

STUDYGUIDE

Species specific module:

Ruminants (goat, sheep, cattle)

Introduction to Laboratory Animal Science



Universiteit Utrecht

Organisation:

Department Farm Animal Health
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Objective of the module

The objective of this module is to present basic and appropriate biology, care, health and management of ruminants, recognition of pain, suffering and distress in these animals and minimally invasive procedures without anaesthesia to be applied on these animals. This course meets the standards for the species-specific education and training requirements for persons designing projects and procedures for ruminants.

Competence

For the function 'designing procedures and projects' the Dutch government requires competency.

On December 18, 2014 the new legislation regarding animal experimentation was implemented. Due to this implementation the course on Laboratory Science has been adapted. The course contains now two parts, a basic course (Introduction to laboratory animal science) and a species specific module. The basic course certificates and, at least, one species specific certificate will give the required competence.

From August 1, 2015 the competence is limited. You are not allowed to perform any procedure on animals, unless there is supplementary education. From now you are competent when you are skilled (competence profile, species and skill(s) stated).

After successful completion of the new basic course and after successful completion of the present module on ruminants, you will be competent to design procedures and projects and to execute simple procedures on these animals. Further skills have to be obtained by working under supervision until competence is demonstrated. Only then are you allowed to work with animals independently.

Workload

The number of credits that can be obtained after successful completion of the course is 1.4 ECTS (European Credit Transfer and Accumulation System). The length of the course is one week (fulltime, 09.00-17.30 hrs). Participation in all parts of the course is mandatory. Knowledge of the content of course material is necessary at the start of the course.

Course material

During the course the book Principles of Laboratory Animal Science, revised edition, 2001, L.F.M. van Zutphen, V. Baumans and F. Ohi (eds.) (ISBN 13: 978-0-444-50612-2) will be used. Bibliography given below. Further material will be provided on a memory-stick.

Learning outcomes

Learning outcomes are in accordance with the EC Training and Education Document relating to Directive EU/2010/63,

http://ec.europa.eu/environment/chemicals/lab_animals/pdf/Endorsed_E-T.pdf

The species-specific course includes the following modules:

- 3.1 Basic and appropriate biology
- 3.2 Basic and appropriate biology – species specific (practical)
4. Animal care, health and management (theory)
5. Recognition of pain, suffering and distress – species specific
6. Humane methods of killing (theory)
7. Minimally invasive procedures without anaesthesia (theory)
8. Minimally invasive procedures without anaesthesia – species specific (skills).

For details, see separate chapters in the study guide.

Final examination

As a group you have to analyze a given article with help of a questionnaire that is based on the ARRIVE guidelines: (Kilkenny C, Browne WJ, Cuthill IC, Emerson M, Altman DG (2010) Improving bioscience research reporting: the ARRIVE guidelines for reporting animal research.). Based on every aspect you learned about during the course you have to describe in detail how the experiments described in the article are performed. You will report this in a small presentation (10-15 min) at the end of the course and discuss your choices with the critical audience- the other students. Each student gets a mark ranging from 0-10 points (0= unsatisfactory, 10=very good) depending on the quality. The examination involves the handbook, the lectures, discussions, demonstrations and practical's.

Certificate

If the participant has met all legal requirements and has successfully passed the exam at the end of the course, the participant will receive a certificate for this species specific module Ruminants.

If you do not meet all legal requirements, like not holding a Master degree (yet), you will receive a written confirmation stating that you followed the module and successfully passed the exam. Together with the certificate for the basic course, after obtaining your Master degree, you can request the final certificate confirming that you meet all legal requirements of the Dutch legislation to be registered for the function "designing projects and procedures for ruminants".

Program outline*

Title	1. Introduction ruminant course
Lecturers	Lecturers Ruminant Health Institute
Content	During this interactive lecture an overview of all topics to be presented during the entire course period will be given. The current national legislation governing the use of ruminants in research will be introduced. In dependence on the natural social structure of these animals implications for housing and testing of these animals will be discussed. Special attention will be paid to welfare related questions.
Key Text	<ul style="list-style-type: none"> a. Cattle b. http://www.cowsignals.com/books/cow_signals_-_english_edition c. http://www.cowsignals.com/books/from_calf_to_heifer_-_english_edition d. Information selected from the following books: http://www.cowsignals.com/books/dry_period_special_needs_cows_-_english_edition http://www.cowsignals.com/books/udder_health_-_english_american_edition http://www.cowsignals.com/books/feeding_signals_-_english_edition http://www.cowsignals.com/books/cow_signals_checkbook_-_english_edition e. Sheep f. http://www.roodbont.nl/en/sheep_signals_concept/index.php g. Goat h. https://www.rspca.org.uk/ImageLocator/LocateAsset?asset=document&assetId=1232713000349&mode=prd
Form	Lecture
Testing your competence	<ol style="list-style-type: none"> 1. Describe the life cycle of a common dairy cow, sheep, goat 2. Describe the most essential needs for cattle, sheep, goats used in experiments 3. When would you decide on cow / calve , sheep or goat as model organism? 4. Give an example of how ruminants might be used as model to study human disease.

Title	2. Animal Handling
Lecturer	Lecturers Ruminant Health Institute
Content	<p>In this setting you will be made able to restrain ruminants. This practicum will prepare you for skills on animal handling. Important to understand that 95% of a procedure is restraining the animal in the right way and a quiet behavior. Restraining is handling an animal in such a way that nor you neither the animal will be harmed when performing a technique.</p> <p>Working safely and concern for animal welfare with laboratory animals requires a core competency in handling and restraint methods. Proper restraint and handling techniques are essential for clinical examination and injections while limiting the amount of stress and/or discomfort to the animal and to the handler.</p> <p>Training will be done in the cubicle stall. You will be taught how to approach, tether a halter, escort, restrain, check (take temperature, check gait, check claws of cattle and small ruminants etc.) of the ruminants. In the first place concerning welfare of the animals.</p>
Key Text	<p>a) http://www.nfacc.ca/codes-of-practice/beef-cattle</p> <p>b) http://www.nfacc.ca/codes-of-practice/dairy-cattle</p> <p>c) http://www.nfacc.ca/pdfs/codes/goat_code_of_practice.pdf</p> <p>d) http://www.nfacc.ca/pdfs/codes/sheep_code_of_practice.pdf</p>
Form	Lecture and practicum
Testing your competence	<p>Describe every own specific way of handling and restraining cattle, sheep and goats.</p> <p>Describe possible consequences (for the animal and for the handler) if animals are not handled and/or restraint properly.</p> <p>Demonstrate certain skills in animal handling</p>

Title	3. Sedation, analgesia, anaesthesia
Lecturers	Dep. Gezondheidszorg Paard – Afd. Veterinaire Anesthesiologie / Lecturers Ruminant Health Institute
Content	<p>This lecture attempts to provide a basic level of knowledge in sedation, analgesia and anesthesia for research workers with special emphasis ruminants in laboratory conditions. The pathophysiology of pain and knowledge concerning different techniques providing analgesia are reviewed. Drugs for either local, regional and total anaesthesia will be discussed. The general principles of peri-operative care, anesthetic techniques and anesthetic management are discussed including injection- and inhalation anesthesia.</p> <p>The most commonly used ways of anaesthesia are interactively demonstrated:</p> <ul style="list-style-type: none"> • intravenous (jugular-, mammary vein, ear vein = vena auricularis lateralis / vena auricularis intermedia, tail vein = v. sacralis mediana, foot vein = v. digitalis palmaris / communis) • local, regional (paravertebral, corneal nerve, lacrimal nerve, inverted I-block, epidural, spinal) • films of these methods used in practice
Key Text	<p>Cattle: https://www.acvs.org/files/proceedings/2012/data/papers/169.pdf Small ruminants: https://www.acvs.org/files/proceedings/2012/data/papers/170.pdf</p>
Form	(Interactive) lecture
Testing your competence	<ol style="list-style-type: none"> 1. Describe pre-emptive analgesia 2. Describe the pillars of anesthesia 3. Describe use of regional anaesthesia in ruminants

Title	4. Importance of diseases of ruminants in laboratory conditions
Lecturer	Lecturers Ruminant Health Institute
Content	<p>Diseases in animals can be a consequence of experimental setup or occur as an unintended effect during the study. This lecture will focus on how to handle when animals have aberrant status praesens. In particular, the risks of disease at different levels will be discussed as well as how to recognize disease and come to a diagnosis. Furthermore, the most common (infectious) diseases of ruminants are reviewed, with a special focus on zoonosis. (Brucellosis, Listeriosis, Leptospirosis, Salmonellosis, Microsporum, trichophyton, Sarcoptes, Campylobacter, Chlamydia, Ecthyma contagiosum, Johne's disease)</p> <p>Measurements to reduce the infection risks as well as how to handle in case of infection the potential effects on the studies.</p>
Key Text	<ul style="list-style-type: none"> • Confronting Zoonoses, Linking Human and Veterinary Medicine; Kahn, Emerging Infectious Diseases, 2006 • Code of Practice: Welzijnsbewaking van proefdieren • Robbins & Cotran Pathologic Basis of Disease, 9e (for reference only) • http://www.vet.cornell.edu/consultant/consult.asp
Form	Interactive lecture
Testing your competence	<ol style="list-style-type: none"> 1. How to handle when laboratory animals are ill or diseased? 2. What are actions with regard to pathology, clinical and microbiological diagnostics that can be considered? 3. What can be consequences of diseases in laboratory animals? 4. What is the importance of collection of samples and how can they be used to diagnose disease? 5. Give an example of how a natural pathogen in lab animals can interfere with research. 6. List the transmission routes of pathogens and indicate what measurements can be taken to reduce the risks of spreading.

Title	5. General Anatomy, with special focus on Cattle, Sheep and Goats
Lecturer	Lecturers Ruminant Health Institute
Content	<p>‘One of the prerequisites for responsible use of animals in biomedical research is a thorough knowledge of the biological characteristics of the species to be used. The choice of animal species, sex, age and strain largely depend on whether their anatomical characteristics are suited to the research demands’.</p> <p>In this lecture the general anatomy of mammals will be discussed. Special attention will be given to the anatomy of ruminants in relation to biomedical research. A visit to the Anatomy Department will clarify interspecies differences</p>
Key Text	Principles of laboratory animal science, chapter 3 ‘Biology and husbandry of laboratory animals’. Handboek Proefdierkunde, hoofdstuk 3; Biologie en Zoötechniek
Form	Lecture
Testing your competence	Describe important differences in the gastrointestinal tract in young and older ruminants

Title	6. Physiology
Lecturer	Lecturers Ruminant Health Institute
Content	<p>Stress, defined as any deviation from homeostasis, induces a behavioral and physiological response that may impact on a wide array of animal experiments. In this lecture, the basic principles of homeostasis and physiological response to stress will be discussed. Specific topics that will be addressed are:</p> <ul style="list-style-type: none"> - Autonomic nervous system and sympathetic and parasympathetic response - Impact on cardiovascular system - Neuroendocrine response to stress - Impact on animal studies
Key Text	Handbook “Principles of Laboratory Animal Science” (course book), chapter “Behavior, stress and welfare”, Environment and Physiology. Physiology and anatomy in relation to make a decision tree for finding the optimal animal model.
Form	Lecture
Testing your competence	How is stress defined? Which physiological systems are affected in response to stress? What is the impact of a sympathetic and neuroendocrine response to stress? Why is it important to consider stress in animal experiments?

	7. Housing and care of ruminants in laboratory conditions
Lecturer	Lecturers Ruminant Health Institute
Content	In this interactive working group assignment students and lecturer will discuss housing and care of ruminants in laboratory conditions, assessment of discomfort, clinical signs indicating the humane endpoint and the best method to euthanize animals (least distress and not interfering with experimental results). On the basis of three hypothetical experiments the above mentioned topics will be discussed: 1. Accommodation of the animals 2. How to assess discomfort 3. Selection of the most appropriate method of euthanasia Films about these issues will be demonstrated
Key Text	<ul style="list-style-type: none"> • “Principles of Laboratory Animal Science; chapter 4 (Behavior, stress and wellbeing) • Council of Europe Convention ETS 123 for the protection of vertebrate animals used for experimental and other scientific purposes. Appendix A: Guidelines for accommodation and care of animals. • EU Working Party Report: Recommendations for euthanasia of experimental animals Parts 1&2 • EU Directive 2010/63/EU on the protection of animals used for scientific purposes; Annex IV: Methods of killing animals • Key text mentioned in ‘Introduction’
Form	Interactive working group assignment
Testing your competence	For each of the three hypothetical experiments <ol style="list-style-type: none"> 1. What is the most appropriate way to house ruminants in laboratory conditions? 2. How do you assess distress, pain in ruminants in laboratory conditions? 3. What is the most appropriate method to euthanize ruminants in laboratory conditions? 4. Which clinical symptoms should be used to define the (humane) endpoint of the animal experiments? 5. In general: how do you prevent avoidable discomfort in ruminants in laboratory conditions?

Title	8. Practical Basic Techniques
Lecturer	Lecturers Ruminant Health Institute
Content	This practical contains a brief description of some basic procedures concerning the administration of drugs. Dutch law demands responsible drug use in animal husbandries in general and especially usage of antibiotics. Possible associations between antimicrobial use and the prevalence of resistance of micro-organisms are discussed. Basic principles of surgery and some administration procedures will be shown and practised. Administering substances to animals, for whatever reason, can have a significant impact on their welfare. If carried out incorrectly, not only can animal welfare be compromised, but the scientific goals of study can be affected. In practice participants will be instructed in the administration of substance (injections i.m., s.c., i.v., oral, pour-on) to ruminants. Films about these issues will be demonstrated
Key Text	<ul style="list-style-type: none"> a) Handbook "Principles of Laboratory Animal Science" (course book), chapter 16 "Experimental procedures". b) Videos on usb-stick on handling/restraining c) http://www.autoriteitdiergezondheidsmiddelen.nl/en/home d) https://www.youtube.com/watch?v=JCwwBEQrMRI e) https://www.youtube.com/watch?v=i3wrvi1ENY f) https://www.youtube.com/watch?v=m0TFBU75DiM g) https://www.youtube.com/watch?v=m5DtF3QO710 h) https://www.youtube.com/watch?v=iSZEyRoeT4k
Form	Lecture and practical
Testing your competence	Which methods of administration do you know? Which routes of administration do you know? How do you decide on a certain method of administration? Understanding a surgical procedure and the different steps needed.

Title	9. Demonstration Basic Techniques
Lecturer	Lecturers Ruminant Health Institute
Content	In this demonstration a brief description of some basic procedures concerning sampling (blood, abdominal fluid etc), feces and urine will be discussed. Injections s.c., i.m., i.v. and the practical ways to take blood samples will be demonstrated/done
Key Text	Videos on memory-stick on handling/restraining
Form	Lecture and demonstration
Testing your competence	Which methods of blood sampling do you know? How do you decide on a certain sampling technique ? When would you anesthetize your animals for sampling and when not? How would you sample urine and feces of mice?

	How would you do that when animals are kept in groups?
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Title	10. LAS assignment
Lecturers (2 per course)	Dr. G.A. Hooijer : g.a.hooijer@uu.nl ; Dr. R. Jorritsma r.jorritsma@uu.nl
Content	As a group you have to analyze a given article with help of a questionnaire that is based on the ARRIVE guidelines: (Kilkenny C, Browne WJ, Cuthill IC, Emerson M, Altman DG (2010) Improving bioscience research reporting: the ARRIVE guidelines for reporting animal research.). Based on every aspect you learned about during the course you have to describe in detail how the experiments described in the article are performed. You will report this in a small presentation (10-15 min) at the end of the course and discuss your choices with the critical audience- the other students.
Key Text	<ul style="list-style-type: none"> • Van Zutphen, L.F.M., Baumans, V., Beynen A.C. (2001) "Principles of Laboratory Animal Science: A Contribution to the Humane Use and Care of Animals and to the Quality of Experimental Results" • Additional literature (sought by the participants themselves)
Form	Working group assignment

Schedule species specific course Ruminants

	Time	Subject	Room	Teacher
Day 1	9.00-10.15	Introduction ruminant course		Gerrit Hooijer
	10.30-12.30	General Anatomy, with special focus on Cattle, Sheep and Goats		Paul Heijnen
	13.15-14.45	Physiology		Marieke Lindhout-Dijkshoorn
	15.00-16.30	Animal Handling		Dick Scholten
Day 2	9.00-10.30	Self-study as preparation on diseases in ruminants		
	10.45-12.30	Importance and / of diseases of ruminants in laboratory conditions		Gerrit Hooijer
	13.00-14.00	Preparation: housing systems in ruminants. Welfare and needs		
	14.15-16.30	Housing and care of ruminants in laboratory conditions		Hilde Aardema
Day 3	9.00-12.30	Sedation, analgesia, anaesthesia		Janny de Grauw
	13.00-15.00	Practical Basic Techniques		Dick Scholten
	15.00-16.00	Demonstration Basic Techniques		Dick Scholten
Day 4	9.00-12.30	Preparation presentation or room for additional individual program		
	13.15-17.00	Presentation articles		Gerrit Hooijer
Day 5	9.00-11.30	LAS assignment		Gerrit Hooijer / Ruurd Jorritsma
	11.45-12.30	Course evaluation		Gerrit Hooijer

* The schedule as mentioned above is intended to provide an overview of the course contents. Exact times and locations for the individual lectures, practicals and working groups may vary from course to course, dependent on the availability of the teachers and will be made available prior to the start of each course

Modules art. 23.2.b function Species specific

Module 3.1: Basic and appropriate biology – species specific (theory)

This module provides an introduction to the basic principles of animal behaviour, care, biology and husbandry. It incorporates information in relation to anatomy and physiological features, including reproduction, behaviour and routine animal husbandry and enrichment practices. It is not intended to provide more than the minimum background information which is needed for someone to be able to begin work under supervision.

Following this module practical training, under supervision, should provide each individual with the expertise and skills needed for them to carry out their particular function. Practical training requirements will, inevitably, differ according to function.

Learning Outcomes

Trainees should be able to:

- 3.1.1. Describe basic anatomy, physiology, reproduction and behaviour of the relevant species.
- 3.1.5. Describe the dietary requirements of the relevant animal species and explain how these can be met.
- 3.1.6. Describe the importance of providing an enriched environment (appropriate to both the species and the science) including social housing and opportunities for exercise, resting and sleeping.
- 3.1.7. When relevant to the species, recognise that there are different strains, and that these can have different characteristics which can affect both welfare and science.
- 3.1.8. When relevant to the species, recognise that alterations to the genome can affect the phenotype in unexpected and subtle ways, and the importance of monitoring such animals very carefully.
- 3.1.9. Maintain and interpret accurate, comprehensive records of animals held in the animal facility, including the wellbeing of the animals

Module 4: Animal care, health and management – species specific (theory)

This module provides information on various aspects of animal health, care and management including, environmental controls, husbandry practices, diet, health status and disease. It also includes relevant basic learning outcomes relating to personal health and zoonoses.

Learning Outcomes

Trainees should be able to:

- 4.1. Describe suitable routines and husbandry practices for the maintenance, care and welfare for a range of animals used in research, to include small laboratory species and large animal species where appropriate.
- 4.2. Describe suitable housing conditions for laboratory animals, how conditions are monitored and identify the consequences for the animal resulting from inappropriate environmental conditions.
- 4.6. Describe how to provide water and an appropriate diet for laboratory animals including the sourcing, storage and presentation of suitable foodstuffs and water

4.7. List the methods, and demonstrate an understanding of appropriate, safe and humane handling, sexing and restraint of one or more named species for common scientific procedures.

4.8. Name different methods for marking individual animals and state an advantages and disadvantage for each method.

4.9. List potential disease risks in the animal facility, including specific predisposing factors which may be relevant. Name methods available for maintaining appropriate health status (including use of barriers, different containment levels use of sentinels as relevant to the species).

4.10. Describe appropriate breeding programmes

4.11. Describe how genetically altered animals can be used for scientific research and the importance of monitoring such animals very carefully.

4.12. List the correct procedures for ensuring health, welfare and care of animals during their transport.

Module 5: Recognition of pain, suffering and distress - species specific

This module prepares individuals to be able to identify normal condition and behaviour of experimental animals and enable them to differentiate between a normal animal and one which is showing signs of pain, suffering or distress which could be a result of factors including environment, husbandry or the effect of experimental protocols. It will also provide information regarding severity classifications, cumulative severity and the use of humane endpoints.

Learning Outcomes

Trainees should be able to:

5.1. Recognise normal or desirable behaviour and appearance of the individuals in the context of species, environment and physiological status.

5.2. Recognise and explain the origin of abnormal behaviour and signs of discomfort, pain, suffering, or distress, as well as signs of positive well-being and principles of how pain, suffering and distress can be managed.

5.3. Discuss factors to be considered and methods available for assessing and recording the welfare of animals e.g. score sheets.

5.4. Describe what a humane end point is. Identify criteria to be used to set humane endpoints. Define action to be taken when a humane endpoint is reached and consider possible options for refining methods to finish at an earlier endpoint.

5.5. Describe the severity classifications included in the Directive and give examples of each category; explain cumulative severity and the effect this may have on the severity classification.

5.6. Describe the circumstances when anaesthesia or analgesia may be necessary to minimise pain, suffering, distress or lasting harm

Module 7: Minimally invasive procedures without anaesthesia – species specific (theory) [Function Specific for Functions A and B]

This module provides an introduction to the theory relating to minor procedures. It provides information about appropriate methods of handling and restraint and describes appropriate techniques for injection, dosing and sampling relevant to the species. It should provide information sufficient for individuals to understand what will

be required of them before they go on to trained in the practical aspects of these skills whilst under supervision.

Learning Outcomes

Trainees should be able to:

- 7.1. Describe appropriate methods and principles to be followed when handling animals (including methods of manual restraint and use of restricted environments).
- 7.2. Describe the biological impact of procedures and restraint on physiology.
- 7.3. Describe refinement opportunities for procedures and restraint
- 7.4. Describe techniques/procedures including, for example, injection, sampling and dosing techniques (routes/volumes/frequency), dietary modification, gavage, tissue biopsy, behavioural tests, use of metabolic cages.
- 7.5. Describe how to perform minor techniques (without anaesthesia) and relate appropriate sample volumes and sampling frequencies for the relevant species.
- 7.6. Describe the need for rigour and consistency in conducting scientific procedures and the correct recording and handling of samples.
- 7.7. Describe appropriate methods for the assessment of the welfare of animals with respect to the severity of procedures and know what appropriate action to take.
- 7.8. Recognize that refinement is an on-going process and know where to find relevant, up-to-date, information.
- 7.9. Describe the biological consequences of transport, acclimatization, husbandry conditions and experimental procedures on the species concerned and describe how these can be minimised.

Module 8: Minimally invasive procedures without anaesthesia – species specific (skills) [Function Specific for Function A]

This module delivers practical elements of training relevant to Module 7. Practical training for minor procedures can be taught through a number of methods using different tools which are available and designed for the purpose (this is likely to include synthetic animal models and the use of cadavers). The module should be designed in such a way that it will enable the trainee to attain a level of proficiency such that, when commencing work under supervision, s/he should cause no pain, suffering, distress or lasting harm to the animal.

Learning Outcomes

Trainees should be able to:

- 8.1. Select and explain the best methods for common procedures (such as blood sampling and application of substances) including route/volume/ frequency as appropriate.
- 8.2. Demonstrate that s/he can handle and restrain the animal in the best position for the technique.
- 8.3. Perform minor techniques under supervision, in a manner that does not inflict unnecessary pain, suffering, distress or lasting harm.