

Three Rs and Three Ss for improving both our science and welfare

The pathway to better research

Adrian Smith, Norecopa

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norecopa.no/220422

"better research?"

- valid data (a true treatment effect)
- reproducible and translatable experiments
- best possible animal welfare
(happy animals give better science)
- health & safety (of animals and people)
- a culture of care in the research group
- communication of best practice to others



colourbox.com

Norway's National Consensus Platform for the
Three Rs: Replacement, Reduction and Refinement
and a source of *global* 3R resources

we welcome more from you!



norecoba

<https://norecoba.no>

Established in 2007

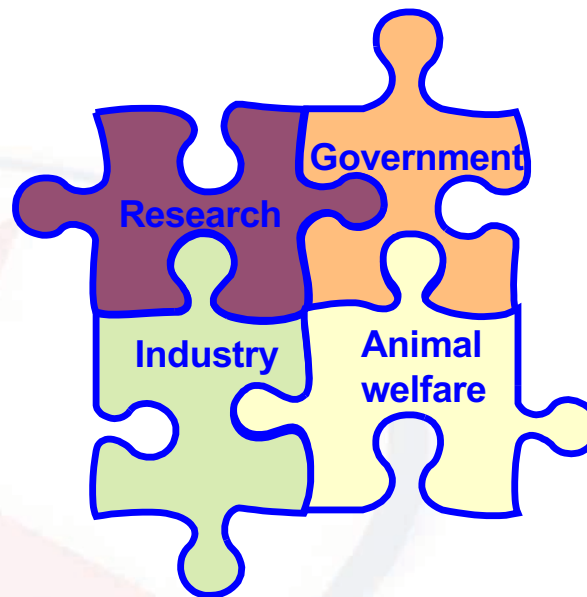
Norecoba: PREPARE for better Science

European Consensus-Platform for Alternatives

ecopa.eu



- Established in 2000
- Recognises **National Consensus Platforms** (NCPs) with **4 stakeholders** equally represented:



Norecopa was established in 2007

Norecopa: PREPARE for better Science

The background for the foundation of Norecopa



peta.org



fbresearch.org

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Centres

- [Replacement](#) i
- [Reduction](#) i
- [Refinement](#) i
- [ecopa](#) i

Associations

- [ACURET](#) i
- [AFLAS \(includes South Korea\)](#) i
- [Culture of Care Network](#) i
- [ecopa](#) i
- [EU-NETVAL](#) i
- [EU3Rnet](#) i
- [FELASA](#) i
- [FESSACAL](#) i
- [Scand-LAS](#) i
- [Concordat on Openness](#) f

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wikipedia.org



journal.eahn.org/article/id/7475



- Site work (excavation, waste & water, paths)
- Metal structures
- Concrete structures
- Masonry
- Carpentry (rough & visible)
- Waterproofing and insulation
- Escalators and lifts
- Heating, ventilation and air conditioning
- Plumbing
- Electrical systems
- Doors & windows
- Fire protection
- Painting
- Landscaping
- Rodent control

From the Master Builder...

...to a coordinated effort from many experts

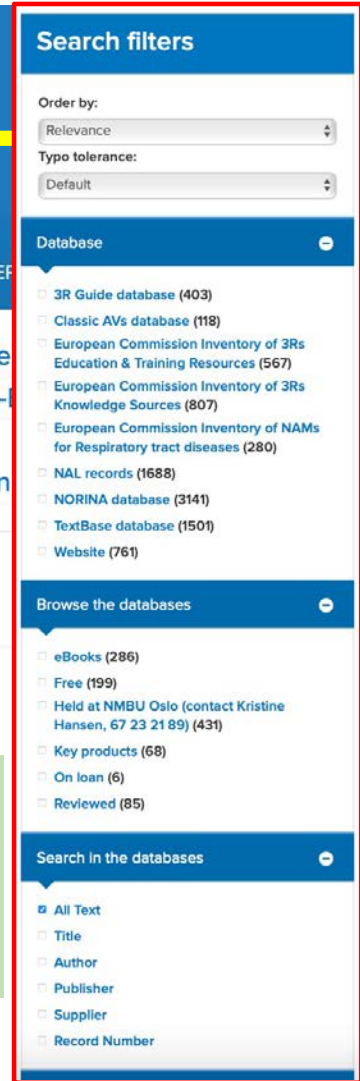
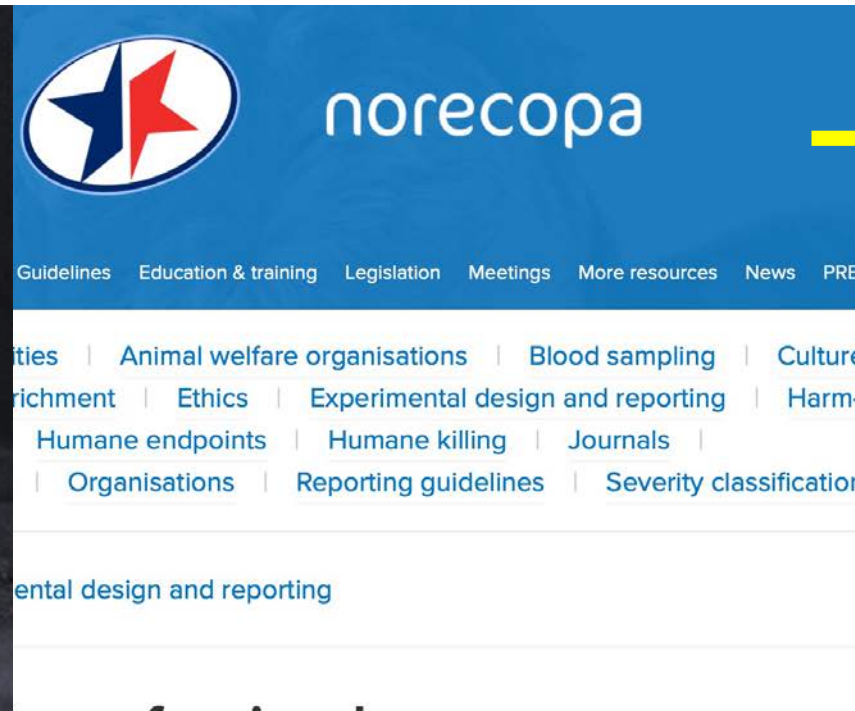
The pathway to better research



Norecopa: PREPARE for better Science

norecopa.no/PREPARE and ivd-utrecht.nl/en/news/better-animal-research-through-open-science-1

norecopa.no : an updated overview of global 3R resources



Design and reporting of animal experiments

This page supplements advice given in [Section 4 of the](#) covers all aspects of design (including animal and faci

approx. 8,900 webpages
320,000 hits annually
7-8 detailed newsletters per year

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Fish



Farm animals



Laboratory animals



Wildlife and wild fish



Cephalopods



Other aquatic animals

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+ webpages for past meetings and recorded meetings

norecopa.no/meetings/meetings-calendar

Webinar and Meetings calendar

- > [Reporting of risks of bias in animal research: an automated institutional monitoring dashboard](#), webinar (Alexandra Bannach Brown), 25 April 2022
- > [Recognition, prevention and alleviation of pain and distress in laboratory animals](#), online workshop, 25-29 April 2022
- > [PREPARE for Better Science](#), online course, 26-28 April 2022
- > [FRAME Training School in Experimental Design](#), Nottingham, 26-28 April 2022
- > [Zebrafish welfare and care](#), webinar (Lars Bräutigam & Petronella Kettunen), 27 April 2022
- > [Managing a gnotobiotic rodents facility: tools and challenges](#), online course, 27 April 2022
- > [Information about the Aachen M.Sc. in Laboratory Animal Science](#), webinar, 28 April 2022
- > [The standardization fallacy in animal research - and how to avoid it](#), webinar (Hanno Würbel), 29 April 2022

May 2022

- > [FELASA Laboratory Animal Course on Primates](#), online, 2-13 May 2022
- > [ABSA International 2nd Biosecurity Symposium](#), Minneapolis, 3-6 May 2022
- > [The impact of food restriction on experimental outcomes and rodent welfare](#), webinar, 4 May 2022
- > [Communicating animal research](#), webinar (Valeska Stephan), 6 May 2022
- > [What exactly is 'N' in animal experiments?](#), webinar (Stanley E. Lazic), 6 May 2022
- > [Anaesthesia, analgesia and surgery \(mice and rats\)](#), online/Stockholm, 9-13 May 2022
- > [BIOCHIP Berlin International Forum on BioChips and BioChip Solutions](#), Berlin, 10-11 May 2022

Pdf files of 80+ presentations held at Norecopa's meetings



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[Fish 2005](#) |
 [Wildlife 2008](#) |
 [Fish 2009](#) |
 [Agricultural animals 2012](#) |
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 [An informal guide to arranging a scientific meeting](#) |
 [Presentations](#)

norecopa.no/meetings/presentations



Most of the presentations on this page are from events arranged by Norecopa. A few of them are from external events where Norecopa's staff have lectured.

They are grouped into

- > [General presentations](#)
- > [Care and use of animals in field research](#)
- > [Care and use of farm animals in research](#)
- > [Care and use of fish in research](#)

Title	Speaker	Affiliation	Year
General presentations			
Design of animal studies: Increasing reproducibility and animal welfare	Adrian Smith	Norecopa	2020
PREPARE before you ARRIVE: Good reporting relies on good planning	Adrian Smith	Norecopa	2019
Animal-free testing and humans-on-a-chip: How far have we come? 	Leopold Koenig	TissUse GMBH, Berlin, Germany	2017
Nordic 3R-Centres: What can we offer? 	Tom Bengtsen	Denmark's 3R-Center	2017
Prize-winning 3R activity in Norway 	Gøril Eide	University of Tromsø, Norway	2017
Have the 3Rs made any difference? 	Elliot Lilley	RSPCA, UK	2017

Databases & Guidelines

Published lists of resources are difficult to search and quickly become outdated. Lists on a website are easier to search, but do not enable the use of filters or intelligent search engines.

Norecopa has therefore constructed four databases, which together with all the text on this website can be searched simultaneously using the search field at the top of every page.

- > **3R Guide:** a global overview of **databases, guidelines, information centres, journals, email lists, regulations and policies** which may be of use when planning experiments which might include animals. [A quick overview of all the guidelines can be accessed here.](#) Norecopa has written several of these, including [the PREPARE guidelines for planning animal research and testing.](#)
- > **NORINA:** a global overview of audiovisual aids and other items which may be used as **alternatives or supplements to animals in education and training** at all levels from junior school to University, including [dissection alternatives](#) and surgical simulators.
- > **TextBase:** a global overview of **textbooks and other literature within laboratory animal science** and related topics.
- > **Classic AVs:** a subset of NORINA covering **audiovisual aids that are based on older technology.**

These databases are updated regularly. [Please give us feedback](#) if you discover errors or omissions.

The Norecopa website also includes four other collections:

- > **NAL:** a collection of literature references relating to [the 3Rs](#) from the US National Agricultural Library
- > European Commission datasets:
 - ▶ **3Rs Knowledge Sources:** over 800 resources collected by the Commission in 2016
 - ▶ **3Rs Education and Training Resources,** over 560 items collected in 2018
 - ▶ **Non-animal models for respiratory tract diseases,** over 280 models identified in a literature review of over 21,000 publications

Here is [an alphabetical global list of all the databases](#) cited on the Norecopa website.

norecopa.no/databases-guidelines

links to over 70 other databases


3rswildlife.info

3Rs PRINCIPLES IN WILDLIFE RESEARCH

BACKGROUND ▾ EXAMPLES OF 3RS IMPLEMENTATION ▾ FAQ LINKS AUTHOR CONTACT

3Rs PRINCIPLES IN WILDLIFE RESEARCH

This site has been created to provide information about the 3Rs principles of animal use and guide their application in wildlife research. It contains examples of peer-reviewed studies that implemented non-lethal or non-invasive methods and that could be used as a guidance. It is the first online resource of its kind developed specifically for wildlife biologists, ecologists, and conservation managers.

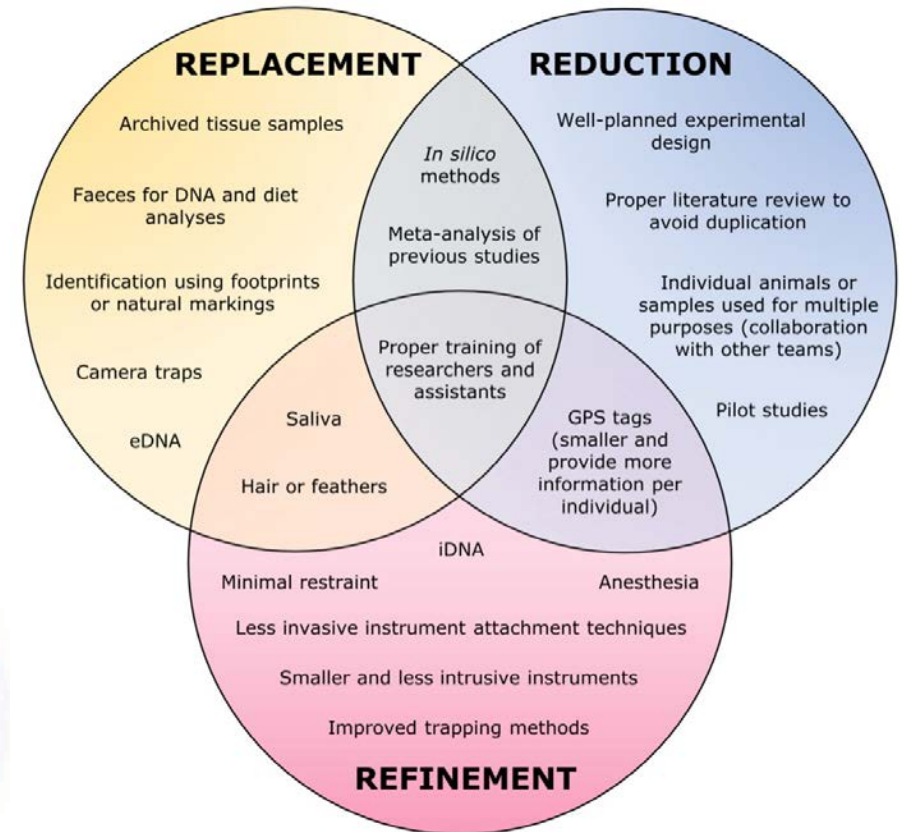


Featured so far:

71 NON-INVASIVE METHODS	937 SPECIES	603 PEER-REVIEWED STUDIES
--------------------------------------	-----------------------	--

THIS WORK HAS BEEN KINDLY SUPPORTED BY:

Animalfree Research
Eva Husi-Stiftung für Tierschutz



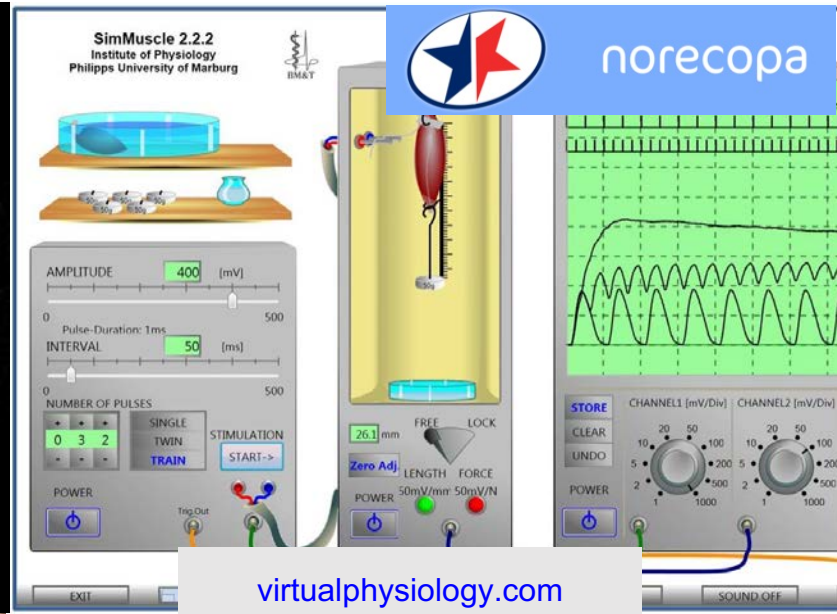
Source: Zemanova 2020

Miriam Zemanova

norecopa.no/NORINA



3dglasshorse.com



virtualphysiology.com



rescuecritters.com



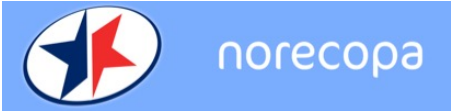
limbsandthings.com

norecopa.no/education-training/homemade-educational-materials



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norecopa.no/education-training/films-and-slide-shows



Rat s.c. injection
Norecopa | 1,380 views



Testing anaesthetic depth in the chicken
Norecopa | 598 views



Blood sampling from the pig
Norecopa | 3,914 views



Subcutaneous injection in the rabbit
Norecopa | 1,479 views



Rat i.p. injection (method 2)
Norecopa | 1,280 views



Blood collection from the saphenous vein in the mouse
Norecopa | 6,777 views



Intravenous injection in a rabbit
Norecopa | 2,025 views



Subcutaneous injection in the chicken
Norecopa | 1,806 views

ANATOMÍA DE LA RATA

Dra. Dolores Vallejo Ruiz
Departamento de Biología de Sistemas, Universidad de Alcalá (Madrid)

Asesoría Científica: Dr. José María Orellana Moriana
Centro de Experimentación Animal, CAI Medicina-Biología, Universidad de Alcalá

Anatomía de la rata
Norecopa | 977 views



Subcutaneous injection in the rat - Technique 1
Norecopa | 2,249 views











Lifting a rabbit
Norecopa | 2,420 views
















Immobilisation of the rabbit
Norecopa | 2,072 views

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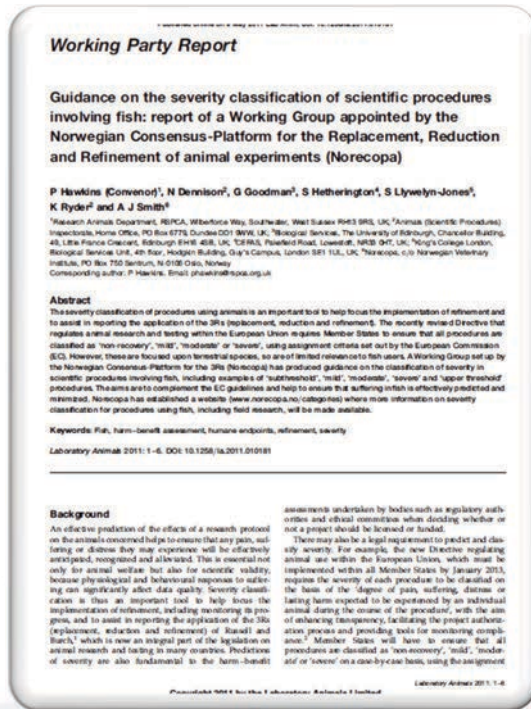
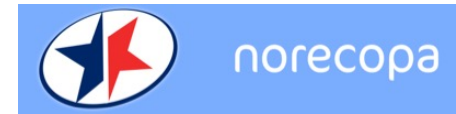
Training resources for animal research

 <p>National Legislation (EU1) Understand the national and international legal and regulatory framework within which projects involving animals are constructed and managed and of the legal responsibilities of the people involved.</p>	 <p>Ethics, Animal Welfare and the 3Rs (EU2) Identify the ethical and welfare issues raised by the use of animals in scientific procedures and understand the basic principles of the 3Rs.</p>
 <p>Basic and Appropriate Biology (EU3) Discover the basic principles of animal behaviour, care, biology and husbandry.</p>	 <p>Animal Care, Health and Management (EU4) Examine information on various aspects of animal health, care and management including: environmental controls, husbandry practices, diet, health status and disease.</p>
 <p>Recognition of Pain, Suffering and Distress (EU5) Identify the normal condition and behaviour of experimental animals and differentiate between a normal animal and one which is showing signs of pain, suffering or distress.</p>	 <p>Humane Methods of Killing (EU6.1) Learn the principles of humane killing including descriptions of the different methods available and information to help you compare the methods permitted to determine the most appropriate method.</p>
 <p>Minor Procedures without Anaesthesia (EU7) An introduction to the theory relating to minor procedures and information about appropriate methods of handling, restraint, appropriate techniques for injection, dosing and sampling relevant to the species.</p>	 <p>Anaesthesia for Minor Procedures (EU20) Guidance and information for individuals who, during their work with animals, will need to apply sedation or short-term anaesthesia for a brief period and mild pain level procedure.</p>

eModules

 <p>eModule – Recognition and Prevention of Pain, Suffering and Distress (EU5) ACCESS</p>	 <p>eModule – Humane Methods of Killing (EU6) ACCESS</p>	 <p>eModule – Design of procedures and projects (level 1) (EU10) ACCESS</p>	 <p>eModule – Design of procedures and projects (level 2) (EU11) ACCESS</p>
 <p>eModule – The Severity Assessment Framework (EU12) ACCESS</p>	 <p>eModule – Anaesthesia for Minor Procedures (EU20) ACCESS</p>	 <p>eModule – Pre-Anaesthetic Preparations (EU21-1) ACCESS</p>	 <p>eModule – Choosing an Anaesthetic (EU21-2) ACCESS</p>
 <p>eModule – Anaesthetic Monitoring and Intraoperative Care (EU21-3) ACCESS</p>	 <p>eModule – Anaesthetic Breathing Systems, Airway Management and Neuromuscular Blocking Agents (EU21-4) ACCESS</p>	 <p>eModule – Anaesthetic Management and Preventing Problems (EU21-5) ACCESS</p>	 <p>eModule – Post Anaesthetic Care (EU21-6) ACCESS</p>
 <p>eModule – Project Evaluation (EU25)</p>			

From **3R-Guide** (380 guidelines for animal research and testing)
norecopa.no/3r-guide



Guidance on the severity classification of procedures involving fish

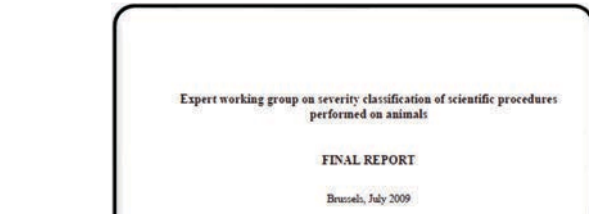
Report from a Working Group convened by Norecopa

P Hawkins, N Dennison, G Goodman, S Hetherington, S Llywelyn-Jones, K Ryder and AJ Smith

Laboratory Animals, 45: 219-224, 2011

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norecopa.no/categories



Food deprivation in rodents
 Toe clipping in mice
 Pain relief in rodents
 Fin clipping in fish



http://ec.europa.eu/environment/chemicals/lab_animals/pdf/report_ewg.pdf

TextBase:

1,500 books related to LAS:

norecopa.no/textbase

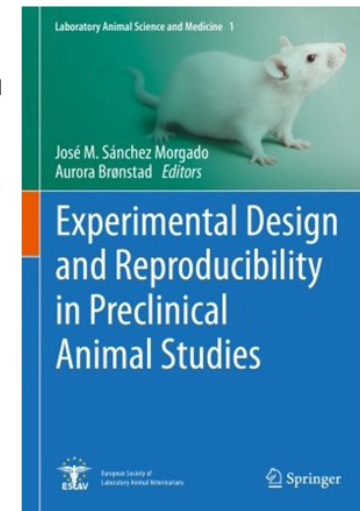
Experimental Design and Reproducibility in Preclinical Animal Studies

By José M. Sánchez Morgado & Aurora Brønstad (Eds.)

Record number: 8619d

This book provides grounds on how to plan and conduct animal experiments that can be reproduced by others. It touches on factors that may impact the reproducibility of animal studies including: the animal genetic background, the animal microbial flora, environmental and physiological variables affecting the animal, animal welfare, statistics and experimental design, systematic reviews of animal studies, and the publishing process.

The book addresses advanced undergraduates, graduate students and all scientists working with animals.



norecopa.no/textbase/experimental-design-and-reproducibility-in-preclinical-animal-studies

Filters: [clear all filters](#)

Database: [TextBase database](#) X

97 results

Animal Welfare

TextBase database/5cf1a

This textbook provides a broad introduction to the key topics in the welfare of animals both large and small, *farm* and companion, wild and zoo.

Author: [Michael Appleby Anna Olsson & Francisco Galindo \(Eds.\)](#)

Publisher: [CAB International](#)

Animal Welfare in Animal Agriculture: Husbandry, Stewardship, and Sustainability in Animal Production

TextBase database/24f23

Name

Typo tolerance:

Default

Database

- 3R Guide database
- Classic AVs database
- European Commission Inventory of 3Rs Education & Training Resources
- European Commission Inventory of 3Rs Knowledge Sources
- European Commission Inventory of NAMs for Respiratory tract diseases
- NAL records
- NORINA database
- Refinement Wiki
- TextBase database (97)
- Website

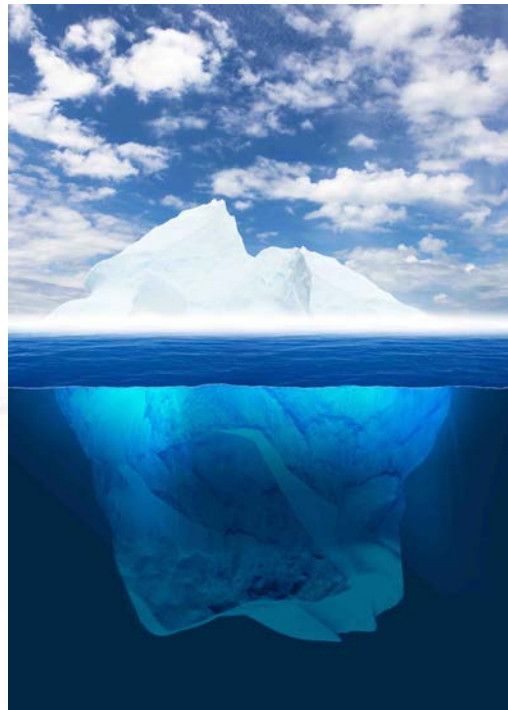
Browse the databases

We have a "reproducibility crisis" in science...

1. **Publication bias** (reporting only positive results)
2. **Low statistical power**
3. **P-value hacking** (manipulating data to obtain significance)
4. **HARKing** (Hypothesizing after the results are known)
5. **Lack of randomisation and blinding**

norecopa.no/concerns





Reporting

Planning

We cannot improve our research by
better reporting alone...



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[reddit.com](https://www.reddit.com)



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The easy parts of design and reporting:

WHAT THE NUMBERS MEAN

Electric → 100 CC

		OREGON		
		.050"	.058"	.063"
.325"	= $\leftarrow +2 \rightarrow$	95		
3/8"	= $\leftarrow +2 \rightarrow$	72	73	75

arborist101.com

- Chainsaw
 - Blade characteristics
 - Sparkplug type
 - Petrol/oil mixture
 - Service history
- Angle of cut in tree
- Length of tree logs



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Critical issues behind the scenes that may not get reported:

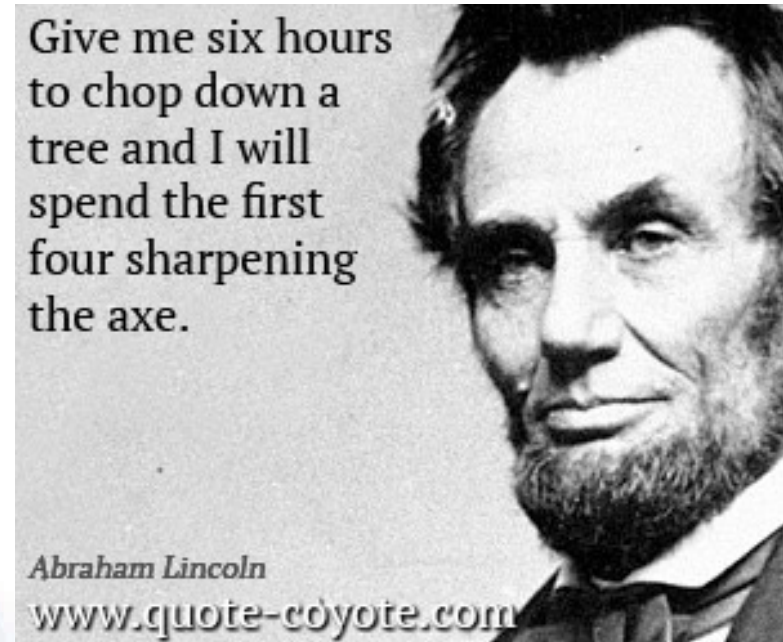
- Experience of the workers
- Inspection for signs of rot and to decide felling direction
- Additional equipment (winch, chains, straps, wedges)
- Routines and equipment for sharpening the chain
- Clearing-up and transport of logs
- Health and safety precautions – clothing, onlookers
- **Division of labour and costs**

Starts long before the actual work.



leaderonomics.com

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editorial | Published: February 2010

Measure twice, think three times, cut once

[L. Noyez](#) 

Netherlands Heart Journal **18**, 60(2010) | [Cite this article](#)

doi.org/10.1007/BF03091738

Abstract

When I was a child, my father taught me how to fix a punctured tyre. He stressed the importance of checking the whole tyre, even if I had already found a puncture, because there could always be more. In addition, he made me check the outer tyre for sharp pieces that could again damage the inside tyre.

How do others achieve reproducibility?



<https://www.meonuk.com/runway-markings-explained>



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...and precision in a variable environment?



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10-15 checklists even on short routine flights



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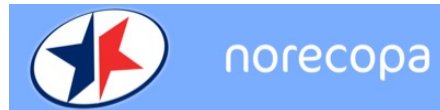


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Checklists

- Reduce risk of **forgetting** to carry out vital actions
- Ensure checks are carried out in the **correct sequence**
- Encourage **cooperation** and **cross-checking** between crew members
- Make sure that everyone is "**on the same page**"

Too late to read the checklists when you have ARRIVED!



colourbox.com

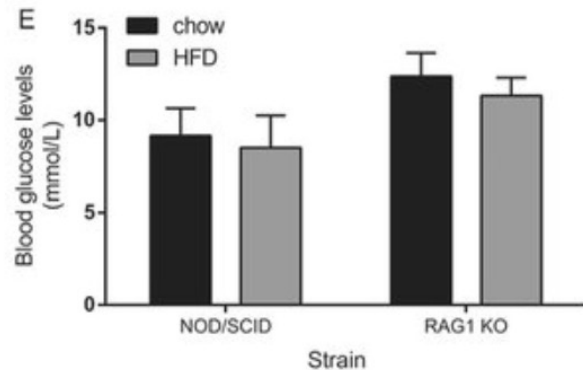
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norecopa.no/PREPARE/film
3-minute cartoon film



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The scientist



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The mouse

Breeding

New social groups

Transportation

Acclimation to research facility

Allocation to experimental group

Adaptation to new diet

Handling and immobilisation

Blood sampling

often also:

injections, gavaging, surgery

pain and distress

developing illness and death

Stress caused by capture and handling



News > Science

Scores of scientific studies based on mice thrown into doubt because they were

Mice pick naturally

Ian Johnston



't act

nc3rs.org.uk/3rs-resources/mouse-handling

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Artefacts caused by poor administration techniques



Photo: NMBU

- *Are you sure that your injection ends up in the same place each time?*
- *Are the injections painful?*
- *Are they realistic? (intramuscular injections in small animals)*

Disposable needles are designed to be used only once!

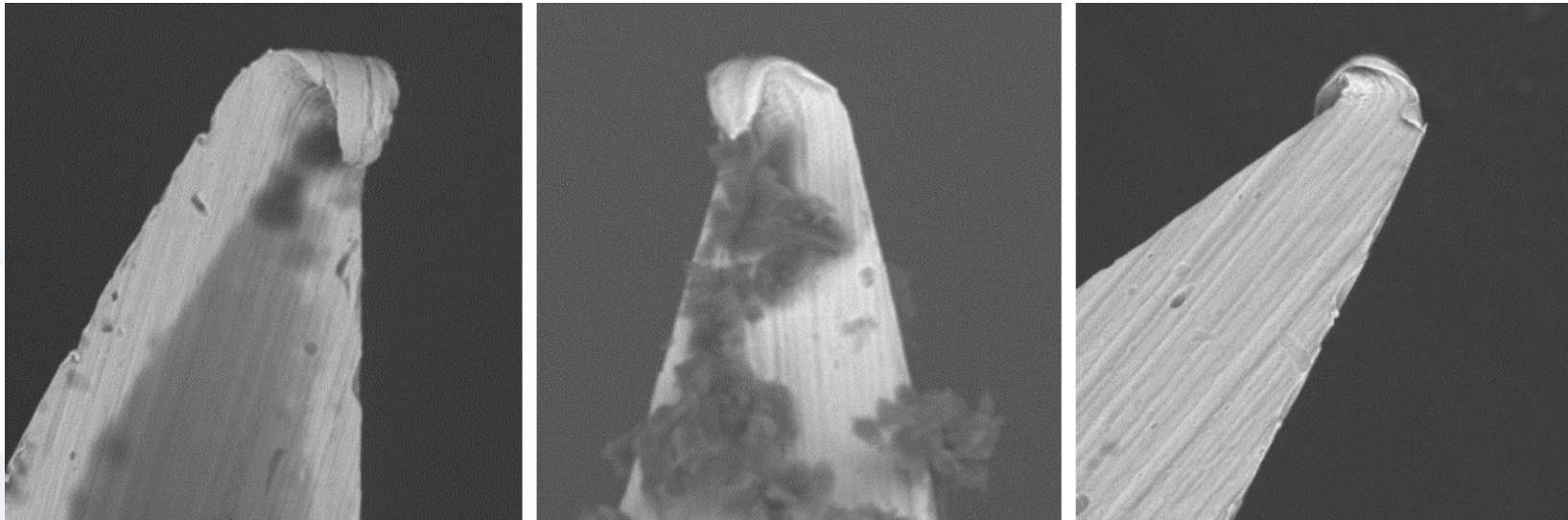
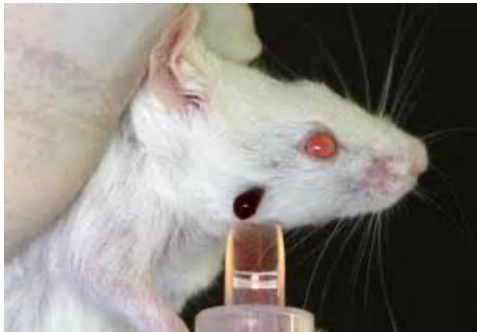


Photo: AstraZeneca

nc3rs.org.uk/news/re-use-needles-indicator-culture-care

'A simple' case: a researcher wants a blood sample



medipoint.com/html/for_use_on_mice.html



[theodora.com/rodent_laboratory/
blood_collection.html](http://theodora.com/rodent_laboratory/blood_collection.html)



photo:NMBU

vimeo.com/486368886

The best blood sampling techniques are those where you can:

- ✓ see the blood vessel
- ✓ regulate the amount of blood you remove
- ✓ stop the bleeding easily (including internal bleeding)
- ✓ avoid damage to the surrounding tissue
- ✓ collect samples rapidly, to avoid artefacts due to mechanical stress, temperature changes, differing lengths of sampling time

While we are waiting for the scientific evidence...

Carol M. Newton (1925-2014)



National Library of Medicine

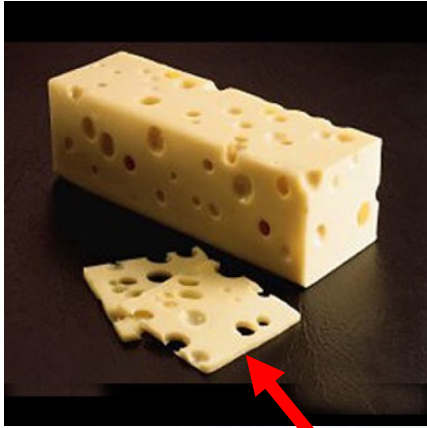
The three S's

- *Good Science*
- *Good Sense*
- *Good Sensibilities*

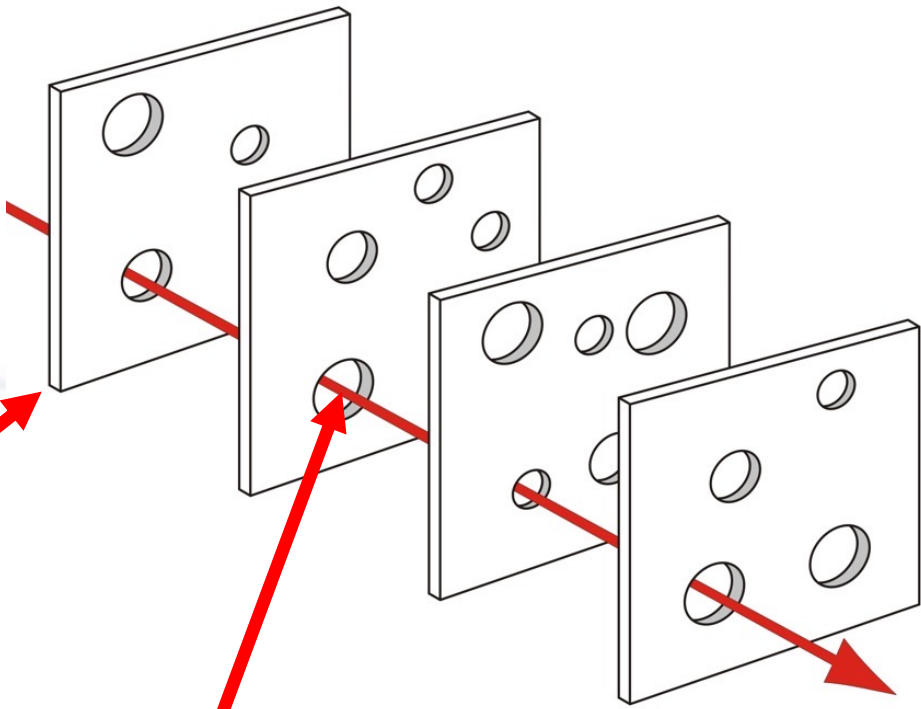
<https://norecopa.no/3S>

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Threat and Error Management



eaugallecheese.com/Swiss-Cheese



"Layer of defence"
or redundancy

Weakness / hazard

Loss

wikipedia.org/wiki/Swiss_cheese_model

Contingency and redundancy

Anything that can go wrong, will go wrong (Murphy's Law)
when it's least convenient (Sod's Law)



Photo: NMBU



Culture of Care

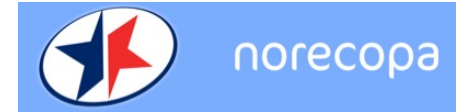
The International Culture of Care Network
norecopa.no/coc

A demonstrable commitment, throughout the establishment, to improving:

- animal welfare
- scientific quality
- care of staff
- transparency for all stakeholders, including the public

It goes beyond simply complying with the law!

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Communication and the Culture of Care

Penny Hawkins, RSPCA Research Animals Department
on behalf of the International Culture of Care Network*

Effective two-way communication between scientists and animal technologists is essential for a good Culture of Care
The European Commission suggests the 'development of formal and informal communication channels, for mutual benefit with respect to science and animal welfare'
Here are some examples from International Culture of Care network members

Regular meetings

Scheduled meetings for scientists, animal technologists, vets, unit managers and AWERB members



Regular refresher/update meetings for all organised by NTCO



Special events

Duo-talks: researcher talks about their science, and animal technologists talk about techniques and animal care within the project



ELH organises an informal meeting for all, in which anyone can raise welfare issues



Building communication into existing processes

Each study has a pre-start and wash-up meeting involving everybody



Three Rs improvements reported to AWERB & shared at external user meetings



Other ideas

A 'boxless' event: anyone can submit 'out of the box' ideas to improve practice



A staff survey for all e.g. how much do you agree with statements such as 'in our group we listen to each others' ideas about animal welfare'



*norecopa.no/culture-of-care



Culture of Care Network

norecopa.no/coc



"because we've always done it that way"

"as often as necessary"

"there are no alternatives"

Closely related to a culture of care is the concept of
a **Culture of Challenge** (Louhimies, 2015).

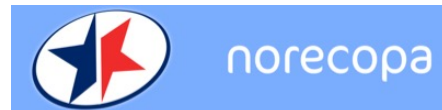
Look for the acceptable, rather than choosing the accepted.

PREPARE encourages scientists to collaborate with animal carers and technicians from Day 1

- they have a right to know and will be more motivated
- they know the possibilities (and limitations) in the animal facility
- they often possess a large range of practical skills and are good at lateral thinking
- they know the animals best
- the animals know them best
- lack of involvement creates anxiety, depression and opposition to animal research, as well as limiting creativity which might improve the experiments



Prepare



Original Article

PREPARE: guidelines for planning animal research and testing

Adrian J Smith¹, R Eddie Clutton², Elliot Lilley³, Kristine E Aa Hansen⁴ and Trond Brattelid⁵

Abstract
There is widespread concern about the quality, reproducibility and translatability of studies involving research animals. Although there are a number of reporting guidelines available, there is very little overarching guidance on how to plan animal experiments, despite the fact that this is the logical place to start ensuring quality. In this paper we present the PREPARE guidelines: Planning Research and Experimental Procedures on Animals: Recommendations for Excellence. PREPARE covers the three broad areas which determine the quality of the preparation for animal studies: formulation, dialogue between scientists and the animal facility, and quality control of the various components in the study. Some topics overlap and the PREPARE checklist should be adapted to suit specific needs, for example in field research. Advice on use of the checklist is available on the Norecoba website, with links to guidelines for animal research and testing, at <https://norecoba.no/PREPARE>.

Keywords
guidelines, planning, design, animal experiments, animal research

Date received: 5 April 2017; accepted: 27 June 2017

Introduction
The quality of animal-based studies is under increasing scrutiny, for good scientific and ethical reasons. Studies of papers reporting animal experiments have revealed alarming deficiencies in the information provided,^{1,2} even after the production and journal endorsement of reporting guidelines.³ There is also widespread concern about the lack of reproducibility and translatability of laboratory animal research.⁴⁻⁷ This can, for example, contribute towards the failure of drugs when they enter human trials.⁸ These issues come in addition to other concerns, not unique to animal research, about publication bias, which tends to favour the reporting of positive results and can lead to the acceptance of claims as fact.⁹ This has understandably sparked a demand for reduced waste when planning experiments involving animals.¹⁰⁻¹² Reporting guidelines alone cannot solve the problem of wasteful experimentation, but thorough planning will increase the likelihood of success and is an important step in the implementation of the 3Rs of Russell & Burch (replacement, reduction, refinement).¹³ The importance of attention to detail at all stages is,

in our experience, often underestimated by scientists. Even small practical details can cause omissions or artefacts that can ruin experiments which in all other respects have been well-designed, and generate health risks for all involved. There is therefore, in our opinion, an urgent need for detailed but overarching guidelines for researchers on how to plan animal experiments which are safe and scientifically sound, address animal

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Norecoba: PREPARE for better Science

PREPARE:

Planning Research and Experimental Procedures on Animals: Recommendations for Excellence

PREPARE covers 15 topics:

Formulation of the study

1. Literature searches
2. Legal issues
3. Ethical issues, harm-benefit assessment and humane endpoints
4. Experimental design and statistical analysis

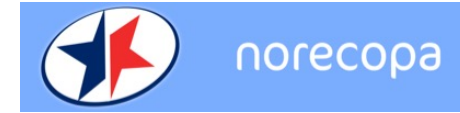
Dialogue between scientists and the animal facility

5. Objectives and timescale, funding and division of labour
6. Facility evaluation
7. Education and training
8. Health risks, waste disposal and decontamination

Methods

9. Test substances and procedures
10. Experimental animals
11. Quarantine and health monitoring
12. Housing and husbandry
13. Experimental procedures
14. Humane killing, release, reuse or rehoming
15. Necropsy

Items in pink are
not typically
highlighted in
reporting guidelines



PREPARE



The PREPARE Guidelines Checklist Planning Research and Experimental Procedures on Animals: Recommendations for Excellence

Adrian J. Smith¹, R. Eddie Clutton², Elliot Lilley³, Kristine E. Aa. Hansen⁴ & Trond Bratteid⁵
¹Norecopa, c/o Norwegian Veterinary Institute, P.O. Box 750 Sentrum, 0106 Oslo, Norway; ²Royal (Dick) School of Veterinary Studies, Easter Bush, Midlothian, EH25 9RG, U.K.; ³Research Animals Department, Science Group, RSPCA, Wilberforce Way, Southwater, Horsham, West Sussex, RH13 9RS, U.K.; ⁴Section of Experimental Biomedicine, Department of Production Animal Clinical Sciences, Faculty of Veterinary Medicine, Norwegian University of Life Sciences, P.O. Box 8146 Dep., 0033 Oslo, Norway; ⁵Division for Research Management and External Funding, Western Norway University of Applied Sciences, 5020 Bergen, Norway.

PREPARE¹ consists of planning guidelines which are complementary to reporting guidelines such as ARRIVE². PREPARE covers the three broad areas which determine the quality of the preparation for animal studies:

1. Formulation of the study
2. Dialogue between scientists and the animal facility
3. Quality control of the components in the study

The topics will not always be addressed in the order in which they are presented here, as a checklist can be adapted to meet special needs, such as field studies. PREPARE includes guidelines for facilities, since in-house experiments are dependent upon their quality. The full version of the checklist is available on the norecopa website, with links to global resources, at <https://norecopa.no/PREPARE>. The PREPARE guidelines are a dynamic set which will evolve as more species- and situation-specific guidelines are produced, and as best practice within Laboratory Animal Science progresses.

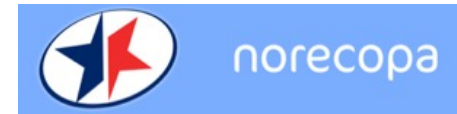
Three Rs!

Topic	Recommendation
(A) Formulation of the study	
1. Literature searches	<input type="checkbox"/> Form a clear hypothesis, with primary and secondary outcomes. <input type="checkbox"/> Consider the use of systematic reviews. <input type="checkbox"/> Decide upon databases and information specialists to be consulted, and construct search terms. <input type="checkbox"/> Assess the relevance of the species to be used, its biology and suitability to answer the experimental questions with the least suffering and to welfare needs. <input type="checkbox"/> Assess the reproducibility and translatability of the project.
2. Legal issues	<input type="checkbox"/> Consider how the research is affected by relevant legislation for animal research and other areas, e.g. animal transport, occupational health and safety. <input type="checkbox"/> Locate relevant guidance documents (e.g. EU guidance on project evaluation).
3. Ethical issues, harm-benefit assessment and humane endpoints	<input type="checkbox"/> Construct a lay summary. <input type="checkbox"/> In dialogue with ethics committees, consider whether statements about this type of research have already been produced. <input type="checkbox"/> Address the 3Rs (replacement, reduction, refinement) and the 3Ss (good science, good sense, good sensibilities). <input type="checkbox"/> Consider pre-regulation and the publication of negative results. <input type="checkbox"/> Perform a harm-benefit assessment and justify any likely animal harm. <input type="checkbox"/> Discuss the learning objectives, if the animal use is for educational or training purposes. <input type="checkbox"/> Allocate a severity classification to the project. <input type="checkbox"/> Define objective, easily measurable and unequivocal humane endpoints. <input type="checkbox"/> Discuss the justification, if any, for death as an end-point.
4. Experimental design and statistical analysis	<input type="checkbox"/> Consider pilot studies, statistical power and significance levels. <input type="checkbox"/> Define the experimental unit and decide upon animal numbers. <input type="checkbox"/> Choose methods of randomisation, prevent observer bias, and decide upon inclusion and exclusion criteria.

Topic	Recommendation
(B) Dialogue between scientists and the animal facility	
5. Objectives and timescale, funding and division of labour	<input type="checkbox"/> Arrange meetings with all relevant staff when early plans for the project exist. <input type="checkbox"/> Construct an approximate timescale for the project, indicating the need for assistance with preparation, animal care, procedures and waste disposal/decontamination. <input type="checkbox"/> Discuss and disclose all expected and potential costs. <input type="checkbox"/> Construct a detailed plan for division of labour and expenses at all stages of the study.
6. Facility evaluation	<input type="checkbox"/> Conduct a physical inspection of the facilities, to evaluate building and equipment standards and needs. <input type="checkbox"/> Discuss staffing levels at times of extra risk.
7. Education and training	<input type="checkbox"/> Assess the current competence of staff members and the need for further education or training prior to the study.
8. Health risks, waste disposal and decontamination	<input type="checkbox"/> Perform a risk assessment, in collaboration with the animal facility, for all persons and animals affected directly or indirectly by the study. <input type="checkbox"/> Assess, and if necessary produce, specific guidance for all stages of the project. <input type="checkbox"/> Discuss means for containment, decontamination, and disposal of all items in the study.
(C) Quality control of the components in the study	
9. Test substances and procedures	<input type="checkbox"/> Provide as much information as possible about test substances. <input type="checkbox"/> Consider the feasibility and validity of test procedures and the skills needed to perform them.
10. Experimental animals	<input type="checkbox"/> Decide upon the characteristics of the animals that are essential for the study and for reporting. <input type="checkbox"/> Avoid generation of surplus animals.
11. Quarantine and health monitoring	<input type="checkbox"/> Discuss the animals' likely health status, any needs for transport, quarantine and isolation, health monitoring and consequences for the personnel.
12. Housing and husbandry	<input type="checkbox"/> Attend to the animals' specific instincts and needs, in collaboration with expert staff. <input type="checkbox"/> Discuss acclimatisation, optimal housing conditions and procedures, environmental factors and any experimental limitations on these (e.g. food deprivation, solitary housing).
13. Experimental procedures	<input type="checkbox"/> Develop refined procedures for capture, immobilisation, marking, and release or rehoming. <input type="checkbox"/> Develop refined procedures for substance administration, sampling, sedation and anaesthesia, surgery and other techniques.
14. Humane killing, release, reuse or rehoming	<input type="checkbox"/> Consult relevant legislation and guidelines well in advance of the study. <input type="checkbox"/> Define primary and emergency methods for humane killing. <input type="checkbox"/> Assess the competence of those who may have to perform these tasks.
15. Necropsy	<input type="checkbox"/> Construct a systematic plan for all stages of necropsy, including location, and identification of all animals and samples.

References
 1. Smith AJ, Clutton RE, Lilley E, Hansen KEA & Bratteid T. PREPARE: Guidelines for Planning Animal Research and Testing. *Laboratory Animals*, 2017, DOI: 10.1177/0023677217724823.
 2. Kilkenny C, Browne WJ, Cuthill IC et al. Improving Bioscience Research Reporting: The ARRIVE Guidelines for Reporting Animal Research. *PLoS Biology*, 2010; DOI: 10.1371/journal.pbio.1000412.

Further information
<https://norecopa.no/PREPARE> | post@norecopa.no | [@norecopa](https://twitter.com/norecopa)



Three versions of the checklist:



The PREPARE Guidelines Checklist

Planning Research and Experimental Procedures on Animals: Recommendations for Excellence

Adrian J. Smith¹, R. Eddie Clutton², Elliot Lilley¹, Kristine E. Aa. Hanssen¹ & Trond Bratlie¹
¹Norecopa, c/o Norwegian Veterinary Institute, P.O. Box 750 Sentrum, 0106 Oslo, Norway; ²Royal (Dick) School of Veterinary Studies, Easter Bush, Midlothian, EH25 9RG, U.K.; ³Research Animals Department, Science Group, RSPCA, Wilberforce Way, Southwater, Horsham, West Sussex, RH13 9RS, U.K.; ⁴Section of Experimental Biomedicine, Department of Production Animal Clinical Sciences, Faculty of Veterinary Medicine, Norwegian University of Life Sciences, P.O. Box 8148 Dep., 0033 Oslo, Norway; ⁵Division for Research Management and External Funding, Western Norway University of Applied Sciences, 5020 Bergen, Norway.

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1. plain pdf file

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Further information
<https://norecopa.no/PREPARE> | post@norecopa.no | [@norecopa](https://www.instagram.com/norecopa)

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Three versions of the checklist:

2. fillable pdf file

norecopa.no/PREPARE-Word

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PREPARE



The PREPARE Guidelines Checklist

Planning Research and Experimental Procedures on Animals: Recommendations for Excellence

Adrian J. Smith^a, R. Eddie Clutton^b, Elliot Lilley^c, Kristine E. Aa. Hansen^d & Trond Brattelid^e

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^dSection of Experimental Biomedicine, Department of Production Animal Clinical Sciences, Faculty of Veterinary Medicine, Norwegian University of Life Sciences, P.O. Box 8146 Dep., 0033 Oslo, Norway; ^eDivision for Research Management and External Funding, Western Norway University of Applied Sciences, 5020 Bergen, Norway.

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Formulation of the study

1. Literature searches

✓ Form a clear hypothesis, with primary and secondary outcomes.

Text stored in the file

Consider the use of systematic reviews.

Decide upon databases and information specialists to be consulted, and construct search terms.

norecopa.no/PREPARE/prepare-checklist

Three versions of the checklist:

3. online version

norecopa.no/PREPARE/Mychecklist

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PREPARE



The PREPARE Guidelines Checklist

Planning Research and Experimental Procedures on Animals: Recommendations for Excellence

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Create new PREPARE checklist

Open existing checklist

Your auth code for this checklist is **deeb7d** Please save this code so you are able to open your checklist at a later time. You can also bookmark this page.

Topic	Recommendation
(A) Formulation of the study	
1. Literature searches	<input type="checkbox"/> Form a clear hypothesis with primary and secondary outcomes. <input type="checkbox"/> Consider the use of systematic reviews. <input checked="" type="checkbox"/> Decide upon databases and information specialists to be consulted, and construct search terms. <input type="checkbox"/> Assess the relevance of the species to be used, its biology and suitability to answer the experimental questions with the least suffering, and its welfare needs.
2. Legal issues	<input type="checkbox"/> Consider how the research is affected by relevant legislation for animal research and other areas, e.g. animal transport, occupational health and safety.

Decide upon databases and information specialists to be consulted, and construct search terms.

Decide upon databases and information specialists to be consulted, and construct search terms.

Decide upon databases and information specialists to be consulted, and construct search terms.

Decide upon databases and information specialists to be consulted, and construct search terms.

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Nore

- 3-Ethical issues, harm-benefit assessment and humane endpoints
 - 3a Construct a lay summary.
 - 3b In dialogue with ethics committees, consider whether statements about this type of research have already been produced.
 - 3c Address the 3Rs (Replacement, Reduction, Refinement) and the 3Ss (Good Science, Good Sense, Good Sensibilities).
 - 3d Assessment and justify any likely animal harm.
 - 3f Discuss the learning objectives, if the animal use is for educational or training purposes.
 - 3g Allocate a severity classification to the project.
 - 3h Define objective, easily measurable and unequivocal humane endpoints.
 - 3i Discuss the justification, if any, for death as an end-point.
- 4-Experimental design and statistical analysis

5. Have the experiments been carried out before, and is any repetition justifiable?
6. What [approaches to reduce distress](#) have been considered?

3a Construct a lay summary.

- General principles
- For fish researchers**

1. Have national or local research ethics committees already produced statements relevant to the research being planned? Consideration should also be paid to the broader context of the research. For example, research directed at increasing the productivity of farming at the expense of (or without improving) individual animal welfare, or wildlife research whose primary aim is population management.

Links to quality guidelines and scientific papers worldwide on e.g. blood sampling, injection volumes, housing and husbandry, analgesia, humane endpoints, experimental design

2. Will any advances in this research be published, and if so, will the publication only index the title and abstract, or will the full text be made available? Will the project be rejected?

3. Have the Three S's ([Good Science, Good Sense and Good Sensibilities](#)) been addressed? Sufficient time should be allocated to this point, since two of the three S's are highly subjective, but equally important. The use of commonsense and critical anthropomorphism are justifiably part of the work to assess the impact of research on animals, not least when a scientific evidence base does not exist.

4. Does the proposed study have a clear rationale and scientific relevance, and what will be the next step if the hypothesis is supported or rejected?

5. Have the experiments been carried out before and is any repetition justifiable?

6. What [approaches to reduce distress](#) have been considered?

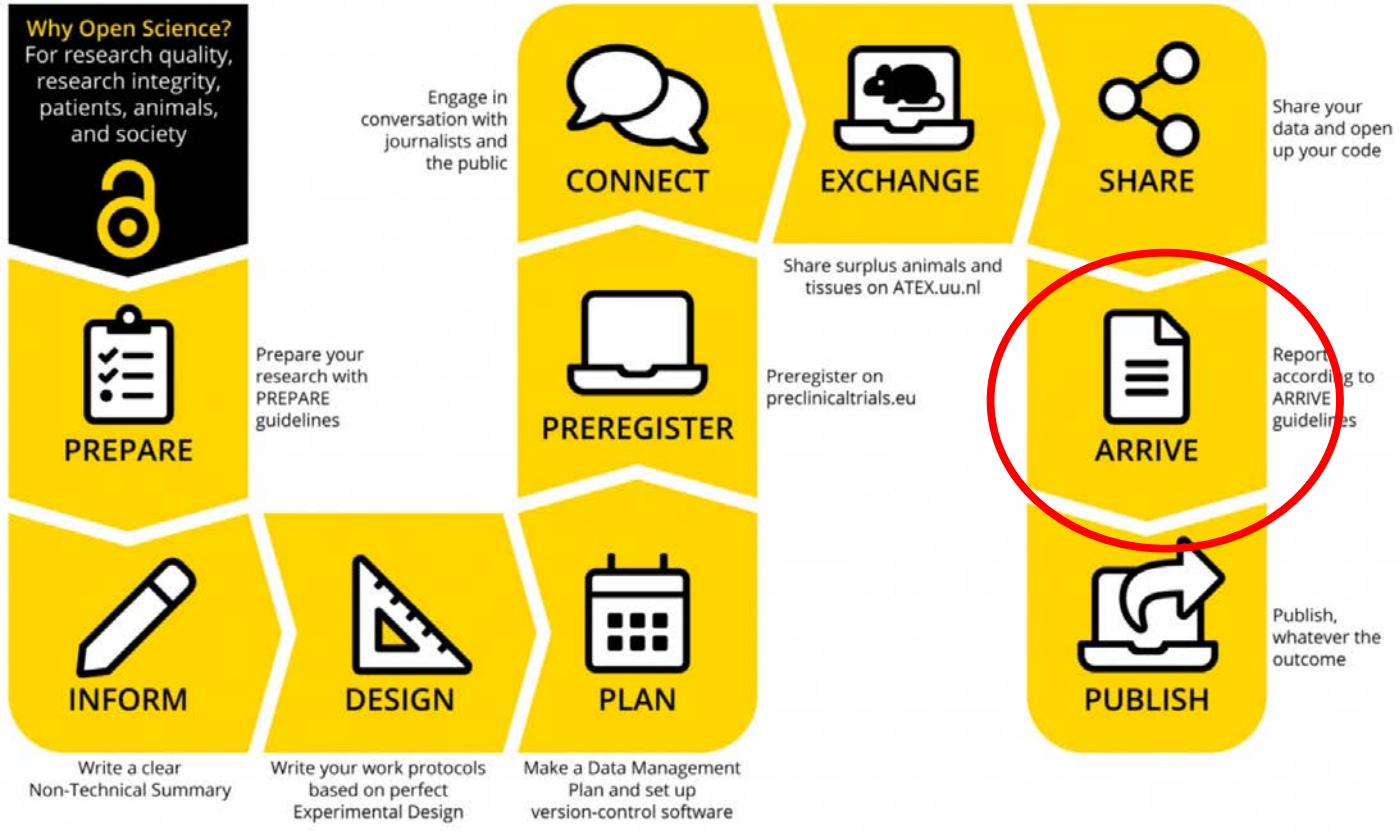
7. Will the project undergo [pre-registration](#) and will negative results be published, to avoid publication bias?

Many more [links to resources on ethics are available here](#).

Details about pre-registration of animal studies and reporting of critical incidents are to be found in the section on [Experimental Design and Statistical Analysis](#).

Harm-Benefit Assessment

The path to better research



Norecopa: PREPARE for better Science

norecopa.no/PREPARE and ivd-utrecht.nl/en/news/better-animal-research-through-open-science-1

The ARRIVE guidelines 2019: updated guidelines for reporting animal research

Nathalie Percie du Sert¹, Viki Hurst¹, Amrita Ahluwalia², Sabina Alam³, Marc T. Avey⁴, Monya Baker⁵, William J. Browne⁶, Alejandra Clark⁷, Innes C. Cuthill⁶, Ulrich Dirnagl⁸, Michael Emerson⁹, Paul Garner¹⁰, Stephen T. Holgate¹¹, David W. Howells¹², Natasha A. Karp¹³, Katie Lidster¹, Catriona J. MacCallum¹⁴, Malcolm Macleod¹⁵, Ole Petersen¹⁶, Frances Rawle¹⁷, Penny Reynolds¹⁸, Kieron Rooney¹⁹, Emily S. Sena¹⁵, Shai D. Silberberg²⁰, Thomas Steckler²¹, Hanno Würbel²²

[biorxiv.org/content/10.1101/703181v1](https://doi.org/10.1101/703181v1)

Version 1 of ARRIVE (2010) 'endorsed by more than a thousand journals'
but
'only a small number of journals actively enforce compliance'

(Swiss study in 2016: 51% of researchers publishing in journals that had endorsed ARRIVE had never heard of them)

'Important information as set out in the ARRIVE guidelines **is still missing from most publications** sampled:
randomisation 30-30%
blinding 20%
sample size justification <10%
all basic animal characteristics <10%'

'Providing the level of journal or editorial input to ensure compliance with all the items of the ARRIVE guidelines is unlikely to be sustainable for most journals because of the resources needed'

arriveguidelines.org

The ARRIVE guidelines 2.0

This section of the website provides detailed explanations about each item of the guidelines. Use the left-hand side menu to navigate to each item.

To facilitate a step-wise approach to improving reporting, the guidelines are organised into two prioritised sets:

ARRIVE Essential 10

These ten items are the basic minimum that must be included in any manuscript describing animal research. Without this information readers and reviewers cannot assess the reliability of the findings.

Recommended Set

These items complement the Essential 10 set and add important context to the study described. Reporting the items in both sets represents best practice.

Norecopa: PREPARE for better Science

ARRIVE 2.0

ARRIVE Essential 10		
Study design	1	For each experiment, provide brief details of study design including: a. The groups being compared, including control groups. If no control group has been used, the rationale should be stated. b. The experimental unit (e.g. a single animal, litter, or cage of animals).
Sample size	2	a. Specify the exact number of experimental units allocated to each group, and the total number in each experiment. Also indicate the total number of animals used. b. Explain how the sample size was decided. Provide details of any <i>a priori</i> sample size calculation, if done.
Inclusion and exclusion criteria	3	a. Describe any criteria established <i>a priori</i> for including and excluding animals (or experimental units) during the experiment, and data points during the analysis. b. For each experimental group, report any animals, experimental units or data points not included in the analysis and explain why. c. For each analysis, report the exact value of N in each experimental group.
Randomisation	4	Describe the methods used: a. To allocate experimental units to control and treatment groups. If randomisation was used, provide the method of randomisation. b. To minimise potential confounding factors such as the order of treatments and measurements, or animal/cage location.
Blinding	5	Describe who was aware of the group allocation at the different stages of the experiment (during the allocation, the conduct of the experiment, the outcome assessment, and the data analysis).
Outcome measures	6	a. Clearly define all outcome measures assessed (e.g. cell death, molecular markers, or behavioural changes). b. For hypothesis-testing studies, specify the primary outcome measure, i.e. the outcome measure that was used to determine the sample size.
Statistical methods	7	a. Provide details of the statistical methods used for each analysis. b. Specify the experimental unit that was used for each statistical test. c. Describe any methods used to assess whether the data met the assumptions of the statistical approach.
Experimental animals	8	a. Provide details of the animals used, including species, strain and substrain, sex, age or developmental stage, and weight. b. Provide further relevant information on the provenance of animals, health/immune status, genetic modification status, genotype, and any previous procedures.
Experimental procedures	9	For each experimental group, including controls, describe the procedures in enough detail to allow others to replicate them, including: a. What was done, how it was done and what was used. b. When and how often. c. Where (including detail of any acclimation periods). d. Why (provide rationale for procedures).
Results	10	For each experiment conducted, including independent replications, report: a. Summary/descriptive statistics for each experimental group, with a measure of variability where applicable. b. If applicable, the effect size with a confidence interval.

ARRIVE 2.0

Recommended Set		
Abstract	11	Provide an accurate summary of the research objectives, animal species, strain and sex, key methods, principal findings, and study conclusions.
Background	12	a. Include sufficient scientific background to understand the rationale and context for the study, and explain the experimental approach. b. Explain how the animal species and model used address the scientific objectives and, where appropriate, the relevance to human biology.
Objectives	13	Clearly describe the research question, research objectives and, where appropriate, specific hypotheses being tested.
Ethical statement	14	Provide the name of the ethical review committee or equivalent that has approved the use of animals in this study and any relevant licence or protocol numbers (if applicable). If ethical approval was not sought or granted, provide a justification.
Housing and husbandry	15	Provide details of housing and husbandry conditions, including any environmental enrichment.
Animal care and monitoring	16	a. Describe any interventions or steps taken in the experimental protocols to reduce pain, suffering and distress. b. Report any expected or unexpected adverse events. c. Describe the humane endpoints established for the study and the frequency of monitoring.
Interpretation /scientific implications	17	a. Interpret the results, taking into account the study objectives and hypotheses, current theory and other relevant studies in the literature. b. Comment on the study limitations including potential sources of bias, limitations of the animal model, and imprecision associated with the results.
Generalisability /translation	18	Comment on whether, and how, the findings of this study are likely to generalise to other species or experimental conditions, including any relevance to human biology (where appropriate).
Protocol registration	19	Provide a statement indicating whether a protocol (including the research question, key design features, and analysis plan) was prepared before the study, and if and where this protocol was registered.
Data access	20	Provide a statement describing if and where study data are available.
Declaration of interests	21	a. Declare any potential conflicts of interest, including financial and non-financial. If none exist, this should be stated. b. List all funding sources (including grant identifier) and the role of the funder(s) in the design, analysis and reporting of the study.

The screenshot shows the ARRIVE guidelines website. The top navigation bar includes 'Home', 'About', 'ARRIVE guidelines', 'Supporters', 'Resources', 'Publications', and 'News'. A left-hand navigation menu lists 14 items, with '11. Abstract' highlighted in a dark purple box and circled in red. The main content area is titled 'RECOMMENDED SET' and '11. Abstract'. It features a purple box with the number '11' and the text: 'Provide an accurate summary of the research objectives, animal species, strain and sex, key methods, principal findings, and study conclusions.' Below this are two tabs: 'Explanation' and 'Examples'. The 'Explanation' tab is active, showing a paragraph: 'A transparent and accurate abstract increases the utility and impact of the manuscript, and allows readers to assess the reliability of the study [1]. The abstract is often used as a screening tool by readers to decide whether to read the full article or whether to select an article for inclusion in a systematic review. However, abstracts often either do not contain enough information for this purpose [2], or contain information that is inconsistent with the results in the rest of the manuscript [3,4]. In systematic reviews, initial screens to identify papers are based on titles, abstracts and keywords [5]. Leaving out of the abstract information such as the species of animal used or the drugs being tested, limits the value of preclinical systematic reviews as relevant studies cannot be identified and included. For example, in a systematic review of the effect of the MVA85A vaccine on tuberculosis challenge in animals, the largest preclinical trial did not include the vaccine name in the abstract or keywords of the publication, the paper was only included in the systematic review following discussions with experts in the field [6]. To maximise utility, include details of the species, sex and strain of animals used, and accurately report the methods, results and conclusions of the study. Also describe the objectives of the study, including whether it was designed to either test a specific hypothesis or to generate a new hypothesis (see item 13 – Objectives). Incorporating this information will enable readers to interpret the strength of evidence, and judge how the study fits within the wider knowledge base.' Below the text is a 'References' section with two entries: 1. Haynes RB, Mulrow CD, Huth EJ, Altman DG and Gardner MJ (1990). More informative abstracts revisited. *Ann Intern Med.* doi: 10.7326/0003-4819-113-1-69 2. Hair K, Macleod MR, Sena ES, Sena ES, Hair K, Macleod MR, Howells D, Bath P, Irvine C, MacCallum C, Morrison G,

There are three broad areas which need to be considered when planning animal studies:

1. The suitability of the species or strain as a model of the target organism
2. The ethical issues surrounding their use: '[choosing the right animal for the right reason](#)'. The large increase in use of genetically altered lines has created increasing [concern about the suitability of these animals as models of human conditions](#).
3. Characterisation of the animals. Items to be considered, in collaboration with the supplier, include:
 - > Species, strain, line and phenotype (with an explanation of any genetic modifications)
 - > Age, developmental stage, sex and weight
 - > Stage of oestrous cycle and any previous breeding history
 - > Any necessary pre-treatment (e.g. castration) for this
 - > Name and address of the supplier/breeder, method of capture and transport
 - > [Health status](#) (e.g. germ-free, gnotobiotic, SPF)
 - > Re-use of animals, which should be justified by legislation
 - > Any plans for release or re-homing, which must be justified

More resources

- > [Examples and references](#) from the NC3Rs
- > [Information on inbred strains of mice and rats](#)
- > [Strategies to minimise genetic drift and maximise experimental reproducibility in mouse research](#)
- > [Mouse Locator, UK](#)
- > [The Collaborative Cross panel of inbred mouse strains](#)
- > [Nude mice - more than what meets the eye](#)
- > [The Rat Guide](#)
- > [Rat Behavior and Biology](#)



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3R improvements are often not highlighted in the scientific literature



http://www.theodora.com/rodent_laboratory/blood_collection.html



photo:NMBU

SCID-Hu mice immunized with a pneumococcal vaccine produce specific human antibodies and show increased resistance to infection.



Flag



Saphenous vein puncture for blood sampling of the mouse, rat, hamster, gerbil, guineapig, ferret and mink

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Summary

A method is described for blood collection from the lateral saphenous vein. This enables rapid sampling, which if necessary can be repeated from the same site without a need for new puncture wounds. The method is a humane and practical alternative to cardiac and retro-orbital puncture, in species where venepuncture has traditionally been regarded as problematic.

Keywords Saphenous vein; blood sampling; mouse; rat; hamster; gerbil; guineapig; rodent; ferret; mink

The title and summary are critical, because they are often the only parts that are indexed by databases.

Not necessarily a high-impact journal.



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Clicker training

Clicker training is an operant conditioning based on positive reinforcement. When the animal offers the desired behavior, a *click* or another distinctive sound (secondary reinforcer) is delivered and within the following few seconds the reward is presented (primary reinforcer)^[1]. The *click* bridges the time between the desired behavior and the presentation of the reward^[1]. A target stick providing a visual guide for the animal can be used for the training.

Animals are usually trained individually, though it is also possible to perform clicker training in a groups, e.g. in mice, rats, and rabbits. For rats, it was demonstrated that they learned tasks by observing the clicker training of their cage mates^[2].

Clicker training can be used to train animals in a stress-free way. The following behaviours are examples for what this technique can be used for:

Mice: entering a tunnel, following a target stick, climbing on the palm of the hand^[3]

Rats: following a target stick, voluntarily change to a cage, observational learning^[2]

Rabbits: following a target stick, rearing/standing up to inspect the abdomen, approaching a human, being touched and lifted by a human, trimming nails, coming on command

Pigs: Pigs can be easily trained to cooperate if they are treated empathetically and desired behavior is reinforced by providing food stuff in form of treats and apple juice^[4].



Clicker training with mice using a target stick. *Left:* The mouse is following the target stick and is climbing on the experimenter's hand. If the hand is lifted, the mouse will remain on the palm of the hand. *Right:* The mice are trained in a group. Two mice are following the target stick on the palm of the experimenter's hand.

- ¹ ^{1.0} ^{1.1} Feng, Lynna C.; Howell, Tiffani J.; Bennett, Pauleen C. (1 August 2016). "How clicker training works: Comparing Reinforcing, Marking, and Bridging Hypotheses"[ⓘ]. *Applied Animal Behaviour Science*. **181**: 34–40. doi:10.1016/j.applanim.2016.05.012[ⓘ]. ISSN 0168-1591[ⓘ].
- ² ^{2.0} ^{2.1} Leidinger, Charlotte Sophie; Kaiser, Nadine; Baumgart, Nadine; Baumgart, Jan (25 October 2018). "Using Clicker Training and Social Observation to Teach Rats to Voluntarily Change Cages"[ⓘ]. *JoVE (Journal of Visualized Experiments)* (140): e58511. doi:10.3791/58511[ⓘ]. ISSN 1940-087X[ⓘ]. PMC 6235608[ⓘ]. PMID 30417890[ⓘ].
- ³ Leidinger, Charlotte; Herrmann, Felix; Thöne-Reineke, Christa; Baumgart, Nadine; Baumgart, Jan (6 March 2017). "Introducing Clicker Training as a Cognitive Enrichment for Laboratory Mice"[ⓘ]. *JoVE (Journal of Visualized Experiments)* (121): e55415. doi:10.3791/55415[ⓘ]. ISSN 1940-087X[ⓘ]. PMC 5408971[ⓘ]. PMID 28287586[ⓘ].
- ⁴ "Positive Reinforcement Training in Large Experimental Animals"[ⓘ] (PDF).

Experts for clicker training in mice and rats: [TARC](#)[ⓘ], Mainz, Germany

This page was created and edited by KH191219 (talk).

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- Analgesia
- Asepsis
- Blood sampling of hamsters
- Blood sampling of pigs
- Blood sampling of rainbow trout
- Breeding strategies for mice
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- Detecting early onset of clinical signs in the mouse model of Covid-19
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All Wiki content is retrievable from Norecopa's search engine

In addition, the Wiki has its own internal search engine

A simple instruction manual to keep the threshold for adding new content as low as possible



Acknowledgements

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European Commission

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Animals used for scientific purposes

Retrieval and provision of information on the "Three Rs" and alternatives

Accessing accurate, relevant and up-to-date information on the Three Rs is a challenge for all those use of animals.

Legislation and implementation

- EU legislative framework
- Implementation of Directive 2010/63/EU
- Q&A and guidance documents

The "Three Rs" and alternative approaches

- Replacement, Reduction and Refinement – the "Three Rs"
- Validation, acceptance and use
- EU activities to advance alternatives
- Member State activities to advance alternatives
- Finding and distributing information on alternatives
- Key resources
 - Search Tools
 - Databases
 - Portals and web-sites
 - Journals
 - Other resources and organisations

Animals used for scientific purposes

Opinions of European Commission Expert Committees related to the use of animals in experiments

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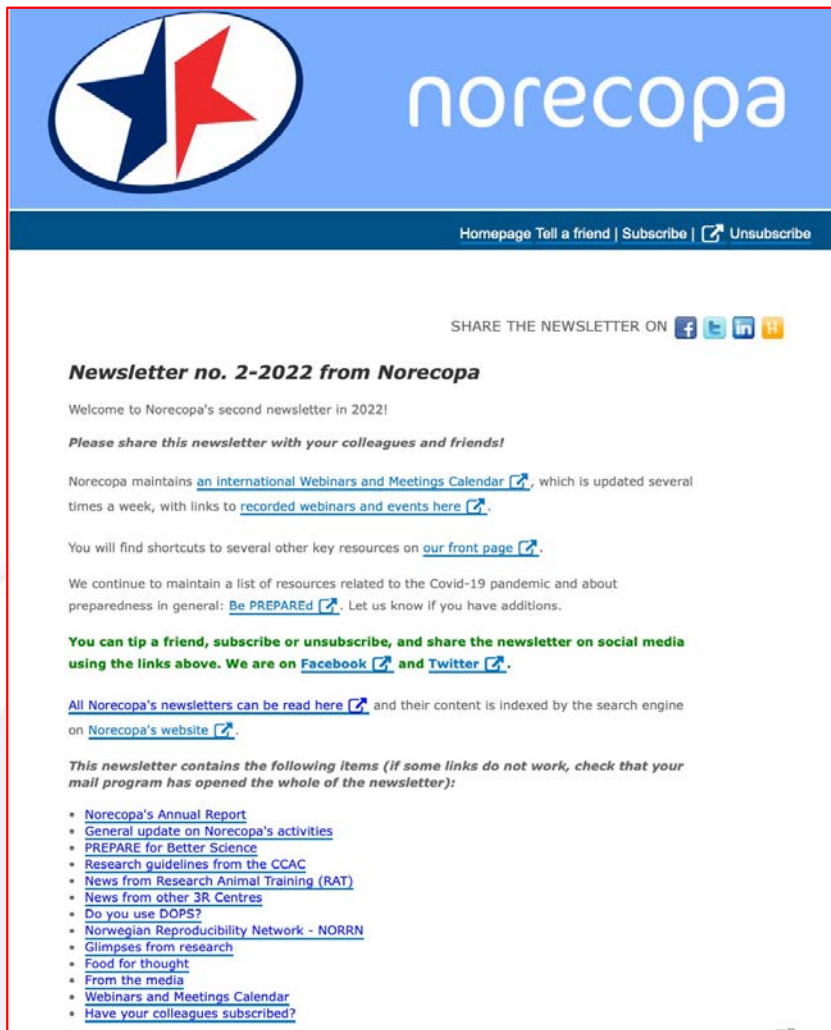


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