of it. They enjoy tubes and tunnels to explore.
- They will spend a lot of time burrowing through their bedding, which can lead to bouts of sneezing.
- They like to sleep in dark enclosed areas such as wooden or cardboard boxes.



22

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23

Laboratory ferrets

- Ferrets kept in standard laboratory conditions spend around 70% of their time sleeping with burst of activity in between.



23

LO 3.1.1, 3.1.6

24

Housing and enrichment

- Domestic ferrets are sociable and gregarious, and benefit from being kept in social groups for social enrichment.
- Groups of Jills without litters, young animals and castrated males (hobbles) should be housed together. If singly housing animals, then they will need an enriched environment and regular interactions.
- Ferrets like to chew into items in their environment. Any cage furniture and enrichment must be sufficiently durable that the animals cannot chew and swallow bits of them. Chewing can also cause trauma to teeth and gums, so they need regular inspections.



24

LO: 3.1.1, 3.1.6, 3.1.5, 4.2

25

Housing and Husbandry

- Ferrets are generally kept in groups in large cages or pens with plenty of substrate and environmental enrichment.
- Their curious nature will lead them to explore all escape routes. They can squeeze into very tight spaces. Generally, if their heads will fit their body will follow. This means ferret housing has to be especially secure.
- They need regular cleaning and will urinate and defecate in one corner of the cage. You can clean corners daily and then full clean once a week depending on numbers.



25

LO: 3.1.1, 3.1.6, 4.2

26

Latrines

- Ferrets are usually clean and generally choose one particular area as latrine (normally corner)
- It is the best to allow them to choose their own site initially
- Ferret litter trays
- The latrine should be cleaned at least once a day



26

LO: 3.1.6

27

Enrichment

- Exercise and enrichment are essential for ferrets.
- Examples of enrichment are:
 - Drainpipes
 - Paper diet sacks
 - Hammocks
 - Deep litter
 - Climbing shelves
 - Play balls
 - Ropes
 - Scatter feeding
 - Solid rubber toys



27

LO: 4.2

28

Environment

Condition	Recommendation
Air	Need to maintain suitable air quality and approximately 10-15 ACH are recommended to reduce the musky odour and to reduce the risk of respiratory disease.
Temperature	15 - 24° Can tolerate a wide range of temperature but are susceptible to heat exhaustion.
Humidity	No need to control as ferrets can tolerate wide fluctuations. Avoid high humidity especially if the temperature is low.
Lighting	Not to be averse to the animals especially albino varieties.
Photoperiod	In artificial lighting a minimum of 8 hours light needed, not to exceed 16 hours in any 24-hour period
sound	Lack of auditory stimulation can be detrimental and make ferrets nervous but no loud noises or vibrations recommended

28

LO: 4.2

29

Housing cont CoP

- Should be socially housed unless veterinary/welfare reasons or PPL authority

Weight of animal (g)	Minimum floor area for one or more ferrets (cm ²)	Minimum floor area per group housed animal (cm ²)	Minimum height (cm)
<600	4500	1500	50
>600	4500	3000	50
Adult male	6000	6000	50
Jill and litter	5400	5400*	50

* For the purpose of this table, a jill and litter shall be counted as one animal until the time of weaning

29

LO: 3.1.5

30

Ferret Nutrition

- Ferrets are obligate carnivores with a short intestinal tract. Transit time for food is 3 to 4 hours so need to eat regular small amounts of easily digestible food.
- The exact nutritional requirements of ferrets have not fully been established; however, it is known they need a protein-rich diet and cannot readily utilise carbohydrates.
- They eat to calorie requirements, so feeding rich in carbohydrates can lead to protein deficiency. Adults need meat-based diets containing 30-40% protein, 18-20% fat and 2% fibre.
- Breeding and young animal require higher levels protein and fats. Suitable carnivore diets are available commercially but do not use diets designed for dogs.

30

LO: 3.1.5, 4.6

31

Nutrition and Feeding

- Dry diets can be given is soaked in water and fed as a stiff paste.
- Treats need to given in moderation and themselves be nutritionally appropriate.
- Food should be presented to ferrets in heavy bowls to stop them knocking them over.
- Ferrets should be provided with access to fresh water at all times and can be delivered in bowls, bottles or automatic drinkers.



31

LO: 5.1, 5.3

32

Pain and stress recognition

- Evaluation of pain in ferrets can be difficult as signs are not always easy to spot as they sleep for much of the time.
- This can only be done when they are awake, and evaluation of their behaviour can be undertaken.
- Pain behaviours can be very subtle and may only be noticed by those who know the animals' individual behaviours.



32

LO: 5.2

33

Indicators of pain and poor health

- Body condition and change of body shape
- Reduced activity and exploratory behaviours
- Altered posture or gait
- Uncharacteristic aggression or apathy
- Vocalisation
- Hiding
- Lack of grooming
- Reduced food and water intake
- Salivation or bruxism (teeth grinding especially associated with abdominal pain)
- Weight loss
- Diarrhoea – tarry, bloody or mucus in the faeces

33

LO: 5.1, 5.3

34

Assessments

- Animals should be observed in their home cages for natural behaviour and signs of illness and then removed to make an assessment of provoked behaviour.
- Normal ferrets exhibit exploratory behaviour: if this is absent then this may be a sign of illness.
- Observe the gait to see if there are signs of hind limb paralysis and other musculoskeletal or neurological disturbances
- Clinical score sheets can be developed to assess the condition of your animals



34

LO: 5.3

35

Grimace scale

- A grimace scale has been developed for ferrets. This is based on evaluation of five facial action units:
 - Orbital tightening
 - Nose bulging
 - Cheek bulging
 - Ear position
 - Whisker reaction
- The grimace score and orbital tightening in particular are potentially useful tools for pain assessment.
- However, be careful of false negatives, a negative score should not be used as reason not to provide pain relief.

35

LO: 5.3

36

Grimace scale

	Not present (0)	Moderately present (1)	Obviously present (2)
Orbital tightening <ul style="list-style-type: none"> • The eyelids close (vertical lines appear) • A wrinkle may be visible around the eye 			
Nose bulging <ul style="list-style-type: none"> • The nose is pulled short • The nose rounds off • The nostrils pull close • The bridge of the nose bulges 			
Cheek bulging <ul style="list-style-type: none"> • The cheek muscles bulge • The contour of the cheeks becomes visible • The cheeks may be pulled up at the side of the ear 			
Ear changes <ul style="list-style-type: none"> • The ears are pulled back against the body • The ears may form a vertical ellipse • The ears may fold over 			
Whisker retraction <ul style="list-style-type: none"> • The whiskers are pulled back against the chest • The whisker follicles converge caudally • The whiskers clump together 			

36

LO: 5.2, 4.9

37

Ferret Diseases



37

LO: 5.2, 4.9

Canine Distemper

- Canine Distemper Virus (CDV)
- Acute disease, 100% mortality within 12-16 days
- Clinical signs: Oculo-nasal discharge, diarrhoea, pyrexia, skin rash, hyperkeratosis, progressing to severe bronchopneumonia or CNS signs, death
- Diagnosis: Virus isolation, PCR
- Main control measure is to source animals from a clean supplier.

38

LO: 5.2, 4.9

Influenza

- Zoonotic
- Transmission between humans and ferrets
- Highly susceptible to human influenza with similar symptoms
- Supportive treatment required
- Control measure is not to allow people near the animals if they are displaying symptoms
- Ferrets common influenza research model

39

LO: 5.2, 4.9

Disease

- Reverse Zoonosis - transmission between ferrets and humans
- Highly susceptible to Covid 19 with similar symptoms but usually mild disease
- Large outbreaks in Mink farms in Holland and Denmark
- Control is by restricting access to the unit by those who are infected

40

LO: 5.2, 4.9

Endocrine - Post-oestrus anaemia

- Persistent oestrus
- Oestrogens cause bone marrow suppression: anaemia and subsequent liver dysfunction
- Clinical signs: bilateral symmetrical alopecia, weight loss, swollen vulva, anorexia, depression, weakness, petechial haemorrhages on membranes
- Death from acute haemorrhages
- Diagnosis: History, symptoms, haematology
- **Treatment:** Prevention! Mating (vasectomised hob)
- Hormone treatment
- Ovariohysterectomy (pets only) if healthy but not ethical
- Support with fluids, antibiotics, extra nutrition



41

LO: 4.7, 7.1

42

Handling and restraint

- Ferrets vary in temperament, while most are non-aggressive, some may be aggressive.
- They are usually docile and easy to restrain if handled frequently from a young age.
- They have poor eyesight and may bite at anything that crosses their field of vision so take care when approaching a ferret.
- Ferrets can be picked up by distracting them with one hand and grasping them round their shoulders or under the rib cage with the other.

42

LO: 4.7, 7.1

43

Handling and restraint

- The animal can then be lifted up and the hindquarters supported with the other hand.
- You can then place a thumb under the jaw to provide extra restraint.



43

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44

Techniques - introduction

- Most procedures are best performed by two people, as it can be difficult to properly restrain a ferret with one hand and administer an injection with the other.
- Anaesthesia is recommended for many procedures to facilitate restraint. This may however impact on haematological parameters – take this into consideration when interpreting results.
- Ferrets have very tough skin, and it can be hard to penetrate. **A new, sharp needle should always be used when giving injections.**

44

LO: 4.8

45

Identification

- Microchips are the most reliable method. These can be inserted at any age without sedation or anaesthesia.
- Collars can be used for short term identification, but their narrow neck can make it difficult to keep them in place.
- Tattooing also provides a permanent method of identification and is best on the inside of the thigh and anaesthesia is recommended for this.
- Albino ferrets may be identified using dyes, but this will need to be reapplied as they fade.
- Another temporary method can be to shave patches of fur from their backs.



45

LO: 7.4, 7.5

46

Routes of administration

- Ferrets have very tough skin, so a new needle is needed for every injection.
- Most procedures are best performed by two people.
- Several injection sites are available:
 - Subcutaneous
 - Intramuscular
 - Intravenous
 - Intraperitoneal
 - Intranasal

46

LO: 7.4, 7.5

47

Subcutaneous

- These should be given into the loose skin over the shoulders or flank.
- The skin is very thick so a 21G needle may need to be used.
- Raise the skin using the thumb and fore finger to make a tent.
- Insert the needle at the base of the tent and inject.



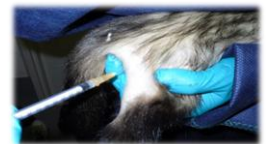
47

LO: 7.4, 7.5

48

Intramuscular

- These should be given into the quadriceps on the front of the thigh or the hamstrings on the rear of the thigh.
- Only inject small samples



48

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49

Intravenous

- These can be made into the cephalic vein.
- Shave the fur from the dorsal surface of the fore limb and clean with antiseptic solution.



- Alternatively, injections can be made with an indwelling cannula

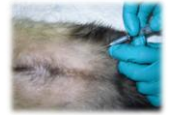
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LO: 7.4, 7.5

50

Intraperitoneal injection (under GA)

- Not commonly used – perform under general anaesthesia
- Injections can be given just off the midline in the lower abdominal quadrant.
- Avoid damaging intestines by keeping a shallow angle.



50

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51

Intranasal administration

- This route of administration may be used for virus instillation
- The substance to be administered is instilled into the nares using a cannula or pipette
- This can be done in conscious, restrained ferrets, or under light inhalation anaesthesia
- Ferrets will sneeze afterwards – be sure to wear PPE to avoid being dosed yourself!

51

LO: 7.4, 7.5

52

Blood sample collection

- Ferrets have a higher packed cell volume than other species.
- Larger blood samples may need be collected to collect sufficient serum or plasma. Use the jugular or anterior vena cava (21g).
- The cephalic, saphenous or ventral tail veins can be used for smaller samples.
- Most ferrets can be manually restrained for blood sampling but for larger samples the animal should be anaesthetised.

52

LO: 7.4

Equipment for blood sampling under GA

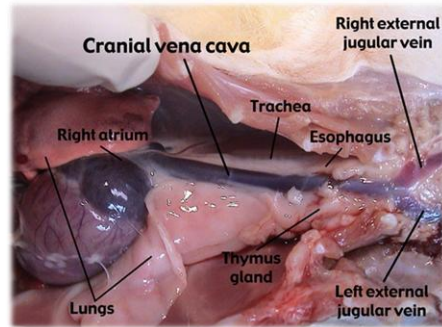
- Clippers
- Drugs
- Syringes
- Needles
- Blood tubes
- Eye cream
- Staff
- Warm, safe and quiet surroundings



53

LO: 7.4

Jugular veins



54

LO: 7.4

55

Terminal bleed



- Only under terminal anaesthesia
- The ferret has a long thoracic cavity with 15 ribs
- Heart between the 6th and 8th rib
- Adult total blood volume: 60 – 120 ml

55

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56

Anaesthesia

- Ferrets have a short gut transit time so fast for around 3 -4 hours to prevent vomiting. Longer periods of fasting may lead to hypoglycaemia.



56

LO: 20.5

57

Pre-anaesthetic considerations

- Anaesthesia in ferrets can be challenging (small size and lack of accessible blood vessels).
- Only healthy animals should be used and keep stress to a minimum.
- Health check your animals and get an accurate weight for drug calculations.
- Premedication may be appropriate to calm the animal down prior to anaesthesia.
- Also, consider analgesics for painful procedures and drying agents as their airways are small and easily blocked.
- Sedatives and premedication's are usually delivered via Sub Cut.

57

LO: 20.6

58

Sedatives and premedicants

Drug	Dose	Comments
Midazolam ¹ with ketamine ¹	0.2mg/kg with 10mg/kg im	Short term sedation with relaxation.
Medetomidine	0.01- 0.2mg/kg sc or im	Dose dependent sedation. Reverse with atipamezole.
Diazepam ¹ or midazolam ¹	0.25-0.5mg/kg iv	Reduces anxiety and produces relaxation. Can be hypotensive.
Atropine	0.05mg/kg sc	Dries airway secretions

(Dose rates from Carpenter 2013; Hawkins and Pascoe 2012; Ko and Marini 2008; Lloyd 2002; Meredith 2015)

58

LO: 20.9

59

Anaesthesia

- General anaesthesia may be induced by injection or inhalation.
- Injectable agents are generally administered Sub Cut.
- In friendly or sedated ferrets, you can insert a catheter into the cephalic vein.
- Injectable agents need to be dose dependant so an accurate weight is needed and there could be seasonal differences.
- Volatile anaesthetics can be used for both induction (after sedation) and maintenance.
- You can use an induction chamber to induce anaesthesia and takes 1-2 minutes.
- Maintain on a face mask using a low resistance circuit.
- Due to the long neck ensure the airways are patent during the anaesthesia period.

59

LO: 20.8

60

Drug combinations for anaesthesia

Drug	Dose	Comments
Isoflurane	3-4% induction, 1.5-3% maintenance	Premedication recommended to smooth induction.
Medetomidine with Ketamine ¹	0.08-0.1 mg/kg with 4-8 mg/kg	Mix in same syringe, administer im/sc for 30-60 minutes surgical anaesthesia. Can reverse with atipamezole, 0.25-0.5 mg/kg im/sc
Xylazine with Ketamine ¹	1-4mg/kg with 10-25 mg/kg im	As above but with more respiratory depression.

Dose rates from Carpenter 2013; Hawkins and Pascoe 2012; Ko and Marini 2008; Lloyd 2002; Meredith 2015

60

LO: 20.12

61

Post operative care

- Hypothermia under anaesthesia is common in ferrets, due to their small size and large surface areas.
- Keep animal warm during the anaesthesia and also until the animal has fully regained consciousness.
- Maintain fluid balance using warm isotonic fluids (Hartmann's solution or normal saline) sub cut.
- Animals may have a depressed appetite so convalescent foods should be offered.
- Ensure access to fresh water is available.
- Consider analgesics if the animal has been through a painful procedure

61

LO: 20.12

62

Analgesics

Drug	Dose	Comments
Buprenorphine ¹	0.01-0.03 mg/kg sc or im	Repeat after 8-12 hours
Butorphanol ¹	0.05-0.4 mg/kg sc or im	Repeat after 4-6 hours.
Morphine ¹	0.2-2mg/kg sc or im	Repeat after 2-6 hours
Carprofen	2-5 mg/kg po or sc	Repeat after 12-24 hours
Meloxicam	0.1-0.3 mg/kg sc	Once daily
Ketoprofen	1-3mg/kg sc	Once daily

Dose rates from Carpenter 2013; Hawkins and Pascoe 2012; Ko and Marini 2008; Lloyd 2002; Meredith 2015

62

LO: 1.12

63

Euthanasia

- Overdose of anaesthesia by administration of barbiturate.
- Intravenous or intraperitoneal injection.
- Prior sedation is recommended (inhalation anaesthetic or medetomidine).
- If scientifically required other methods are available (decapitation, inhalation followed by exsanguination, or perfusion fixation under GA all of which will require licence authority to carry out.
- Confirmation of death

63

Questions



64