

NCEA Biology Resource

Student
Resource

Using Animals in Science

The use of animals in
scientific research, teaching,
and testing in New Zealand



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This resource provides information about the use of animals in scientific research, teaching, and testing in New Zealand. It deals with why animals are used, how any harm done to the animals is kept as low as it can be, what benefits arise from their use, and the importance of weighing any harm against the benefits when deciding whether or not to use animals.

The resource also covers the importance of ethical thinking for and against the use of animals in science. Finally, the control of the scientific uses of animals in New Zealand is described.



What do research, teaching and testing mean?

Research, teaching and testing refer to three separate and different ways animals can be used. Some questions about animals, humans, or the environment don't have answers because we don't have the right information.

Animal use in research is the scientific process of designing and conducting experiments involving animals in order to produce this information and answer these questions. Answering these questions generates scientific knowledge. Sometimes animals are used to help students to learn about animals, humans or biological sciences. This is animal use in teaching. Animals can be used to test new products to ensure that they are safe for human or animal use, and to produce biological products used in teaching or research. This is animal use in testing.

Why study animals?

There are many reasons why scientists study animals, for example:

Human health



Animal models

Animals are used to model body function in humans because the bodies of many different animals can work in similar ways. Thus, when scientists study one animal species they can often apply that knowledge to other species as well. Our knowledge of the workings of virtually every system of the human body has been developed in this way. Scientists working with animals aim to improve the health and well-being of people and animals by:

- Understanding how the body works normally
- Understanding what causes abnormal function, illness and diseases and how they may be detected, treated and prevented.

Parallels between animal and human diseases

Some infectious diseases only occur in particular animal species and cannot be caught by others, but the infectious agent (e.g., a bacterium or a virus) may belong to a family where different members of it do cause similar diseases in a different animal species. For example, the viruses that causes AIDS in people is similar to Feline Immunodeficiency Virus Infection (FIV) in cats. Comparing the way the bodies of the different species respond to their similar, but distinct, disease agents can improve our knowledge of the way the disease operates in both species.

Controlling diseases

A well-known example of this is the use of insulin injections by people with diabetes mellitus. The injected insulin is needed because secretion of the body's own insulin, by the pancreas, is not adequate to control blood sugar levels. Another example of a control treatment is the use of medication to prevent fits (seizures) in animals and people with epilepsy. Knowing what causes diseases like diabetes and epilepsy is necessary before treatments that control them safely can be devised.

Curing diseases

Knowing what causes diseases is the key to finding cures. For instance, deficiency diseases, which arise because important substances like vitamin C and iodine are not present in food in sufficient quantities, are cured by identifying what the deficiency is and then by providing the necessary substance. Infections caused by bacteria can be cured by antibiotics, which are designed to kill the bacteria while doing little or no harm to the body.

Palliative treatments

These are designed to reduce the painful and other unpleasant effects of currently incurable diseases. They are also used during the treatment of curable diseases and injuries. A most striking example is the development and use of the many treatments we now have for relieving pain. For instance, pain-relieving drugs, and other methods, can completely remove the pain or can very markedly reduce it in cancer patients, and can provide relief after surgical operations used to help cure some diseases and to repair injuries like those caused by car accidents.

Preventing diseases

Learning what causes diseases helps us to work out ways we can prevent them. For instance, no or very low amounts of important substances in our food cause what are called deficiency diseases (e.g. shortage of vitamin C causes scurvy; shortage of iodine causes goitre). Deficiency diseases are prevented by eating a balanced diet (e.g., fruit and vegetables supply vitamin C) or by adding the deficient element to food (e.g., adding iodine to table salt). Knowing that micro-organisms (germs or bugs) cause infectious diseases allows us to reduce our chances of catching those diseases. We can do this by using good hygiene to reduce our exposure to micro-organisms (e.g., washing hands before eating and after using the toilet, making sure food is prepared cleanly and cooked well), and by taking care when we handle animals that carry diseases that can infect us. Knowing which micro-organisms cause particular diseases and how body defence responses protect animals and people, allows the development of vaccines which are designed to improve the way the body can defend itself against dangerous diseases.



Health of companion, sport and service animals

Animal research also aims to improve the health and welfare of animals that provide us with companionship as pets, and with which we share other activities.

Pets/Companion animals

These are the animals we keep in our homes, including birds, cats, dogs, fish, guinea-pigs, rabbits, mice, rats and terrapins. Scientists have helped us to understand the special needs of these animals. For example: the special diets of animals at different ages, when pregnant and nursing offspring, the special diets, exercise and health care required during the training and racing of sports animals, and the health of companion, sport and service animals.

Animals can also keep us healthy by giving us a reason to exercise, and reduce stress by providing a companion to care for. Young children, especially those with learning problems, and elderly people living alone can be helped by owning pets, and recovery from illness or injury may be assisted by contact with pets.

Entertainment

Animals mentioned here are in circuses, game parks, rodeos and zoos. They have special needs in their natural state and when kept for entertainment. They are studied to determine whether those special needs can be met and that they can be kept in a good state of welfare. In zoos, they are also studied to help save endangered species as part of conservation programmes.

Sport and recreation

These animals are either the main focus of some leisure activities or are an important part of them, such as horse riding. They also include club, competition and show birds, cats, dogs and ponies or horses.

Service

These animals include farm dogs, guard dogs, guide dogs for the blind, government ministry food and drug dogs (like those you see at the airport), police dogs and search and rescue dogs. They help us in a wide range of daily activities. In other countries there are many draught animals like donkeys and buffalo which provide transport and motive power (pulling, pushing) for people.

In recreation, sport and service, animal research determines the biological and psychological needs of animals in these environments, and how they can be catered for to optimise animal health, welfare and performance.



Farm and other production animals

Scientists work to improve the health, welfare and productivity of farm animals and other animals used to provide:

- **Food:** meat (e.g., beef/veal, lamb/mutton, pork/ham/bacon, chicken, fish), dairy products (e.g., milk, cheese, yoghurt) and eggs
- **Fibre:** for example, fur, hair and wool
- **Other products:** for example, leather goods (e.g., shoes, gloves, wallets, clothes) and rugs derived from skins; feathers; medicines and many other things.

Additionally, information obtained in one species can be used to help another animal species, for example, knowledge about digestion of food in the gut of sheep helps us to better manage cattle. The differences between species helps us understand the animal kingdom as a whole.



Native and endangered wildlife

Native animals

We need to learn about the unique biology of these animals – in what ways their bodies work differently from other animals of a similar type. With endangered species, this also means learning about what special conditions (e.g., providing particular foods) must be met to enable them to reproduce successfully. Our unique native animals include the bellbirds, kākāpō, kea, kereru, kiwi, tui, weka, tuatara, geckos and skinks.

Scientists work to find more effective and humane ways to preserve, protect and manage a range of animal species that is endemic to the New Zealand environment. This work is directed at safeguarding New Zealand's native animals, many of which are birds, and New Zealand's native plants. It involves knowing about the native animals themselves, the foods they like and need, and the animals that threaten their survival. Threats to native animals arise from direct attacks by predators or by over-browsing of essential food plants by other so-called 'pest' animals such as possums. Thus, safeguarding our native animals and plants also involves developing humane and effective pest control methods to protect such animal and plant species from the animals that threaten them.

Pest and predator control

Protecting endangered species often involves devising humane and effective pest control methods. There are several species of animals that were introduced into New Zealand long ago that directly attack or damage the habitat of our native animals, especially our flightless ground dwelling birds. These include cats, dogs, ferrets, possums, rats, stoats and weasels. Animal-based scientists contribute to controlling their numbers, for example, by working out which traps or poisons cause the least suffering to possums, how to avoid killing non-target animals and how, in a pain-free way, to prevent reproduction in possums.

Knowledge of biological processes

Scientists work to broaden the foundations of biological science, including our knowledge and understanding of life processes in all animal species. We have an in-built curiosity to discover how things work. This curiosity leads us to explore how the bodies of animals and people work, simply because we would like to know. This desire for knowledge is a separate and distinct reason, quite different from all of the others noted here.





Benefits of animal-based science

The benefits or successes of animal-based science are so widespread that it is hard to imagine any area of our lives that is unaffected by them. Some of the examples of the benefits provided here arose from direct observation of people. However, the details of the body mechanisms in people were mostly worked out by studying similar functions in animals. The benefits brought to animals were mostly worked out by direct animal studies, but sometimes arose from studies of people.

A very brief history of biomedical developments

Direct animal studies led to many of the biomedical developments listed here, especially those made during the last 100 years. However, some of these developments first arose from direct observation of people. In those cases the details of the body mechanisms in people were mostly worked out by studying similar functions in animals. Parallel developments benefited both people and animals.

Direct animal studies have led to many biomedical developments

- 1898 ● Discovery of radium, which eventually led to its use to treat cancer.
- 1913 ● Diphtheria prevented by immunisation.
- 1921 ● Insulin isolated and used to successfully treat diabetes.
- 1930s ... ● Efficacy of penicillin proven in animals and used to treat injured soldiers in 1942.
- 1955 ● Development of a vaccine for polio.
- 1960 ● First oral contraceptive made commercially available.
- 1972 ● Discovery that prenatal steroids can improve the breathing of newborn babies.
- 1980s + 90s ... ● Introduction of statins to reduce cholesterol.
- 1987 ● The first AIDS drug, AZT made commercially available.
- 2000s ... ● Vaccination for cervical cancer developed.
Therapeutic hypothermia became the first treatment to protect babies from brain damage.

To learn more about the biomedical developments arising from animal studies use the following website:
www.understandinganimalresearch.org.uk/why/health-timeline/

Vaccines for animals

We can now provide protection against at least 56 of the many infectious diseases that cause pain, suffering, lasting harm and/or death in animals. Some of the agents causing these diseases can also infect people (e.g., anthrax, rabies).

Examples of vaccines developed for animals:

Cattle



Anthrax, Bovine virus diarrhoea, Brucellosis, Clostridial diseases, Contagious bovine pleuropneumonia, Foot and mouth disease, Infectious rhinotracheitis, Louping-ill, Parasitic lung infections, Pasteurellosis, Rabies, Rinderpest, Tuberculosis.

Cats



Calicivirus infection, Leukaemia, Panleucopaenia (parvovirus), Rhinotracheitis (herpes virus).

Horses



Equine abortion, Equine rhinopneumonitis, Influenza, Strangles, Tetanus.

Dogs



Distemper, Infectious hepatitis, Kennel cough complex, Leptospirosis, Parvovirus, Rabies.

Pigs



Atrophic rhinitis, Aujeszky's disease, Coliform enteritis, Hog cholera, Parvovirus infection, Pasteurellosis, Swine erysipelas.

Sheep



Cheesy gland, Clostridial diseases (6 or more), Contagious pustular dermatitis, Foot and mouth disease, Foot-rot, Louping-ill, Pasteurellosis, Scabby mouth.

Poultry



Avian encephalomyelitis, Egg drop syndrome, Infectious bronchitis, Infectious bursal disease (Burnavirus), Infectious laryngotracheitis, Marek's disease, Newcastle disease.

Who controls the use of animals in science?

Under New Zealand law (Animal Welfare Act 1999) we have a “Duty of Care” towards animals, i.e., we have a duty to provide for the physical, health and behavioural needs of animals. These needs and how they can be met are outlined in Codes of Welfare. For further information use the following website: www.mpi.govt.nz/protection-and-response/animal-welfare/codes-of-welfare/

All scientists as individuals, and through their institutions (Company, Institute or University), are legally required to work under a Code of Ethical Conduct. To make sure that this Code is followed, each institution must also have an Animal Ethics Committee.

For people in New Zealand to trust this system and continue to give permission for it to be used, animal-based scientists need to do two important things.

First, they must follow the *letter* of the law. This means they must follow the rules exactly as they are written. Second, and this is more important, they must also operate according to the *spirit* of the law. This means that, while operating within the law as it is written:

- They should behave honestly and responsibly
- The work they do must be worthwhile, i.e., it must be of value in helping animals or people in some way
- They must think ethically. This means they must think about issues like what the best things to study are, what the best methods of study are, what ways of using animals are acceptable and what ways are not acceptable, and how we can be sure that the new knowledge obtained from animal work will be used to do good things and not bad
- They must make sure that the highest standards of animal care are used at all times.

National Animal Ethics Advisory Committee (NAEAC)

NAEAC was established under the Animal Welfare Act to provide independent advice to the government Minister for Primary Industries. They consider and advise on all matters to do with the use of animals in research, teaching and testing. They deal with:

- The details of each institution’s Code of Ethical Conduct, to make sure that they meet the high standard required for approval
- Whether the ways we make sure that scientists and their institutions are following the Code of Ethical Conduct are working well or not
- Whether each Animal Ethics Committee is doing its job properly
- How animal use in science can be improved, both by finding better ways of decreasing any harm that might be done to the animals and by finding better ways of making sure that the benefits of the work are as great as they can be
- Whether the ways we look after the animals used in science are acceptable
- What people in New Zealand and overseas think are acceptable and unacceptable uses of animals in science, and how ideas about this are changing.

The members of NAEAC, as a group, are required to have a wide range of interests and experience. These include:

- Animal welfare advocacy
- Animal use in research, teaching and testing
- Biological, medical and veterinary sciences
- Commercial interests in research and testing
- Education
- Environmental and conservation management
- Ethical standards and conduct towards animals
- Other relevant matters.

There also needs to be balance in the members who are actively engaged in research, teaching and testing and those who are not, since this may affect the point of view that members have about these uses of animals.



Codes of ethical conduct

Each institution undertaking animal-based science must have a Code of Ethical Conduct. This Code defines what the organisation must do ethically and practically when it engages in animal-based science. Before any institution can start such work, it must submit its Code to the NAEAC. If the NAEAC thinks the Code is good enough, it is then passed to the Director General for the Ministry for Primary Industries (MPI) for approval. Once approved, each Code is allowed to operate for no more than 5 years. Each Code can be renewed, but only if the institution demonstrates to an independent reviewer that it has been working within its Code and its Animal Ethics Committee has been working properly.

Some institutions, like schools and companies that use animals for scientific purposes to a limited extent, can approach large institutions like universities and make formal arrangements to abide by their Codes of Ethical Conduct, rather than create their own. Once in place, these formal arrangements allow the school or company to submit all of their proposals to use animals in research, teaching or testing to that large institution's Animal Ethics Committee for review.

Animal ethics committees

Each institution must have an Animal Ethics Committee. The membership and responsibilities of this committee are prescribed in the Animal Welfare Act 1999 and detailed in the institution's Code of Ethical conduct. Every person wishing to conduct a research, teaching or testing procedure must first apply to, and receive approval for the proposed work, from their institution's Animal Ethics Committee. To do this they must make a formal written application to the Committee in which they provide all the information relevant for their decision-making, described below.

Among other things, the Animal Ethics Committee has the following responsibilities. It must:

- Assess the necessity of using animals, as opposed to any alternatives to animals that would allow the research question to be answered
- Assess any harm that may be done to the animals and how the scientists will keep that harm as low as possible
- Review the expected benefits of the work and how those benefits will be made as great as possible
- Decide on whether any harm will be outweighed by the expected benefits to a large enough extent to make it acceptable to do the work
- Make sure that the training and experience of all people involved with the animals are of a high enough standard and cover the full range of skills required for the work
- Be sure that animal care meets regulatory standards
- Ensure that the people doing the work know who is responsible for the day-to-day care of the animals and that emergency attention to the animals is speedily available at all times.

In addition to senior staff of the institution and animal care staff, there are three very important members of each Animal Ethics Committee. These are independent members who are watchdogs on behalf of animals and the public, comprising a member of a recognised animal welfare organisation, a layperson nominated by the local authority, and a veterinarian nominated by the New Zealand Veterinary Association. Their role is so important that they are given advice on how to do it well. This advice comes from ANZCCART (the Australian and New Zealand Council for the Care of Animals in Research and Teaching), the National Animal Ethics Advisory Committee, and from some of the organisations who suggested the three independent members. These organisations include the SPCA New Zealand [Royal (New Zealand) Society for the Prevention of Cruelty to Animals] and the New Zealand Veterinary Association.

Surveillance – checking that things are done properly

Each institution's Code of Ethical Conduct is allowed to operate for no more than 5 years. Before it can be renewed, the institution must demonstrate to an *independent reviewer* that the way it conducts animal-based science has, to that point, followed its Code and reached acceptable national standards. To assess this, the independent reviewer assesses how well the institution's Animal Ethics Committee does its work, and whether the scientists and other staff are committed to following all animal ethics guidance and rules. The suitability of the independent reviewers is determined by the Ministry for Primary Industries (MPI).

Aside from the oversight of members of animal ethics committees (especially the independent members mentioned previously), colleagues of the animal-based scientists who actually conduct the work also have a role as watchdogs and are encouraged to report and discuss any matters of concern which may arise. A mechanism for reporting any abuses, and protecting those who report, is laid down in the Animal Welfare Act 1999.

Within institutions there may also be animal welfare officers (AWOs). In addition to providing clinical veterinary services, the AWO provides technical advice, education and training to researchers and animal care staff about animal ethics, welfare and animal management. The AWO promote advances in good practices in animal care and welfare, and the principles of Replacement, Reduction and Refinement (3Rs, see below for further information). The AWO also works closely with institutions and researchers

and animal care staff to ensure they meet their legal obligations to animal care and welfare under the Animal Welfare Act.

Finally, the National Animal Ethics Advisory Committee is responsible for making sure that the Codes of Ethical Conduct and Animal Ethics Committee system work properly, that all the safeguards for the public are effective, and to see that all parts of the system are kept up-to-date.

Heavy penalties for breaches of animal ethics

It is an offence to wilfully ill-treat an animal. Under the provisions of the Animal Welfare Act 1999, individuals can be fined up to \$50,000 and/or sent to prison for up to 3 years, and an institution (e.g., a company or a university) can be fined of up to \$250,000.

If animal-based scientists or their institutions break the rules when operating *under* the Codes of Ethical Conduct and Animal Ethics Committee system, the penalties are fines of up to \$25,000 and/or 6 months imprisonment for individuals and fines of up to \$125,000 for institutions. Any individual prosecuted successfully and penalised by the Courts for a serious breach of their institution's Code of Ethical Conduct may also face consequences such as loss of employment or being banned by the institution from conducting animal-based procedures there. In very serious cases an institution's Code of Ethical Conduct can be suspended or revoked, which would make it illegal for it to conduct any research, teaching or testing procedures.





Weighing harm and benefit, minimising harm and ensuring welfare

Conducting a harm-benefit analysis is a key part of the thinking that each animal-based scientist and their institutional Animal Ethics Committee must do during the planning stages, before any research, teaching or testing procedure with animals can begin.

The Animal Welfare Act permits uses of animals in research, teaching, and testing only when the expected benefits of the use, in combination with other relevant research conducted or planned, outweigh the harms done to animals. Its function is also to promote the minimising of these harms, and the maximising of expected benefits. This means that, for researchers to follow both the letter and spirit of the Act, they need to find ways to maximise the difference between the total harm and total expected benefit in all their work using animals.

This requires that animal-based scientists and animal ethics committees have to do three things before a proposal to conduct a research, teaching or testing procedure can be approved:

- They must make sure that any harm caused is as low as it can be, or eliminated
- They must make sure that the expected benefits of the work are achievable and are as great as possible
- They must weigh any harms to the animals against the expected benefits of the work.

The Three Rs

The Three Rs principle is embodied in the Animal Welfare Act 1999, and applied at the planning stages before any direct work with animals begins. Its purpose is to help scientists to minimise any negative impact of their work on animal welfare, and to encourage them to consider alternative methods that do not use animals. For further information use the websites:

- National Centre for Replacement, Refinement, and Reduction of Animals in Research (www.nc3rs.org.uk/)
- Ministry for Primary Industries: The Three Rs (www.mpi.govt.nz/protection-and-response/animal-welfare/animals-in-research-testing-and-teaching/the-3rs/)

The Three Rs principle is designed to ensure that:

- Animals which might suffer are only used when necessary (Replacement)
- That no more and no fewer animals are used than are required to achieve the objectives of the work (Reduction)
- That if any harm is caused during the work, it is kept as low as possible (Refinement).

Replacement

To minimise potential harm, animals should not be used if the same research, teaching or testing aim can be achieved in other ways. Researchers should assess whether they can use other tools, models or technologies to achieve their scientific objectives.

Under the Animal Welfare Act 1999, higher order animals include all mammals (but not human beings), birds, reptiles, fish (bony or cartilaginous), octopus, squid, crab, lobster or crayfish (fresh and salt water). In the context of research, teaching and testing, higher order animals are also considered to include mammalian fetuses (unborn babies) during the last half of pregnancy, the unhatched young of birds or reptiles during the last half of their development in the egg, and marsupial pouch young during the last half of pouch life. This is because it is thought likely that animals in these stages of development might be capable of feeling pain, like adult higher order animals. In comparison, lower order animals include some micro-organisms and non-vertebrate animals.

The first question scientists must ask themselves at the planning stage of a study is: *Do I need to use higher order animals at all?* If the answer is “Yes” then Reduction and Refinement must be applied.

There are three important questions here:

- What alternatives can be used instead of higher order animals?
- When is it appropriate scientifically to use alternatives to higher order animals?
- When is it not appropriate scientifically to use alternatives to higher order animals?

What alternatives are available?

For further information see the ANZCCART website for resources, and the 3Rs websites listed above for specific examples.

- Non-animal alternatives (computer models, chemical models, charts, diagrams, manikins and physical models, mathematical and statistical models, use of plants)
- Alternatives derived from lower order animals (micro-organisms, cells derived from invertebrates and lower order vertebrates, intact invertebrates and lower order vertebrates)
- Alternatives derived from higher order animals (tissue culture using cells derived from higher order animals, videos of procedures conducted on animals to avoid repetition)
- Alternatives derived from human beings (voluntarily donated human tissues (e.g., the placenta and other tissues), human volunteers).

When can alternatives to whole animals be used?

The answer is: when the alternative to animal use can genuinely reveal new knowledge or demonstrate particular features of the body organ or tissue or the whole body processes of interest. To date, replacement alternatives have been used extensively in teaching and during some stages of drug and cosmetic testing, but less extensively during research designed to understand how the body as a whole works. Computer, mathematical and other models are helpful for analysing, presenting or accessing knowledge we have already obtained about body processes, but they are less helpful in generating new knowledge.

When is it not appropriate to use alternatives to whole animals?

- When chemical or computer or physical or mathematical models cannot reveal relevant new knowledge or demonstrate the known fact or principle
- When microbial or tissue cultures cannot be applied to achieve the desired goals
- When the processes to be studied or demonstrated cannot be effectively modelled using non-vertebrate or lower order vertebrate animals
- When the processes to be studied or demonstrated can only be modelled effectively using the chosen species of higher order animal – e.g., when functions in the particular chosen species (e.g., sheep) closely parallel functions in another animal species (e.g. goats, cattle) or in human beings
- When the processes to be studied relate explicitly to the chosen species of higher order animal (e.g., studies of pregnant sheep to reduce death or sickness in newborn lambs).

Reduction

This means keeping the number of animals used to the minimum necessary to achieve the research, teaching or testing purposes of the work. This avoids using unnecessarily large numbers of animals. However, it is equally important to avoid using too few animals. If not enough animals are used, it will not be possible to interpret the results and the animals used would have been wasted.

The main question here is: How can the number of animals used be reduced to the minimum needed to achieve the aim(s) of the work?

This can be done in several ways:

- If related but different work has been done before, it can be used to assess the number of animals that will need to be studied to produce a definite result
- Science-based statisticians can advise on the minimum numbers required
- In some situations, the animals can be studied during spontaneous occurrences of the illness or injury or other phenomena of interest, so that no extra animals are required for the purposes of the study
- Some studies can be done, painlessly and with no distress, in animals that have been studied for other scientific purposes. That can occur during a short period of unconsciousness while they are under anaesthetic just *before* they are killed using an overdose of that anaesthetic, or immediately *after* killing
- Tissues from animals killed in abattoirs can also be retrieved immediately after death and used for research, teaching or testing, thereby avoiding the need to use extra animals.

Refinement

Refers to keeping any pain, suffering or other harm (collectively referred to as *noxiousness*) which may be caused as low as possible for every animal used in the work. This means that every aspect of the work must be reviewed carefully and great care taken to minimise any noxious effects on the animals. Thus, the third question scientists must ask is: *How can I minimise the noxiousness of every aspect of this work?* It is worth noting that many studies cause very low or no pain, suffering or other harm to the animals involved, while others do indeed have noxious effects.

There are many different ways of refining procedures. For example, studies can involve:

- Non-invasive behavioural observations of conscious animals
- Non-invasive methods such as ultrasound scanning or X-ray examinations or other sophisticated imaging techniques in conscious animals
- Non-invasive methods such as external collection of urine and faeces
- Limiting the invasiveness by taking blood samples using a needle the minimum number of times required to achieve the desired goals
- A hormone implant is placed under the skin using local anaesthesia instead of, for example, surgically modifying the animal to change the way it produces the hormone
- The animals are kept unconscious with a general anaesthetic throughout the study at the end of which they are killed with an overdose of that anaesthetic – unconscious and dead animals cannot suffer or experience pain
- Anaesthetics, pain-killers (analgesics), sedatives and/or tranquillisers are used to relieve anxiety, fear, pain or distress in conscious animals
- Any surgery on the animals is done by expert surgeons and great care is taken to keep damage to body tissues to an absolute minimum, thereby reducing any pain experienced when the anaesthetic used during the surgery wears off
- When the animals are likely to experience pain, distress or other harm (e.g., in studies of diseases), their condition is assessed regularly, the earliest signs that the study objectives have been met are identified, and the animals are withdrawn from the study or killed humanely at that earliest time.



Assessing the invasiveness, severity or noxiousness of a scientific manipulation

The invasiveness, severity or noxiousness of any proposed research, teaching or testing procedure must be given very careful consideration during the planning stages of the work.

Noxious or unpleasant experiences that animals may have are of two main types. The first type reflects the many different things that can happen inside the bodies of animals. These experiences include breathlessness, thirst, hunger, pain, nausea, dizziness, debility, weakness and sickness. The second type reflects the different impacts that an animal's external circumstances can have. The experiences here include anxiety, fear, panic, frustration, anger, helplessness, loneliness, boredom and depression.

Understanding the various general causes of these negative experiences helps animal-based scientists to focus on ways to reduce their unpleasant

impacts by using specifically targeted refinement approaches. This is also a very important step towards assessing how noxious, i.e. how severe or intense, each of the experiences generated during a planned study is likely to be, and the best ways to keep any noxiousness as low as possible using refinement strategies.

To help with this process various invasiveness, severity or noxiousness scales have been developed worldwide. These help animal-based scientists work out what the negative impact of a proposed procedure is likely to be on the animals. A noxiousness scale devised and used in New Zealand recognises five grades of severity, ranging from no or virtually no impact, to very high impact, assessed in the domains of mental state, food/water, environmental challenge, disease/injury/functional impairment and behaviour.

Note that the higher the severity of a procedure, the greater the anticipated benefits must be before it can be approved.

The current five grades of severity grades are:



No impact or virtually no impact

Procedures that do not cause unpleasant, distressing or noxious experiences, such as non-invasive observation of animals in unchallenging circumstances.

For example: field observations of grazing behaviour on farms which do not require any animal handling, or nutritional and growth studies where production is measured in response to benign dietary changes. Another example would be the animals used for training veterinary staff in general handling skills. Such animals are often familiar with all personnel and procedures and with the place where the procedures are conducted.



Little impact

Procedures that have a minor impact and or are of short duration.

For example: experiments on completely anaesthetised animals which do not regain consciousness; standard methods of euthanasia that rapidly induce unconsciousness (e.g., anaesthetic overdose); taking a blood sample from a superficial vein; injecting a non-toxic substance; short-term changes in dietary composition which cause no clinical signs of deficiency or toxicity, but which would cause such symptoms in the longer term; mild or short-term restraint; injections testing vaccines using killed pathogens, skin tests which cause low-level irritation without ulceration.



Moderate impact

Procedures that include manipulations of minor impact and long duration or moderate impact and short duration.

For example: recovery from major surgeries like opening and closing the rib-cage, bone operations, or removal of the uterus or gall bladder, done under general anaesthetic and *with* effective use of pain killers after the operation; surgical procedures on conscious animals, but with the use of local anaesthetics to prevent pain during the operation and other pain killers after it; moderate surgical and/or pharmacological modification to homeostatic capacity (e.g., limited gut resection; endocrine gland removal with delayed or incomplete hormone replacement therapy); movement of excitable free-range domesticated livestock to unfamiliar housing; short-term exposure to severe extremes of cold or heat which would lead to collapse if prolonged.



High impact

Procedures include manipulations of moderate impact and long duration or high impact and short duration.

For example: recovery from major surgery done under general anaesthetic but without the use of pain killer after the operation (e.g., reference animals used in studies to test how well particular pain killers work after surgery done under anaesthetic); marked social or environmental deprivation; capture, handling, restraint or housing, without the use of tranquillisers, of wild or semi-domesticated animals that exhibit marked flight responses; studies of severe facial eczema; induction of severe diarrhoea or severe infectious pneumonia; severe restrictions of water and/or feed intake beyond the normal period of satiation.



Very high impact

Manipulations of high impact and long duration or very high impact for any duration.

For example: testing the effects of analgesics after surgery; testing the effectiveness of pain-killers (analgesics) in animals with induced severe pain; poisoning by toxins in the diet; purposeful exposure of conscious animals to lethal extremes of cold, heat or barometric pressure which duplicate naturally occurring conditions; studies of methods for killing pest animals; evaluation of vaccines where death is the measure of failure to protect; application of marked and repeated extremely noxious stimuli from which escape is impossible; prolonged periods of close physical restraint.



Animal welfare

An animal's welfare is how good life is for that animal. It is dependent on how well an animal is coping with its environment, expressed in terms of its feelings (mental experiences or emotions), and how well the animal is being managed by people. When an animal's major needs are being met, and it has opportunities to engage in rewarding experiences, its welfare may be good. There are five main ways life can be good for an animal. These can be broadly described as nutritional, environmental, health, behavioural, and mental domains of animal welfare. These domains can guide us when we want to find out how to prevent an animal's welfare from being harmed. They also show us where animal welfare problems can occur, and they help us work out how to prevent or correct those problems. Below are examples of welfare problems in each of these domains, and ways to prevent or correct them.

Domain	Welfare problem	Prevention or correction
NUTRITIONAL	Water shortage, food shortage, unbalanced diet.	By ensuring ready access to fresh water and an appropriate diet in sufficient quantities and with a composition that maintain full health and vigour.
ENVIRONMENTAL	Environmental challenge.	By providing a suitable environment including shelter and a comfortable resting area, whether outdoors or indoors.
HEALTH	Disease or injury.	By prevention or by rapid diagnosis and treatment.
BEHAVIOURAL	Behavioural restriction.	By providing sufficient space, proper facilities and the company of the animal's own kind.
MENTAL	Suffering (mental and physical), lack of pleasure.	By determining the cause of unacceptable levels of anxiety, fear, distress, boredom, sickness, pain, thirst, hunger, lack of pleasure, and eliminating these causes.

Big improvements in animal welfare standards have been achieved by the application of new scientific knowledge about how to reduce the negative experiences animals may have. In New Zealand this knowledge has been used to devise Codes of Welfare. These Codes set minimum animal welfare standards. They also describe “good practice” – the ways animals can be managed so that their welfare is kept above the minimum acceptable level in the practical circumstances in which we keep and use them. In the past, and even today, preventing *bad experiences* (like undernutrition, disease or injury) has been and is the main way of making welfare improvements. However, increasing attention is now also being given to enhancing *good experiences*. These good experiences include pleasurable activities, comfort, companionship and contentment.

Codes of Welfare are prepared by the National Animal Welfare Advisory Committee and are available from the Ministry for Primary Industries in Wellington. These Codes set minimum animal welfare standards. They also describe “good practice” – the ways animals can be managed so that their welfare is kept above the minimum acceptable level in the practical circumstances in which we keep and use them. There are a number of different Codes, for different animal usage types, and animals. For further information see the website: www.mpi.govt.nz/protection-and-response/animal-welfare/codes-of-welfare/

The Codes are reviewed regularly to allow for new knowledge about animal welfare, new developments in the ways we keep and use animals, and changes in our ideas about what are acceptable and unacceptable ways of keeping and using animals.



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Duty of care

Our “duty of care” towards animals means those responsible for animals must meet their welfare needs. This means providing for their nutritional, environmental, health, behavioural and mental needs, so that animal welfare problems are avoided or are corrected quickly.

“Duty of care” is an important principle in the current animal welfare legislation in New Zealand (The Animal Welfare Act 1999). The Animal Welfare Act is not just about preventing cruelty to animals (i.e., making their welfare worse without sufficient reason). New Zealanders are also legally required to ensure that animals have good lives by keeping a wide range of welfare problems to a minimum.

We need to make sure that we know how to meet the needs of the particular species of animals we are responsible for (e.g., animals we own or are in charge of). This means finding out what those special needs are. We also need to make sure we properly provide for those needs. We can do this in the following ways.

- By giving the animals fresh water and the right food in the right amounts at the right time
- By keeping them in a place (indoors or outdoors) that suits them well and in this way minimise, for example, exposure to extreme weather or physical discomfort
- By watching for signs of ill-health or injury and getting veterinary help when necessary
- By giving them appropriate exercise and, when appropriate, the company of animals of their own or another type
- By keeping anxiety, fear, pain, distress and other potentially noxious experiences as low as can be practically managed, and providing opportunities for pleasure, play, and other positive experiences.

If we are breeding animals, we must take care to avoid breeding animals that are likely to have poor or diminished welfare. This is true too for the breeding of animals in scientific research, where animals can sometimes be bred in order to model a specific aspect of human disease. We can also breed animals for which the reverse is true – which tolerate particular environments, are less susceptible to disease and are more at ease when managed by people. However, we would still have to make sure that their remaining welfare needs are met, even if they are more resistant to some problems than are other animals.

Ethics and animal use in science

Humans are among the higher animals that can reason about their actions in a special way. This is thinking about whether they are good or bad actions. Ethics is our system for understanding, and reasoning about, what is good and bad, right and wrong. We have been talking about one part of this in our discussion of animal welfare. There we discussed what makes life *good* and *bad* for animals, and what we ought to do in light of this – not being cruel, providing care and opportunities for a good life for the animals for which we are responsible.

We all adopt moral and ethical positions, whether or not we know it and can describe them. Over the centuries, thinkers in ethics have tried to explain these different positions. They have also developed many different ideas about how we can decide what is good and bad, right and wrong, in all aspects of daily life. These include how we can decide the acceptable and unacceptable ways to use animals in farming, health, recreation, and animal-based science. As a result, we now have available a range of ideas on how to decide what is ethical behaviour towards animals. Some of the ideas, which relate particularly to the use of animals in research, teaching and testing, are briefly outlined below to help your own thinking about this subject. You may feel that one idea best explains the way you think about animal use. On the other hand, and this is quite common, you may feel that a combination of two or more of these ideas is best for you. The important thing here is to think about all of these ideas, weighing their strengths and weaknesses, before coming to your decision. It is also important to recognise that you may change your mind as you think and learn more about this subject. Just like scientific reasoning, we should test our thinking, and be prepared to abandon incorrect or inadequate ways of thinking when there are better alternatives.

Animal welfarism

Some people who are concerned about animal welfare emphasise giving practical help to improve the lives of animals as they are used now. Their focus is on the animal's state of welfare, and how this can be improved while gradually reforming current animal use practices, such as farming, or animal use in science, for the value they provide. This contrasts with the main focus of animal liberation and animal rights groups who want to make fundamental changes to the ways we think about the place of animals in our world, and advocate for radically reforming or abolishing ways of using animals that, they argue, are ethically wrong. Both welfare and liberation/rights groups aim to improve the lot of animals, but they often disagree on how that should be achieved.

Animal welfare groups often oppose the harmful use of animals in research, teaching and testing. They have a long-term goal of ending such animal use. However, they believe it is not realistic to expect that the scientific use of animals will come to an end in the very near future. So they work actively to improve the welfare of the animals used in science until abolition of that use can be achieved. They therefore strongly support all measures that minimise any harm done to animals used in science, and measures that provide other benefits to these animals.

Animal liberation

In the mid-1970s Peter Singer (born in 1946), an Australian philosopher, wrote a book called *Animal Liberation*. In it he defended a form of ethical equality among some animals – those higher order animals which can suffer or can be harmed by our actions; sentient animals. To be sentient is to have the capacity to have some kind of good feelings (e.g. pleasure, contentment, happiness, satisfaction, comfort), and of bad feelings (e.g. pain, unhappiness, discomfort, fear, frustration). These are animals that have *interests*. An interest is another word for a stake in something. If you can consciously perceive pain, you have a stake in the matter of whether you are in pain or not. More specifically, you have a stake, or interest, in avoiding pain, because it is unpleasant. More generally, all sentient animals have an interest in their own welfare, whether that is experienced as pleasant or unpleasant feelings in any of the domains of welfare we discussed previously.

Singer argued that similar interests have the same ethical value, or importance, regardless of who or what animal has them. This is the ethical principle of *equal consideration of interests*. This principle is designed to help us work out if the ways we use animals are acceptable or not. According to this principle, when thinking about whether particular animal uses are right or wrong, we should give the same ethical value or weight to any interests of the animals as we would give to our own similar interests if we were used in the same ways. Now, this does not mean that the interests

of animals and people are the same. In fact, it can easily be shown that they are often different. Many animals have an interest in performing behaviours (e.g., nest building) that we have no interest in ourselves and vice versa. Rather it means that, for example, it is as bad for a sentient animal to experience pain as it is for a human to experience pain (it feels equally bad to both), so their interests in avoiding pain have the same ethical value and deserve equal consideration in our ethical reasoning.

If less value is accorded to animal interests than to similar interests humans have, then, argues Singer, this can only be because animals are of a different species from humans. This, he claims, is a form of prejudice like racism or sexism, and is just as morally unacceptable. This alleged prejudice is now known as “speciesism” and is claimed to underlie the routine uses of animals that cause them harm, or otherwise fail to recognise the ethical value of animals and their own interests.

Some animal protection groups use these ideas to support their wish to abolish what they call “exploitation” of animals by people. Exploitation here means the wrongful use of animals, such as by dominating and controlling their lives or subjecting them to harm. Such exploitation generally includes the harmful use of animals in research, teaching and testing, and in farming, circuses and zoos. For some groups it includes *all* use of animals by people, even keeping pets. The aim of such groups is to free – to *liberate* – animals from domination and oppression by people, hence the phrase “animal liberation”.

Singer opposes most animal use in science. However, he does not think that the principle of “equal consideration of interests” totally rules out the use of animals in science, but it does very substantially reduce it. In his view, scientific animal use might be justified, but only if *all* of the following very stringent conditions are met: any harm done to the animals must be very low indeed, *and* the human or animal need to be met by using animals must be exceptionally compelling, *and* the likely success of meeting that need by using the animals must be very great.

Animal rights

In the early 1980s Tom Regan (1938 – 2017), an American philosopher, developed an ethical theory of animal rights. A right in this sense is a claim that one individual can make, which imposes a duty on someone else to fulfil or protect that right, and not to violate it. If we have a right to privacy, someone else has a duty to enable or protect our privacy, and not to invade our privacy. Regan argues that some animals have “inherent value”. Inherent value is value animals have in themselves, or in their own right. That is, independent of what we think of them, and the value or disvalue (such as in the case of ‘pest’ animals) they have for us. All animals that have inherent value (and this includes we human animals), have it equally – it doesn’t vary according to how good life is or can be for that animal.

Regan identifies inherent value as arising in animals that have a range of mental capacities: sentience, a range of interests, a sense of the future and their own life across time, and more. He identifies mammals and some other animals as having these capacities, calling them “subjects-of-a-life”. Any animal with inherent value (i.e., subject-of-a-life) has an equal right to treatment that respects their value. Roughly, what this rules out is any use of these animals that treats them as though their value comes from satisfying the desires or needs of others. If we need to use subjects-of-a-life harmfully in science to achieve some significant benefit for humans, or even other animals, that would violate their rights, and is ruled out. Regan leaves the door open slightly for some use of animals in science. Therapeutic research is research that aims to benefit the animals used in research (through developing a novel treatment for a health problem they have). Some animal use in science is not harmful for them in any way. These would not clearly violate their rights. However, it is clear that Regan does not think science could be constrained to only these cases, so it is best to abolish animal use in science altogether, in favour of the use of non-animal alternatives.

Achieving the most good with the least harm

Many thinkers consider that what counts above all other things is the consequences – the outcomes – of our actions, but they go further. They also say, and this is important, that actions can be judged as good *only* if they bring the *greatest* good to the *greatest* number. The use of the word *greatest*, instead of the weaker word *greater*, reduces the risk that this way of thinking can be used to justify getting the greatest good at the expense of a small number of victims. Achieving the *greatest good* therefore also means causing the *least harm*.

This has direct relevance to the use of animals in research, teaching and testing. Animal-based scientists have brought many benefits to animals and people. It is true that often, but not always, the animals involved experience pain, distress or other harm, even when great care is taken to avoid it or minimise it. Even so, the New Zealand public wants the further benefits that animal-based science can bring in the future. That is especially so because very many more animals and people are expected to benefit than the number of animals that will be used in the required studies. But it is also on the understanding that any harm done to the animals used in research, teaching and testing *must* be kept to the minimum level it can be – this is required by New Zealand law (Animal Welfare Act 1999). The main way this is done is to apply the Three Rs principle of replacement, reduction and refinement. Careful application of this principle ensures that animals are only used when non-animal alternatives are not suitable (*replacement*), that only the smallest number of animals required to achieve the aims of the work are used (*reduction*), and that if any pain or other noxious experiences are caused during the work, they are kept as low as possible (*refinement*).

It is also worth noting that ideas about animal liberation, animal rights, and animal welfare do not only influence those people who agree with them. These ideas also influence animal-based scientists. They lead such scientists to consider very carefully how much harm can or cannot be justified by the benefits of research, teaching and testing when they apply the principle of achieving the most good with the least harm.

Concluding comments

The role of ANZCCART is to provide a focus for consideration of the scientific, ethical and social issues associated with the use of animals in research and teaching. This document provides information and resources about the use of animals in scientific research, teaching and testing, as well as an introduction to issues and questions surrounding animal ethics and welfare. Further information can be found on the ANZCCART website: www.anzccart.org.nz/. Regulations and good practices in ethics, welfare and animal care also change regularly and this website contains regular updates.

We also refer the reader to the work undertaken on animal ethics and welfare at Massey University and on animal ethics at the University of Otago, which also offers an undergraduate paper on animal ethics as well as ethics of the life sciences more broadly:

Animal Welfare Science and Bioethics Centre, Massey University

(www.massey.ac.nz/massey/learning/departments/centres-research/animal-welfare-science-and-bioethics-centre/animal-welfare-science-and-bioethics-centre_home.cfm)

The Bioethics Centre, University of Otago

(www.otago.ac.nz/bioethics/index.html)



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