CCAC training module on: the ethical use and care of farm animals in science

Companion Notes

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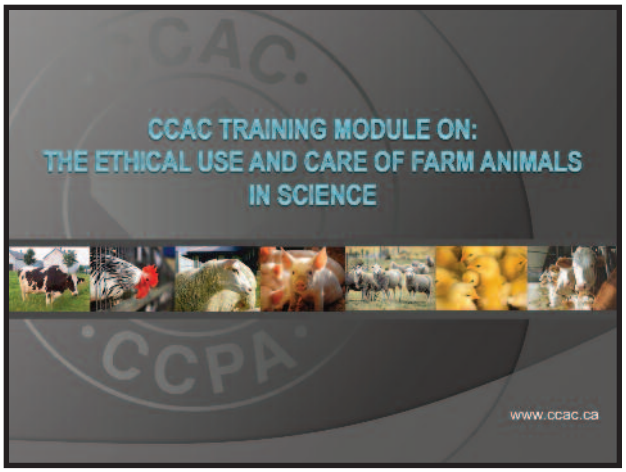
Slide 1 CCAC training module on: the ethical use and care of farm animals in science

This module provides an introductory overview of the welfare, management and safety factors that relate to the use of farm animals in science. The intention is that this overview be utilized in conjunction with hands-on training. Before any research is carried out, all personnel involved must receive practical instruction, and be able to demonstrate competence in all techniques required within the protocol.

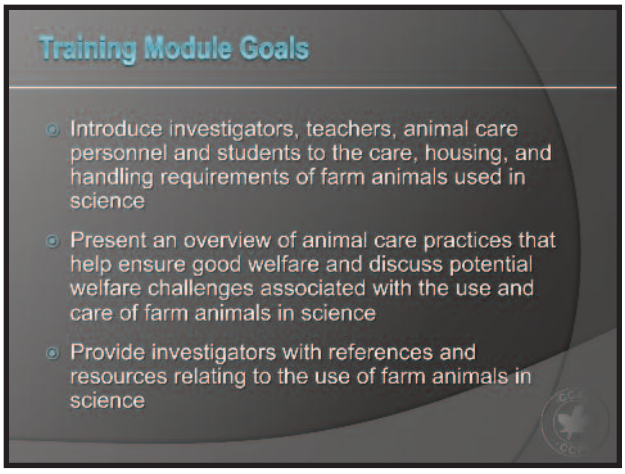
This training module is based on the *CCAC guidelines on: the care and use of farm animals in research, teaching and testing* (2009).



Slide 2 Relevance of this Training Module

Although this training module focuses on cattle, swine, poultry, sheep and goats, the general principles and considerations outlined in the *CCAC guidelines on: the care and use of farm animals in research, teaching and testing* (2009) and this training module also apply to other types of farm animals, including horses and farmed wildlife used in science.

Slide 3 Training Module Goals



This training module aims to achieve three goals:

1. **To outline the care, housing and handling requirements of farm animals used in science.** Stemming from their origins in the agriculture production industry, farm animals differ significantly from animals conventionally used in scientific applications (e.g., rodents). Depending on the species and scientific application, investigators may be faced with animals having unique physiological and behavioural issues and must therefore be prepared to address the specific needs of the farm animals being utilized.

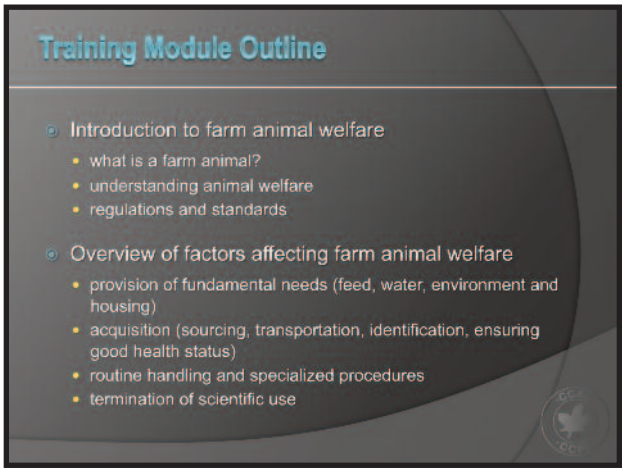
2. **To present an overview of practices that help ensure good welfare of farm animals used in science.** Investigators, teachers, animal care personnel and students are presented with basic knowledge of what animal welfare encompasses, and how it relates to animal use responsibilities. Significant focus is given to discussing potential challenges to the welfare of farm animals when used for scientific purposes as well as recommendations for dealing with these challenges.

3. **Provide references and resources to more detailed texts, guidelines and training manuals.** Where appropriate, hyperlinks have been embedded into the module to provide direct access to the texts and guidelines.

References cited in this module are intended to provide direction to further information; however, animal users should consult relevant experts and scientific literature for the most recent information on the species and techniques under consideration.

Care has been taken to ensure that any provided web links are up-to-date; however, the dynamic nature of the internet may mean that some links will become out-of-date. Therefore, keyword search suggestions are provided for situations in which links to additional resources may be broken. The keywords can be entered into any standard internet search engine.

Slide 4 Training Module Outline



Achieving good welfare of farm animals used in science is based largely on understanding the primary components influencing animal welfare as well as adhering to a few basic principles (Replacement, Refinement and Reduction). Application of the Three Rs in scientific applications is detailed in section 2.4 of the *CCAC guidelines on the care and use of farm animals in research, teaching and testing* (2009). Applicable government regulations must also be followed in all scientific uses of farm animals.

Investigators, teachers, animal care personnel and students should be aware that farm animal welfare

is impacted by a large number of factors. In the context of this training module, the factors are grouped under the following broad headings:

- **fundamental needs**: providing appropriate feed and water (e.g., quality and quantity), as well as a safe and comfortable environment (e.g., proper management and design of housing systems);
- **acquisition**: following appropriate regulations, guidelines and protocols to ensure proper sourcing, transportation, identification, and good health of new animals;
- **routine handling and specialized procedures**: maintaining appropriate treatment of animals while they are being used in science, including minimizing handling stress and providing pain mitigation as required during procedures; and
- **termination of scientific use**: determining the fate of animals following their use in science and appropriate endpoints, as well as planned and emergency euthanasia and animal disposal.

The above factors will be considered in more detail throughout the rest of this module.

Additional References and Resources:

Colditz I.G. (2006) The application of Russell and Burch's Three Rs in commercial livestock experimentation. *Animal Welfare* 15:1–5.

Slide 5 What is a Farm Animal?

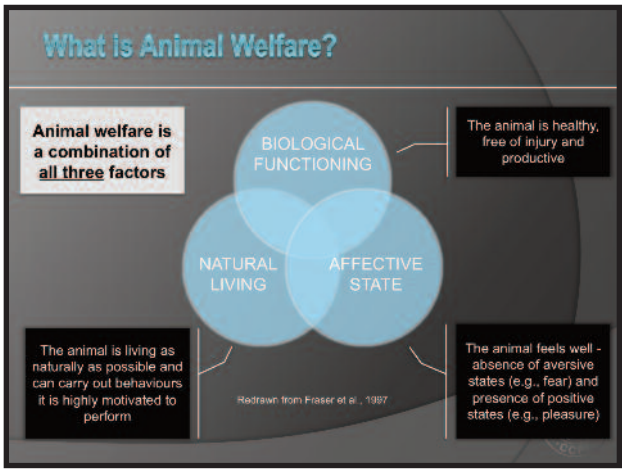
In the context of the CCAC guidelines, the term "farm animal" refers to mammals or birds commonly kept for agricultural purposes, which include the production of food, fibre, or fertilizer and/or the use of animals for farm work. These animals include horses, cattle, sheep, goats, swine, poultry, llamas, alpacas and farmed wildlife such as mink, elk, deer, and bison.

Slide 6 Farm Animal Welfare

This section provides the user with a foundation necessary for understanding the care requirements of farm animals used in science by discussing farm animal welfare, the common factors affecting welfare, as well as relevant regulations and guidelines. A note is made regarding the application of industry standards in a scientific application. Finally, the importance of standard operating procedures (SOPs) is discussed.

Slide 7 What is Animal Welfare?

Broadly speaking, animal welfare refers to the quality of life experienced by an animal; it is based on three predominant factors – biological functioning (e.g., health status), natural living (e.g., the ability to express natural behaviours), and affective states (i.e., how an animal perceives its present physical, psychological and social situation) (Fraser et al., 1997; von Keyserlingk et al. 2009). The balance among all three factors dictates whether an animal experiences good or poor welfare. For example, a confined farrowing sow may have its nutritional needs met and thus maintains high reproductive productivity (good biological functioning); however, she lacks the ability to move (compromised natural living) and may be distressed due to lack of social contact (negative affective state). Therefore, although the sow has good biological functioning, her welfare is compromised because the other two welfare factors are not being addressed.



Biological Functioning

Proper biological functioning involves an animal being in good health, free of injury and maintaining desired levels of growth, productivity and reproduction. Investigators should be aware that any factor preventing good biological functioning may not only result in negative animal welfare, but will also impact their research results. Investigators can help ensure proper biological functioning by monitoring animals regularly for signs of disease and injury, adhering to a herd/flock health program outlined by a veterinarian, identifying and correcting issues in the animals' housing environment and maintaining the highest possible animal husbandry standards in line with their research objectives.

Natural Living

For practical and economic reasons, many modern agricultural industry practices do not focus on the concept of natural living, making this welfare component the most challenging to understand and implement

(von Keyserlingk et al., 2009). Nonetheless, investigators should recognize the importance of providing farm animals with an environment that provides opportunity for expression of natural behaviours that are most likely to benefit the animal. See slide 18, "Improving Farm Animal Environments" for an outline of environmental improvements that may benefit farm animals. Although dependent on species, age, sex, housing and scientific use, promoting aspects of natural living may include more natural eating regimes (e.g., providing sheep grazing forages as opposed to concentrated pellets), opportunity for outdoor exercise (e.g., providing pasture access to laying hens), or materials for nesting where appropriate (e.g., providing farrowing sows with straw for nest building).

Affective States

The way an animal perceives its own state impacts its welfare. When an animal experiences negative states (e.g., pain and fear), its welfare is compromised. However, an absence of negative states should be combined with the presence of positive states in order to achieve and maintain good welfare (Yeates and Main, 2008). See Boissy et al. (2007) for a detailed review of positive states and how these states impact welfare. Investigators can help promote positive states by providing resources to the animals that provide benefit (e.g., scratching devices to cattle (DeVries et al., 2007)), or by providing opportunity for performance of behaviours the animals are motivated to perform (e.g., group housing calves to accommodate socialization and play behaviour (Jensen and Kyhn, 2000)).

Some scientific procedures may result in animals experiencing negative states such as pain and distress (e.g., invasive management and experimental procedures). Investigators are obligated to mitigate such negative states in a manner consistent with good scientific principles.

Additional References and Resources:

Boissy, A., Manteuffel G., Jensen M.B., Moe R.O., Spruijt B., Keeling L.J., Winckler C., Forkman B., Dimitrov I., Langbein J., Bakken M., Veissier I., and Aubert, A. (2007) Assessment of positive emotions in animals to improve their welfare. *Physiology & Behavior* 92:375–397.

DeVries T.J., Vankova M., Veira D.M. and von Keyserlingk, M.A.G. (2007) Short communication: Usage of mechanical brushes by lactating dairy cows. *Journal of Dairy Science* 90:2241–2245.

Fraser D., Weary D.M., Pajor E.A. and Milligan B.N. (1997) A scientific conception of animal welfare that reflects ethical concerns. *Animal Welfare* 6:187–205.

Fraser D. and Duncan I.J.H. (1998) Pleasures, pains and animal welfare: toward a natural history of affect. *Animal Welfare* 7:383–396.

Fraser D. (2008) *Understanding Animal Welfare: The Science in its Cultural Context*. Oxford UK: Wiley-Blackwell.

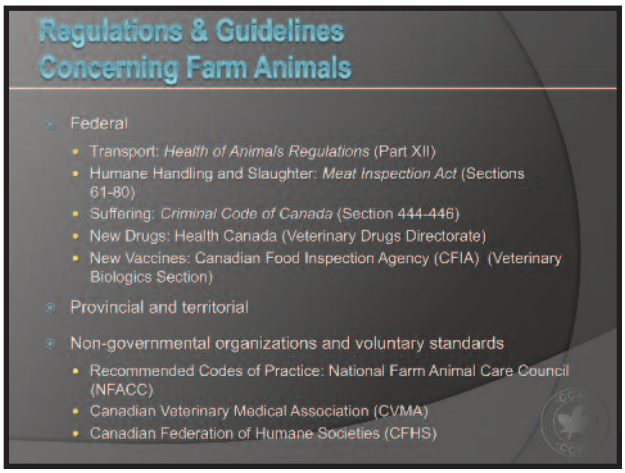
Jensen, M.B. and Kyhn, R. (2000) Play behaviour in group-housed dairy calves, the effect of space allowance. *Applied Animal Behaviour Science* 67:35–46.

von Keyserlingk M.A.G., Rushen R., de Passillé A.M. and Weary D.M. (2009) Invited review: the welfare of dairy cattle—Key concepts and the role of science. *Journal of Dairy Science* 92:4101–4111.

Yeates J.W. and Main D.C.J. (2008) Assessment of positive welfare: A review. *The Veterinary Journal* 175:293–300.

Slide 8 Regulations & Guidelines Concerning Farm Animals

Federal – Transport: *Health of Animals Act* (Part XII)



- The regulations associated with this act outline the conditions necessary for humane transportation of all animals. It prohibits undue suffering caused by transporting sick or injured animals, as well as by continuing to transport animals that become unfit to travel. In addition to designating appropriate types of vehicle design and bedding requirements, the regulations also require that animals not be mixed with incompatible individuals and that they not be overcrowded to the point that injury or suffering will result. Maximum times for transportation and feed and water deprivation are indicated for different species.
- It should be noted that the *Health of Animals Act* (Part XII) only addresses the needs of animals during transport, and does not apply to the care and handling of animals outside of transportation situations.
- Administered and enforced by the CFIA
- http://laws.justice.gc.ca/en/showdoc/cr/C.R.C.-c.296/bo-ga:1_XII/en#anchorbo-ga:I_XII

Federal – Humane Handling and Slaughter: *Meat Inspection Act* (Sections 61 – 80)

- This act sets standards for the humane handling and slaughter of food animals in federally registered slaughter facilities. It prohibits handling that causes avoidable animal distress and pain, including the use of goads and electric prods on sensitive (anal, genital or facial) regions of the animal. The act also prohibits mixing of different species and addresses the need for food and water prior to slaughter.
- Administered and enforced by the CFIA
- http://laws.justice.gc.ca/eng/SOR-90-288/page-4.html

Federal – Suffering: *Criminal Code of Canada* (Section 444 – 446)

- This federal code prohibits any person from willfully causing an animal to suffer from neglect, pain or injury. Section 444 refers specifically to cattle, whereas sections 445 – 446 are applicable to all other animals, including birds.
- Enforced by police forces, societies for the prevention of cruelty to animals (SPCAs) and humane societies.
- http://laws.justice.gc.ca/eng/C-46/page-7.html

(Note: if any of the above links are broken, search for: Department of Justice Canada and then use the tabs "Statutes by Title"and "Regulations by Title" to locate the specific act or regulation).

Federal – Drug and Vaccine Studies

- Studies involving the testing of new drugs and vaccines in food animals may require approval from the CFIA or Health Canada.

- For new vaccines, contact the Veterinary Biologics Section of the CFIA: http://www.inspection.gc.ca/english/anima/vetbio/vbpbve.shtml (Note: if link is broken, search: CFIA Veterinary Biologics)
- For new drugs, contact the Veterinary Drugs Directorate of Health Canada:
  - Emergency Drug Release: http://www.hc-sc.gc.ca/dhp-mps/vet/edr-dmu/index-eng.php (Note: if link is broken, search: Health Canada Emergency Drug Release)
  - Experimental Studies Certificate: http://www.hc-sc.gc.ca/dhp-mps/vet/applic-demande/form/esc-cee_08-2002-eng.php (Note: if link is broken, search: Health Canada Experimental Studies Certificate for Veterinary Drug)

Provincial and Non-Governmental Organizations

- All provinces and territories have legislation governing the care of animals. Numerous non-government organizations also produce recommendations related to the care and use of animals. A summary of the available regulations and guidelines, including details of the individual provincial and non-government organizations' guidelines can be found at: http://www.inspection.gc.ca/english/anima/trans/infrae.shtml (Note: if link is broken, please search: CFIA Animal Welfare in Canada)
- The National Farm Animal Care Council (NFACC) develops voluntary *Recommended Codes of Practice for the Care and Handling of Farm Animals*. All currently available codes of practice are available from the NFACC website: http://nfacc.ca/code.aspx (Note: if link is broken, please search: NFACC codes).

  When research must be directly relevant to the agricultural industry, these codes of practice should be used as minimum standards, but require approval by the animal care committee (ACC).

Slide 9 A Note on Agricultural Industry Standards

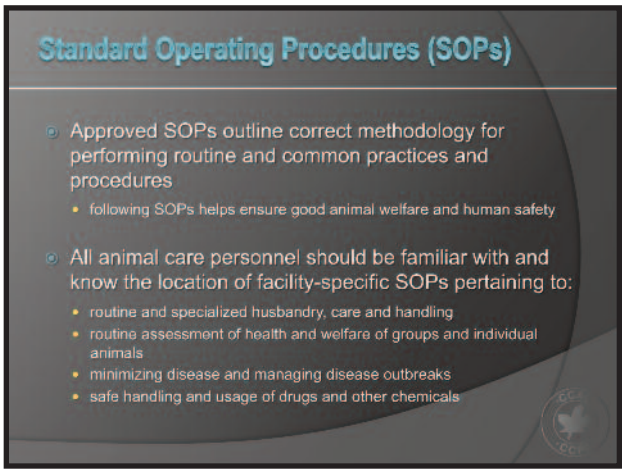
It is not appropriate to assume that practices will be acceptable within a research setting just because they are common in agricultural industry. All industry standards should be considered as minimums. Furthermore, any deviation from the CCAC guidelines must be justified to the ACC.

- *CCAC guidelines on: the care and use of farm animals in research, teaching and testing* (2009). Visit the CCAC website at www.ccac.ca to access and consult this guidelines document.

General Rule:

- **Scientific institutions should take a leadership role in the adherence to, and the development of, improved standards that encourage good animal welfare.**

Slide 10 Standard Operating Procedures (SOPs)



Each facility should have SOPs addressing facility management and maintenance. SOPs should also outline all facets of animal care (husbandry, routine invasive procedures, health care, disease prevention, etc). Investigators, teachers, animal care personnel and students should be aware of, and comply with, these facility-specific SOPs. It is important for all individuals to be aware of the procedures involved in maintaining good farm animal health status. SOPs outlining proper health care practices should include:

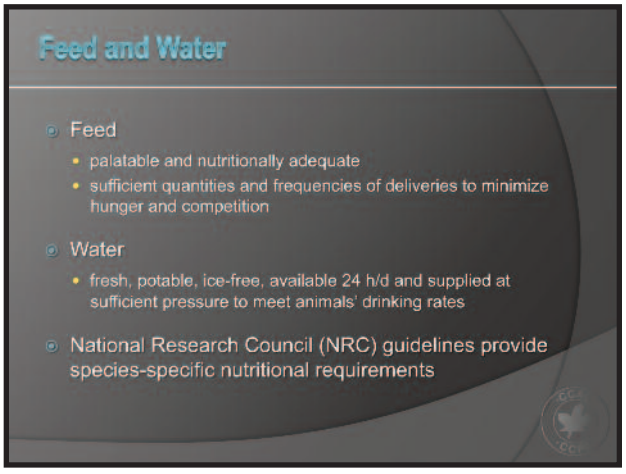
- practices that minimize disease persistence in the environment (e.g., all-in, all-out animal movement);
- routine health checks for groups and individual animals;
- welfare assessment of individual animals (complements the welfare assessment methodology outlined in the animal care and use protocol);
- management of disease outbreaks within or in nearby facilities; and
- drug safety
    - safe storage and limited access to authorized personnel;
    - drug and biological use records (see *CALAM Standards of Veterinary Care*, 2007: http://www.calam-acmal.org/wp-content/uploads/2010/01/CALAM-Standards-of-Veterinary-Care.pdf) (Note: if link is broken, please search: CALAM standards of veterinary care);
    - safe disposal of expired drugs, needles and syringes;
    - management of off-label and extra-label use; and
    - safe withdrawal and withholding times (Food Animal Residue Avoidance Databank, FARAD: http://www.farad.org) (Note: if link is broken, please search: Food Animal Residue Avoidance Databank).

Slide 11 Fundamental Needs

All farm animals, regardless of their scientific use, have a set of basic requirements that must be met. This includes nutritious and sufficient quantities of feed, ad libitum access to clean, fresh water, as well as safely designed, well-managed housing. The environment must meet animals' basic needs (provision of space for lying, movement, feeding, etc.), and it should also allow for natural behaviours which animals are highly motivated to perform. Some environmental improvements should be made in order to prevent animal suffering. Furthermore, environmental enrichment is strongly encouraged in order to stimulate farm animals to perform a variety of natural behaviours, including those that may provide pleasure.

Slide 12 Feed and Water

National Research Council (NRC) guidelines (or other standard texts) should be consulted for species-specific nutritional requirements. Nutrient content of feed should be determined via laboratory analysis, or other acceptable tests.



Feed should be palatable, wholesome and nutritionally adequate. Research demonstrates that animals are highly motivated to feed upon fresh feed delivery (DeVries et al. 2005). Therefore, feed should be fed in sufficient quantities and frequencies to minimize hunger and competition, unless otherwise necessary due to the experimental protocol.

Fresh, clean, ice-free water should be available and easily accessible 24 hours a day. The delivery system must have sufficient pressure to meet drinking rates. Investigators should be aware that watering systems need periodic testing. The water itself should be periodically tested to ensure acceptable levels of a variety of factors: pH, sulphates, nitrates, total dissolved solids (TDS), and heavy metals. Testing should also ensure that bacteria (including cyanobacteria), parasites and viruses are not present in harmful quantities. Poor water quality may result in reduced overall wellness and even illness.

Additional References and Resources:

Agriculture and Agri-Food Canada's *Livestock Water Quality - A Field Guide for Cattle, Horses, Poultry, and Swine*: http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1259101276424&lang=eng (Note: if link is broken, please search: Agriculture Canada Field Guide Cattle, Horses, Poultry, and Swine)

Canadian Council of Ministers of the Environment's *Canadian Water Quality Guidelines for the Protection of Agricultural Water Uses*: http://ceqg-rcqe.ccme.ca/ (Note: if link is broken, please search: CCME Water Quality Guidelines for the Protection of Agricultural Water Uses)

DeVries T.J., von Keyserlingk M.A.G., and Beauchemin K.A. (2005) Frequency of Feed Delivery Affects the Behavior of Lactating Dairy Cows. *Journal of Dairy Science* 88:3553–3562.

National Research Council (NRC) (1985) *Nutrient Requirements of Sheep*, 6th ed. Washington DC: National Academy Press.

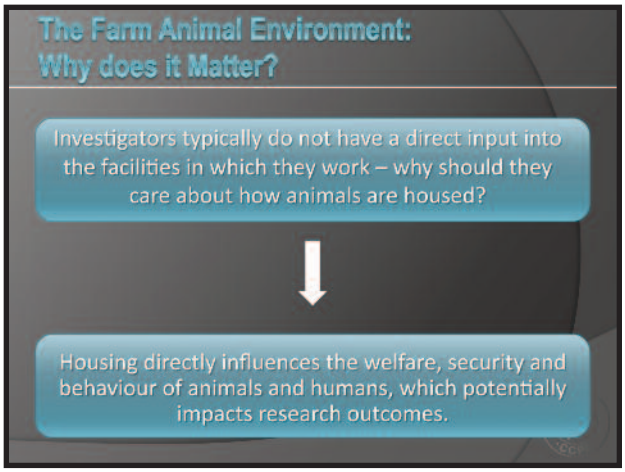
National Research Council (NRC) (1994) *Nutrient Requirements of Poultry*, 9th ed. Washington DC: National Academy Press.

National Research Council (NRC) (1998) *Nutrient Requirements of Swine*, 10th ed. Washington DC: National Academy Press.

National Research Council (NRC) (2000) *Nutrient Requirements of Beef Cattle*, 7th ed. Washington DC: National Academy Press.

National Research Council (NRC) (2001) *Nutrient Requirements of Dairy Cattle*, 7th ed. Washington DC: National Academy Press.

Slide 13 The Farm Animal Environment: Why Does It Matter?



Except in a case where a new facility is being designed and built, investigators typically do not have a great deal of control over the facility design and the nature of animal enclosures. Nonetheless, investigators should still be aware of the key elements of properly designed facilities. How their facility either complies or deviates from these elements will have a great impact on both human and animal welfare, behaviour and security – when these factors are affected, research outcomes can also be affected.

In light of preventing negative welfare issues and promoting positive welfare, as well as ensuring the most accurate scientific outcomes, effort should be made to make certain that the design meets the physical, physiological and behavioural needs of the species being housed. A facility should have flexibility to address changes in breed requirements (e.g., dairy breeds have become substantially larger in the past half century) and improvements in housing practices (e.g., group versus individual housing of calves). **Investigators should always be aware of the particular shortcomings associated with their facilities and attempt to address these through appropriate husbandry practices in order to limit negative impacts on welfare. Poor animal welfare may impact research outcomes.**

Slide 14 Housing Requirements

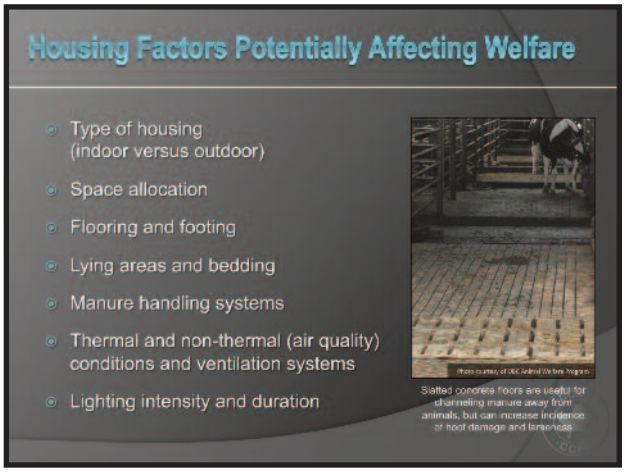
In order to properly address the basic needs of farm animals, facilities should provide:

- shelter from adverse weather conditions, including excess heat and cold, and extreme precipitation events (e.g., blizzards, hail, prolonged heavy rain, particularly in cold temperatures);
- access to safe, potable water and nutritious, palatable feed;
- air quality to maintain good health;
- room for exercise, with access to the outdoors (if possible);
- space for resting without competition;
- urination and defecation area separate from lying and rest area;
- space for social contact and interaction, when appropriate (e.g., housing sows in groups rather than individually); and
- separate location for specialized needs (e.g., young, sick or quarantined animals).

Investigators, teachers, animal care personnel and students should all be aware that in many cases, meeting the physiological and psychological needs of animals requires augmenting the basic housing environment (i.e., **environmental improvement**). **Further improvements to the animals' environment, termed environmental enrichment are strongly encouraged**. For more detailed information regarding the enrichment of animal environments:

- *CCAC training module on: environmental enrichment* (2003). Visit the CCAC website at www.ccac.ca to access and consult this training module.

Slide 15 Housing Factors Potentially Affecting Welfare



Providing appropriate housing to farm animals used in science is necessary to maintain good animal welfare, which is imperative for accurate scientific outcomes. A variety of housing-related factors may impact the welfare of farm animals housed for scientific purposes.

- **Housing type**: farm animal species, climate, available technology and intended use should be deciding factors when choosing housing type; farm animals housed in naturally ventilated, unheated facilities will have different environmental requirements compared to those housed in mechanically ventilated, heated facilities (e.g., naturally ventilated housing pro-

vides protection from temperature extremes, but does not provide the climate control of mechanically ventilated facilities).

- **Space allocation**: housing should provide individual animals with space to rest and feed without an excessive amount of competition (e.g. dairy cattle housed in an overstocked free stall environment may experience poorer welfare than cattle provided with one lying spot per animal).

- **Flooring and footing**: materials used in flooring should provide non-abrasive walking surfaces, and should allow for normal movements and postural changes without slipping and/or injury; a common flooring material is concrete because it is easy to clean and sanitize, however it must be used with caution (e.g., prolonged exposure to concrete may cause issues such as lameness); compressible flooring should be used whenever possible in order to reduce the risk of hoof and leg damage.

- **Lying areas and bedding**: species appropriate bedding must be provided as required to provide a dry, comfortable lying surface (e.g., inappropriate bedding type, insufficient quantities of bedding or an incompatibility of the bedding with the flooring type may increase animal susceptibility to infection and injuries).

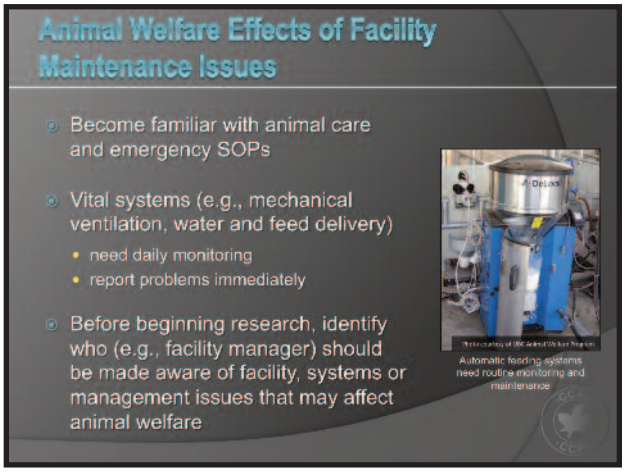
- **Manure handling systems**: except in the case of poultry housing systems, it is of utmost importance that animal wastes are separated from animals as soon as possible and are not allowed to buildup in the environment (e.g., both human and animal welfare may be affected if manure is allowed to accumulate, since dangerous gases such as hydrogen sulphide, ammonia and methane may form).

- **Thermal and non-thermal (air quality) conditions and ventilation systems**: maintaining appropriate air movement, temperature and humidity as well as low noxious gas and dust levels is essential for the health and welfare of both humans and animals (e.g., appropriate ventilation systems are vital for maintaining good indoor air quality).

- **Lighting intensity and duration**: farm animals should never be kept in complete darkness nor should the lights be left on continuously (for suggested lighting levels, please see applicable species-specific modules).

Slide 16 Animal Welfare Effects of Facility Maintenance Issues

Investigators, teachers, animal care personnel and students should be aware of the SOPs outlining facility maintenance, especially those that cover important system failures. It is essential that vital systems (e.g., feed and water delivery, ventilation, manure removal, etc.) be inspected daily. **Both the welfare of animals as well as research outcomes may be negatively impacted if vital systems fail**. There should be SOPs in place for dealing with the temporary failure, and investigators should ensure they, as well as any of the personnel involved in their project, are aware of the emergency procedures necessary to maintain good animal welfare.

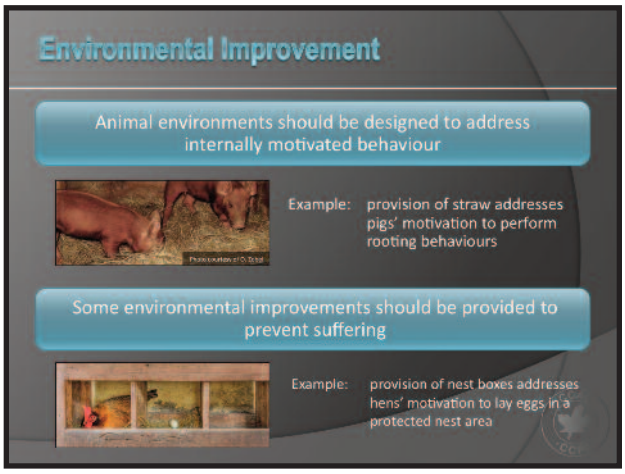


The facility manager is responsible for the appropriate upkeep of the facility and should be made aware of any issues immediately.

Additional References and Resources:

Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching, Third Edition (FASS, 2010): http://www.fass.org/page.asp?pageID=216 (Note: if link is broken, please search: FASS pdf guide for the care and use of agricultural animals in research and teaching)

Slide 17 Environmental Improvement



Animals perform behaviour patterns based on internal and external stimuli (Hughes and Duncan, 1988). The animal environment should be designed to avoid externally motivated behaviours, like fear response to predators, **and allow the animals to perform internally motivated behaviours**. Examples of means to address internally motivated behaviour is the provision of nesting materials to farrowing sows (Damm et al., 2005), or providing non-nutritive teats to calves (Rushen and de Passillé, 1995). Improvements to the animals' environment that address internally motivated behaviour are encouraged, as the absence of such improvements results in some degree of suffering. **Any improvements provided should be biologically relevant to the species and development of the animal** (e.g., dust bathing material encourages chickens to perform natural dust bathing behaviours).

It is particularly important to consider the impact of housing on the welfare of animals in closely controlled situations, such as in biomedical research. The investigator should understand the behavioural needs of the chosen species, and although it may not be possible to address all the needs, consideration should be given towards meeting as many as possible. For instance, if grazing animals are used, they should be given access to feed that mimics their natural foraging behaviour (e.g., feeding sheep pellet-based feed might meet their nutritional requirements, but is quickly consumed and does not meet their natural desire to graze; therefore, the investigator should provide at least some fibrous feed that takes longer to consume).

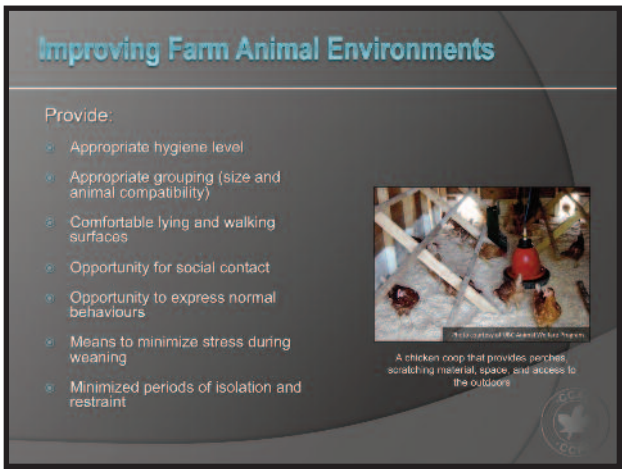
Additional References and Resources:

Damm B.I., Pedersen L.J., Heiskanen T. and Nielsen N.P. (2005) Long-stemmed straw as an additional nesting material in modified Schmid pens in a commercial breeding unit: effects on sow behaviour, and on piglet mortality and growth. *Applied Animal Behaviour Science* 92:45–60.

Hughes B.O. and Duncan I.J.H. (1988) The notion of ethological 'need', models of motivation and animal welfare. *Animal Behaviour* 36:1696–1707.

Rushen J. and de Passillé A.M. (1995) The motivation of non-nutritive sucking calve Bos Taurus. *Animal Behaviour* 49:1503–1510.

Slide 18 Improving Farm Animal Environments



Since scientific (research, teaching and testing) institutions should take leadership roles in maintaining high animal care standards, there should be a constant focus towards improving and enriching animal housing. Therefore, **investigators should ensure their studies are compliant with high animal care standards, even if a certain level of inconvenience may occur** (e.g., welfare advantages point to group housing, however blood sampling animals housed in this manner may require additional time in order to sample an individual with minimal stress).

The following factors should be considered when aiming to provide the best possible housing environment:

- **physical environment**: ensuring appropriate hygiene levels (e.g., providing appropriate bedding type and amount for species), providing comfortable lying and walking surfaces (e.g., provision of a dry lying pack for group-housed goats);
- **social environment**: maintaining appropriate group sizes and compatible social groups (e.g., smaller group size to reduce feather pecking in chickens), as well as considering optimal weaning times from a good animal welfare perspective (e.g., fence-line weaning of beef cattle to promote independence of calves from dams); and
- **individual animal comfort**: encouraging natural behaviours (e.g., providing dust bathing material to hens), minimal isolation and restraint (e.g., free stall housing of pregnant sows), as well as individual lying comfort (e.g., avoiding overstocking of free stall housed dairy cows to ensure all animals can lie concurrently).

For examples of environment improvements and enrichments for each species, see applicable species-specific modules.

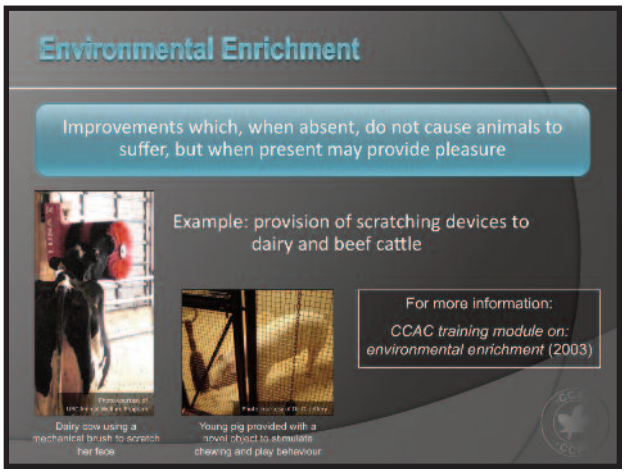
Additional References and Resources:

Arey D.S., Petchey A.M. and Fowler V.R. (1991) The preparturient behaviour of sows in enriched pens and the effect of pre-formed nests. *Applied Animal Behaviour Science* 31:61–68.

Bilcik B. and Keeling L.J. (1999) Changes in feather condition in relation to feather pecking and aggressive behaviour in laying hens. *British Poultry Science* 40: 444–51.

Panivivat R., Kegley E.B., Pennington J.A., Kellogg D.W. and Krumpelman S.L. (2004) Growth performance and health of dairy calves bedded with different types of materials. *Journal of Dairy Science* 87:3736–3745.

Slide 19 Environmental Enrichment



Environmental enrichment builds on the concept of environmental improvement. Animals experience pleasure when provided with these specific improvements. The primary difference is that when absent, improvements deemed to be "environmental enrichments" do not cause the animal to suffer. An example would be scratching devices provided to feedlot cattle (Wilson et al., 2002). **Environmental enrichment is strongly encouraged**.

It should be noted that in order to be effective, enrichment devices should be engaging to the animals for more than a short time. This can be achieved by providing devices that can be manipulated or destroyed by the animals. The environment can also be enriched by frequently changing the objects provided, thereby keeping a sense of novelty in the environment.

For more detailed information regarding the improvement of animal environments:

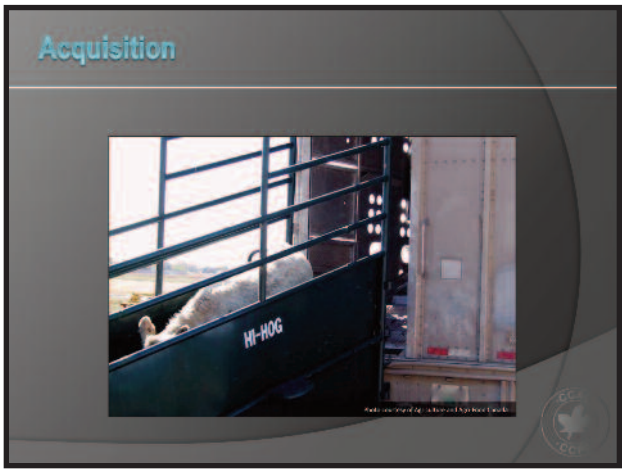
- *CCAC training module on: environmental enrichment* (2003). Visit the CCAC website at www.ccac.ca to access and consult this training module.

Additional References and Resources:

Wilson S.C., Mitlöhnera F.M., Morrow-Tesch J., Dailey J.W. and McGlone J.J. (2002) An assessment of several potential enrichment devices for feedlot cattle. *Applied Animal Behaviour Science* 76:259–265.

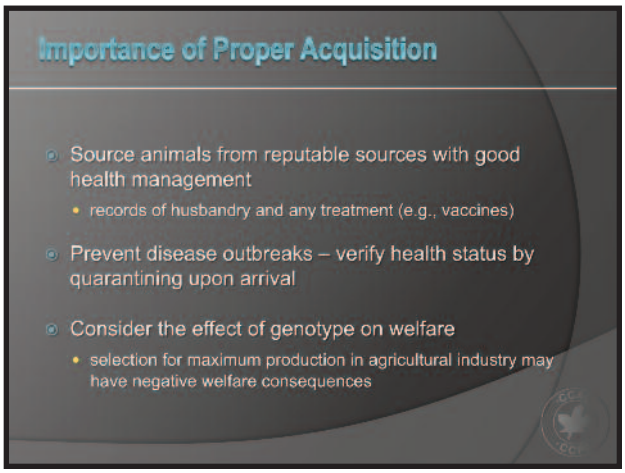
Young R.W. (eds.) (2003) *Environmental Enrichment for Captive Animals*. Oxford UK: Wiley-Blackwell.

Slide 20 Acquisition



When farm animals are acquired for use in science, a number of factors should be considered. These include properly sourcing the animals, transporting in adherence with regulations and following strict identification protocols. Periods of acclimation and quarantine are necessary before animals can be used in science.

Slide 21 Importance of Proper Acquisition



The investigator should be aware of how the acquisition process functions. Animals should only be acquired after a protocol has been approved by the ACC. The investigator should ensure that the animals being acquired meet protocol requirements and should also confirm that facilities are available to house the animals. Animals should only be obtained from reputable sources known for their good health management and provision of husbandry and treatment records. Animals should be carefully screened (see slide 25, "Quarantine: Essential for Maintaining Good Health and Welfare") before being introduced into the main population. The investigator should be aware of the screening process and be able to identify issues with newly introduced animals.

When sourcing animals, genotype should be considered. Most farm animals have undergone a great deal of genetic selection for specific production traits. However, in some cases this selection has resulted in welfare issues.

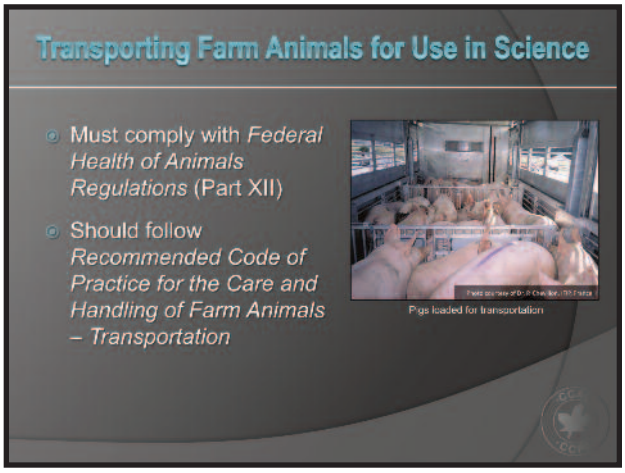
Example - Fast-Growing Broilers:

- selection for quick growth has resulted in increases in leg and cardiovascular problems (Scientific Committee on Animal Health and Animal Welfare, 2000); and
- unless using these fast-growing broilers is essential to the experimental protocol, it might be advantageous to use a slower growing type of chicken as they are less likely to be affected by these health and welfare issues.

Additional References and Resources:

Scientific Committee on Animal Health and Animal Welfare. (2000). *The Welfare of Chickens Kept for Meat Production (Broilers)*.149 pp. European Commission, Health & Consumer Protection Directorate-General: http://ec.europa.eu/food/fs/sc/scah/out39_en.pdf (Note: if link is broken, please search: Europe welfare of chickens kept for meat)

Slide 22 Transporting Farm Animals for Use in Science



Transportation of all animals, including those being brought to a research facility, must comply with federal regulations, and should also follow the NFACC's recommended code of practice.

- Part XII of the *Federal Health of Animals Regulations*: http://laws.justice.gc.ca/en/showdoc/cr/C.R.C.-c.296/bo-ga:l_XII//en (Note: if link is broken, search for: Department of Justice Canada and then use the "Browse Statutes by Title" to the Health of Animals Act.)
- *Recommended Code of Practice for the Care and Handling of Farm Animals – Transportation*, 2001: http://www.nfacc.ca/pdf/english/Transportation2001.pdf (Note: if link is broken, please search: NFACC codes and select "Transportation (2001)")

Slide 23 Importance of Proper Identification and Animal Record Keeping

A permanent identification system should be in place. Any identification method that is applied directly to the animal (e.g., ear tagging) should be done by a trained individual. Improperly placed identification may result in difficult identification in the future as well as potential injury to the animal (e.g., nerve damage to calves' ears caused by improperly applied ear tags).

Animal identification should be in accordance with federal and/or provincial guidelines. Some species have specific identification requirements; for instance, in addition to the commonly used ear tags (e.g., easy-to-read feedlot tags), the Canadian Cattle Identification Agency (CCIA) requires that all cattle be tagged with CCIA approved radio-frequency identification (RFID) tags.

A recording system should include:

- **individual records**: birth date, sex, pedigree, origin, physical measurements, reproductive information, and health, medical and nutritional history; and
- **experimental records**: protocol number, principal investigator, emergency contact information, and summary of experimental procedure (all located near enclosures).

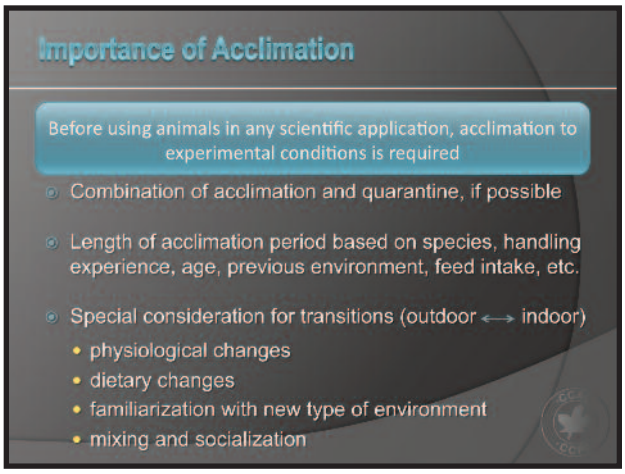
Full research activity records should be kept to ensure that an animal's experimental treatment in one study does not impact its response to treatment in subsequent study.

Additional References and Resources:

CFIA's Livestock Traceability Information: http:// ww.inspection.gc.ca/english/anima/trac/trace.shtml (Note: if link is broken, please search: CFIA livestock)

CCIA's Cattle Identification Information: http://www.canadaid.com/ (Note: if link is broken, please search: CCIA cattle)

Slide 24 Importance of Acclimation



Before farm animals are used in science, they should be acclimated to experimental conditions; it is preferable to accomplish the acclimation and quarantine periods together. The time required for acclimation will be heavily dependent on species, age, previous housing conditions, feeding regime and any treatments given prior to arrival.

For suggested acclimation time periods, please see applicable species-specific modules.

The acclimation duration will depend greatly on the amount of environmental change imposed. For instance, animals accustomed to group housing will adjust to individual housing fairly quickly, especially if pre-conditioning occurs in a step-wise fashion (e.g., increase the duration of isolation over a period of days). However, when animals are moved from outdoor housing to indoor, controlled environmental conditions, there will be a longer acclimation time needed. Changes in ambient conditions will typically lead to physiological changes and may require special husbandry procedures (e.g., sheep may initially hyperventilate when moved indoors, but clipping them will help in the acclimatization process). Other considerations include the need to introduce dietary changes and increased human handling gradually, as well as the need to carefully structure new social groups.

Acclimation will also be necessary when transitioning animals back to outdoor conditions.

Slide 25 Quarantine: Essential for Maintaining Good Health and Welfare

The purpose of a quarantine period is to protect the health of animals within a facility by isolating new animals of unknown health status or ill animals already in the population. Investigators must ensure that the animals they are using are subject to a quarantine period, by coordinating with the farm/facility manager and the herd/flock veterinarian. The length of time for quarantine is dependent on the species and the anticipated timeframe for pathogen expression; quarantine duration should be established in consultation with the herd/flock veterinarian. Once animals are deemed healthy, they can be integrated into the facility population. Quarantined animals need to be monitored very carefully and detailed

records made at least twice daily of any changes in feeding patterns, water intake as well as general behaviour and appearance. If there is any doubt about an animal's condition, its body temperature should also be monitored. Records acquired during quarantine may be important to the investigator if health concerns arise during the experimental period.

Quarantine areas should be managed according to rigorous infectious agent control practices, which include:

- security fences, entry alarms and signage;
- separate animal housing areas, with provision for external observation of animals;
- limiting visitor access, or when not possible, imposing a physical boundary between visitors and animals;
- removal of organic debris from footwear paired with sufficient contact time with germicidal footbaths, as well as plastic footwear covers, hand washing stations, shower-in/shower-out, and clothing changes;
- dedicated ventilation systems, air filters and equipment;
- dedicated storage for feed and bedding;
- clean to dirty traffic flow; and
- physical protection between contained animals and wildlife, pests and predators.

For more details, see the *CCAC training module on: occupational health and safety* (2003). Visit the CCAC website at www.ccac.ca to access and consult this training module.

There should be an established SOP outlining these practices, including effluent treatment when applicable. Investigators should be aware of the procedures outlined within the SOP.

Slide 26 Routine Handling and Specialized Procedures

Farm animals used in science may be exposed to numerous handling, testing, sampling and other routine and invasive procedures over the course of their lives. Investigators, teachers, animal care personnel and students should be aware of how to properly conduct procedures, as well as how each type of procedure affects the welfare of animals involved.

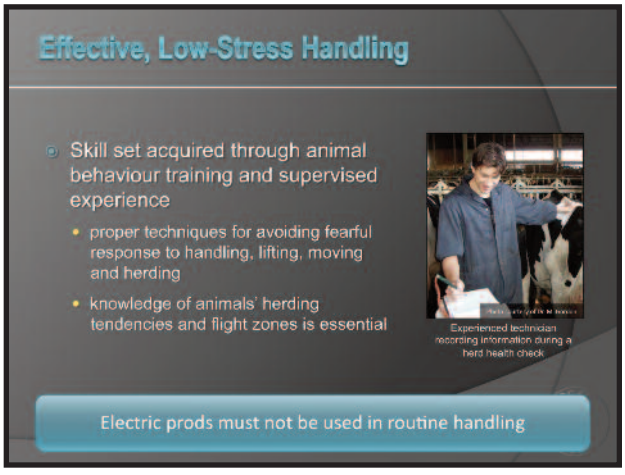
Slide 27 Human Contact and Handling

Human-animal contact has a large impact on animal welfare. An animal is likely to perceive a negative handling experience fearfully. When an animal is fearful its stress responses increase, and subsequently, its welfare is reduced. Reduced welfare may manifest itself in many ways including (but not limited to) altered behaviour and reduced productivity. In the context of scientific applications and research, poor animal welfare may result in altered and/or biased research results. Therefore, when animals are handled positively, it not only benefits the animal, but also the research.

Slide 28 Effective, Low-Stress Handling

Effective and low-stress handling of farm animals stems from proper training and experience. Investigators should ensure that they, as well as all personnel involved in their project, are familiar with:

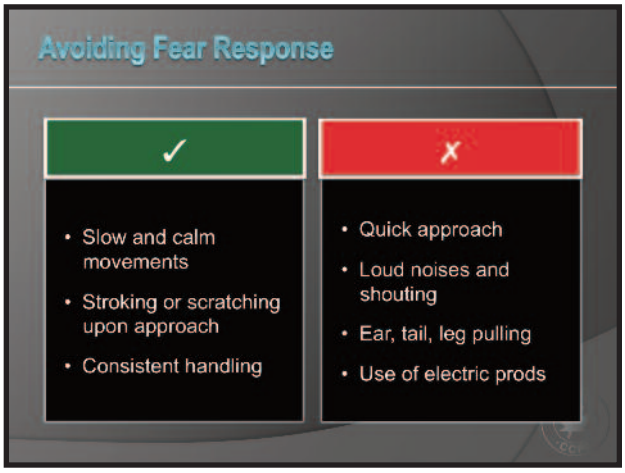
- species-specific animal behaviour;
- animal herding and flight zones; and
- techniques required to safely and calmly handle, lift, move and herd animals.



Stress related to handling activities can be greatly reduced by personnel working within the natural behavioural responses of the animals (e.g., when a herd animal requires treatment, removing it from its group with one or two conspecifics will reduce isolation-based fear). Where applicable, conditioning animals to routine handling should be considered, as it will reduce animals' natural fear response, in turn helping personnel to maintain consistent, positive handling techniques.

Electric prods must be severely restricted, and only be used when not doing so will place the animal under additional stress or risk.

Slide 29 Avoiding Fear Response



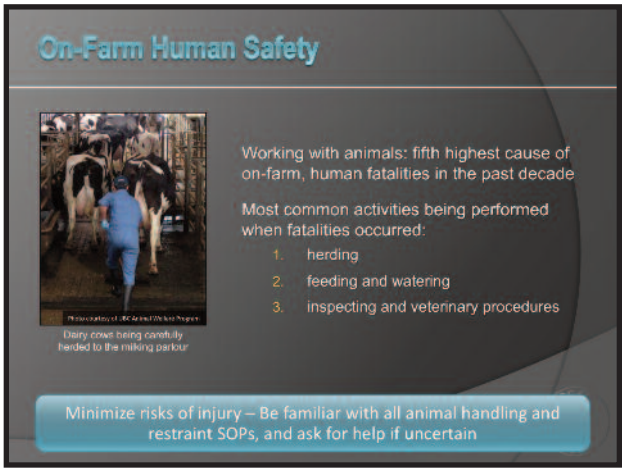
Evidence exists that negative handling can have long-term physiological impacts on animals (e.g., Hemsworth and Barnett, 1991; Rushen et al., 1999). Animals are able to recognize and remember individual people, and will respond fearfully to those that have treated them negatively in the past. It is important to note that fear is not just produced by rough handling, it also occurs when handlers move quickly, shout or use electric prods. An animal's ears, tail or legs should not be pulled. Fear reactions are easily reduced when handlers use slow and calm approach methods, including scratching and stroking when close enough to do so. Furthermore, since animals recognize individuals and recall previous treatment, it is important for personnel to handle animals in a consistent manner. **Personnel who are positive and consistent in their animal handling will find that animals will respond less fearfully over time, thus making handling situations less stressful for both animals and humans**.

Additional References and Resources:

Hemsworth P.H., and Barnett J.L. (1991) The effects of aversively handling pigs either individually or in groups on their behaviour, growth and corticosteroids. *Applied Animal Behaviour Science* 30:61–72.

Rushen J., de Passillé A.M., and Munksgaard L. (1999) Fear of people by cows and effects on milk yield, behavior, and heart rate at milking. *Journal of Dairy Science* 82:720–727.

Slide 30 On-Farm Human Safety



In the past decade, the fifth highest cause of on-farm deaths was animal-related. Of these on-farm deaths related to working with animals, the most common occurred during:

1. herding;
2. feeding and watering; and
3. inspecting and veterinary procedures.

It is very important for everyone working with animals to identify potential safety hazards. Effective procedures, such as SOPs and training, must be implemented to assess and control identified hazards and risks. Of particular importance are proper animal restraint methods that minimize injury.

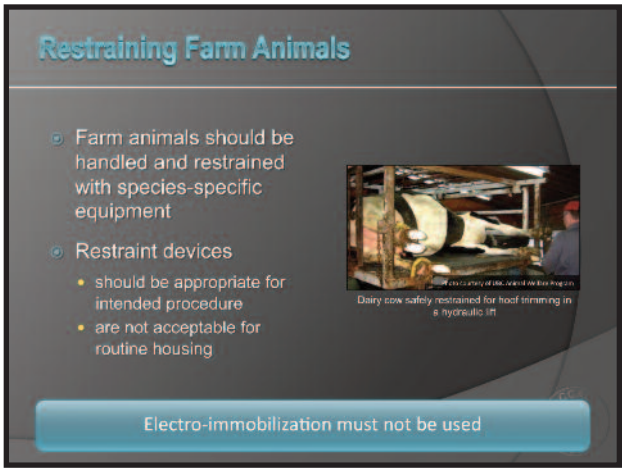
Additional References and Resources:

Canadian Agricultural Injury Reporting (http://cair-sbac.ca/tecrep.html) (Note: if link is broken, please search: CAIR-SBAC)

Handling Farm Animals Safely. (Farm Safety Association, 2002): http://nasdonline.org/document/44/d001612/handling-farm-animals-safely.html (Note: if link is broken, please search: NASD handling farm animals safely)

On-Farm Safety Manuals: Protect Yourself from Livestock Injuries (Nova Scotia Department of Agriculture, 2004): http://www.gov.ns.ca/agri/farmsafety/livestock/index.shtml (Note: if link is broken, please search: farm safety protect yourself from livestock injuries)

Slide 31 Restraining Farm Animals



Handling and restraint of animals should be done using species-appropriate equipment and facilities. **Restraint devices should not be used for routine housing**. Where there is a need to use these devices for prolonged periods, this use must be approved by the ACC.

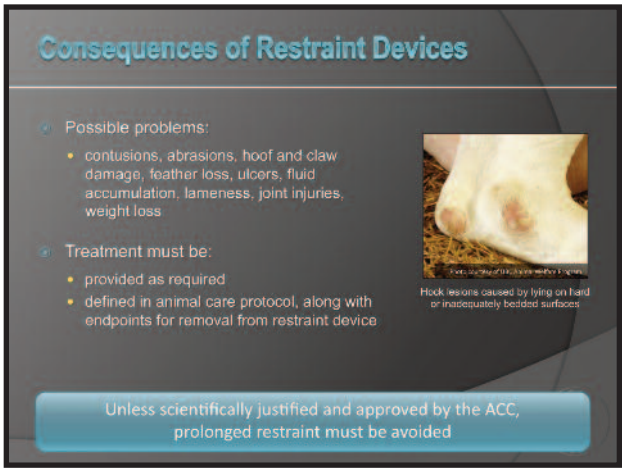
Some larger farm animals may pose a threat to the welfare of conspecifics as well as handlers. To minimize the impact of their behaviour, restraint devices such as hobbles, squeeze chutes and stanchions, may be utilized. However, **only the minimum amount of restraint necessary to control the animal should be used**.

Electro-immobilization is highly aversive and induces paralysis without providing any anesthetic or analgesic effects. **Electro-immobilization must not be used**.

Slide 32 Minimizing Stress Associated with Restraint

When restraint of an animal is required, the focus should always be to use the least amount of restraint necessary in order to ensure animal and handler safety. Many farm animals can be gradually conditioned to restraint devices, particularly with the use of food rewards. **Training animals to cooperate with treatments and the associated restraint devices and procedures minimizes stress for the animals** even in the case of more prolonged and frequent bouts of restraint.

Slide 33 Consequences of Restraint Devices



Even the best-designed restraint devices will have negative impacts on the animals, particularly when they are used for extended periods. In addition to potential psychological/behavioural impacts, physical issues may include (but are not limited to): contusions, knee/hock abrasions, horn damage, extensive feather loss, ulcers, dependent edema (fluid accumulation in lower or dependent parts of the body), lameness, joint injuries and weight loss. Investigators are responsible for monitoring the animals for signs of these problems, and should be prepared to administer treatment accordingly. The animal care and use protocol should make provisions for such treatment, including the temporary or permanent removal of the animal from the restraint device. Such treatment and their endpoints must be clearly defined in the protocol and approved by the ACC.

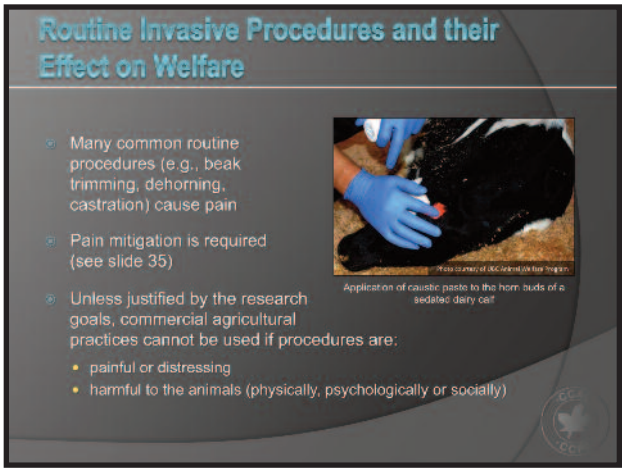
- *CCAC guidelines on: choosing an appropriate endpoint in experiments using animals for research, teaching and testing* (1998). Visit the CCAC website at www.ccac.ca to access and consult this guidelines document.

Typically many physical consequences of restraint devices are due to long-term restraint. Investigators should keep this in mind when designing their protocols; unless scientifically justified within the experimental protocol, prolonged restraint must be avoided.

Additional References and Resources:

Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching, Third Edition (FASS, 2010): http://www.fass.org/page.asp?pageID=216 (Note: if link is broken, please search: FASS pdf Guide for the Care and Use of Agricultural Animals in Research and Teaching)

Slide 34 Routine Invasive Procedures and their Effect on Welfare



Many routine and accepted agricultural practices are known to cause temporary and chronic pain (e.g., dehorning, branding, castration, beak trimming, and tail docking).

Investigators are encouraged to use alternative practices, minimize invasiveness of the procedures and use analgesics and anesthetics, when appropriate. Any routine invasive procedures that have potential to cause temporary or chronic pain must be described in an ACC approved SOP accompanying the experimental protocol. Scientific institutions should encourage investigation of alternative methods in an effort to establish the best agriculture practices. As research develops improved practices, SOPs should be updated accordingly.

Although considered routine management practices by agricultural industry, procedures such as dehorning and castration are minor surgeries; therefore, investigators should ensure their protocol makes provisions for appropriate and safe analgesic use before the procedure, sedative and/or anesthetic use during the procedure, and post-operative pain mitigation following the procedure (see slide 35, "Pain Management"). **Investigators should be aware that some routine invasive procedures might have long-term negative impacts on the animals** (e.g., calves castrated with the rubber ring method show indicators of chronic pain, including leg stamping, licking, abnormal standing and decreased growth rate for weeks following the procedure (Molony et al., 1995; Thuer et al., 2007)).

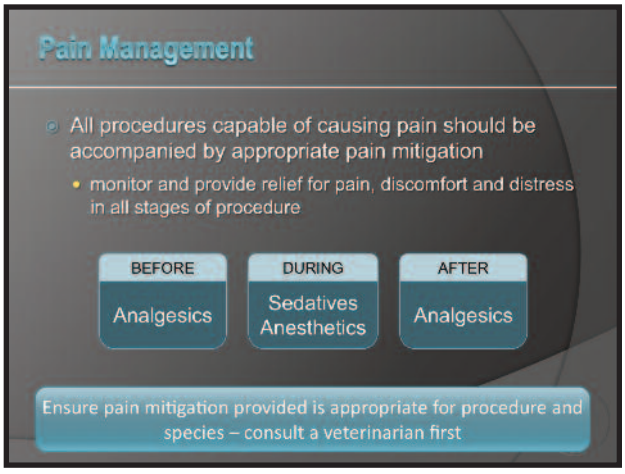
Painful or distressing procedures, or ones that may be harmful physically, psychologically and socially, cannot be justified by indicating they are commonly practiced commercially. Such practices can only be justified if the use of agricultural industry practices is essential to the scientific research outcomes, and should never be used to demonstrate to students a procedure that is otherwise not recommended.

Additional References and Resources:

Molony V., Kent J.E. and Robertson I.S. (1995) Assessment of acute and chronic pain after different methods of castration of calves. *Applied Animal Behaviour Science* 46:33–48.

Thuer S., Mellema S., Doherr M.G., Wechsler B., Nuss K. and Steiner A. (2007) Effect of local anaesthesia on short- and long-term pain induced by two bloodless castration methods in calves. *The Veterinary Journal* 173:333–342.

Slide 35 Pain Management



All procedures capable of causing pain (e.g., minor and major surgeries, routine invasive procedures, etc.) should be accompanied with appropriate pain management. This may include sedatives and anesthetics during the procedure and analgesics prior to and following the procedure. During the development of the protocol, the potential for pain associated with the planned procedures should be identified. **It is important to note that not all pain control options are suitable for all procedures and farm animal species, and a veterinarian should be consulted to ensure an appropriate pain mitigation program is developed**.

Personnel knowledgeable in the identification of post-procedural pain, distress and/or discomfort should monitor the animals frequently. If concerns are identified, prompt pain relief must be provided. Pain management should also be included in the herd/flock health program SOP.

Local anesthetics are only useful for short-term application. Other longer-term pain mitigation strategies should be planned. **The pain mitigation strategy should be developed by a veterinarian in order to ensure that it is appropriate for the procedure and the species**.

Additional References and Resources:

Flecknell P.A. and Waterman-Pearson A. (eds.) (2000) *Pain Management in Animals*. London UK: WB. Saunders/Elsevier Inc.

Slide 36 Specialized Procedures

In addition to the care and attention already outlined for farm animals being used in scientific applications, many experimental conditions involving specialized procedures which require additional care and monitoring; these include:

- metabolic crates;
- blood and tissue sampling;
- major and minor surgeries;
- fistulation/catheterization;
- biomedical research (see the *CCAC training module on: farm animals used in biomedical research* (2010)); and
- genetic engineering (see the *CCAC training module on: genetically-engineered farm animals* (2010)).

Consideration should be given to the necessity of performing specific procedures, as well as the availability of less invasive alternatives (e.g., using other bodily fluids such as milk instead of blood to sample hormones or metabolites). All handling and sampling will have both behavioural and physiological impacts on the animal, which may in turn impact research results; therefore, effort should be made to minimize the impact of handling. **One of the most effective means of lowering associated procedural stress is to precondition animals** to the procedures prior to the commencement of the experiment. This may include a gradual introduction to restraint devices, coupled with food rewards or may simply involve accustoming the animals to handling by specific personnel.

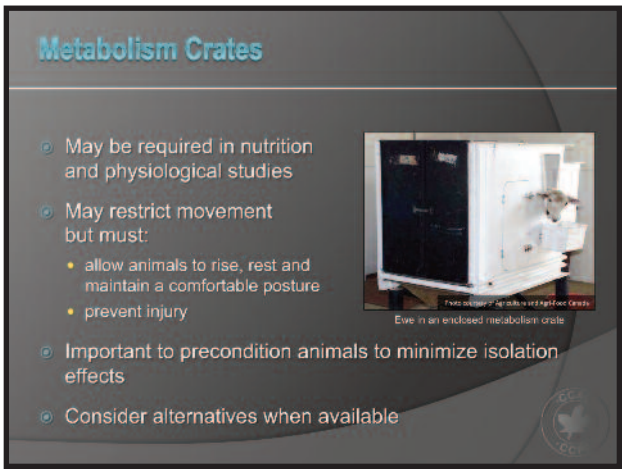
All specialized procedures require separate SOPs detailing additional husbandry, nutrition and other requirements, with particular attention paid to animal pain and distress. It is the responsibility of investigators to ensure any personnel caring for these animals are properly trained and are familiar with the relevant SOPs.

Veterinarians involved in the care of the animals should have access to detailed records of all procedures, as early identification and treatment of problems is imperative for maintaining good animal welfare.

It should be every investigator's goal to use as few animals as possible while maintaining statistically valid results. This is particularly applicable in cases where animals are exposed to pain and/or distress. In certain cases it may be appropriate to re-use animals rather than subjecting new animals to a procedure. For instance, if a scientific application requires the use of rumen fistulated ruminants, it is preferable to use previously fistulated animals, rather than performing the procedure on new animals. However, in teaching situations, the instructor should consider the pedagogical merit of performing procedures on the same animal; reducing the number of animals utilized is encouraged, but consideration must be given towards how many times a procedure can humanely be performed on a single animal.

Slide 37 Metabolism Crates

Metabolism crates may be required in nutrition and physiology studies to facilitate the collection of urine, feces and respiratory gases as well as to protect catheters and cannulae. These crates can severely restrict the ability of animals to move up and down and side to side. Although movement is heavily restricted, **space must be adequate both in height and length to allow the animals to eat, rise and rest normally, as well as to maintain a comfortable posture**. Due to their restrictive nature, structural integrity and maintenance of the metabolism crates are extremely important in order to prevent injury. Cleanliness is very important and crates should be sanitized on a weekly basis.

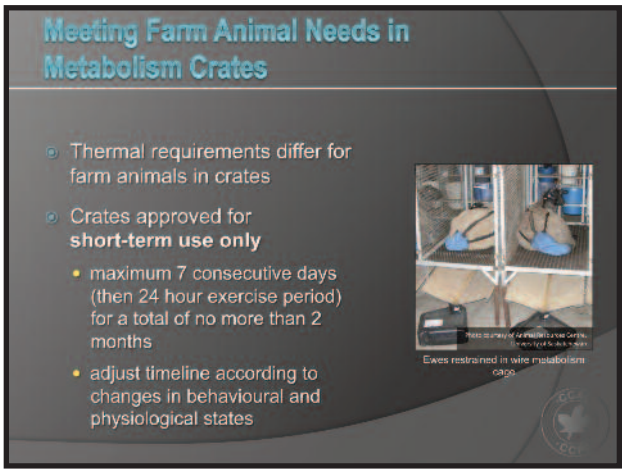


Animals will have varying reactions to the confining nature of metabolism crates, and consideration must be given to individual adjustment. In particular, animals housed in groups prior to the commencement of the experiment may become distressed, making preconditioning to the crates a necessary step. The experimental protocol should provide for this preconditioning period; it is typically a minimum of five days in length, but is subject to the discretion of the ACC.

The effects of confinement and isolation can be at least partially addressed by allowing for visual, auditory and olfactory contact with conspecifics. Crates should be positioned in a manner to ensure animals will have such contact; if necessary, animals not included in the study should be housed in the same room to ease the distress associated with isolation.

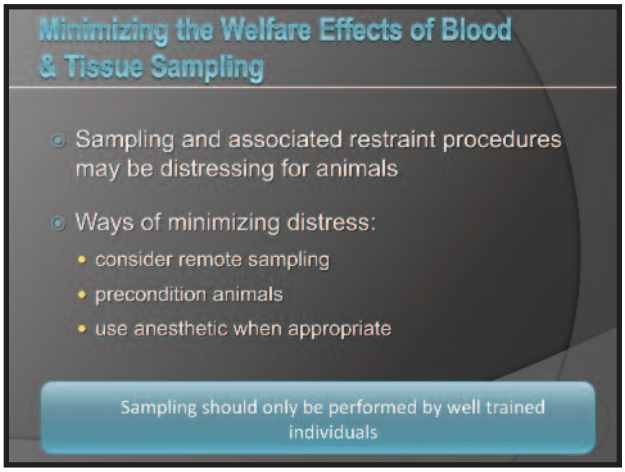
Slide 38 Meeting Farm Animal Needs in Metabolism Crates

Farm animals, particularly herding species, are adapted towards heat sharing with conspecifics. Their tolerance for lower temperatures is impacted when they are housed alone. The absence of bedding will exacerbate this effect. Therefore, investigators should ensure personnel caring for animals in metabolism crates are trained to identify the signs of thermal distress; **provisions should exist for alleviating the negative consequences of any environmental stressors animals might experience**. Monitoring of thermal stress indicators should be included in an SOP.



Metabolism crates are approved for short-term use only, and should never be used as permanent housing. The maximum total experiment time should not exceed two months. Animals must be provided with a 24-hour opportunity to exercise every seven days; however, this time may be adjusted based on professional judgment, ACC approval and adherence to the welfare of individual animals. Frequent monitoring and assessment of behavioural and body condition is necessary and should be used in evaluating the welfare of the animals.

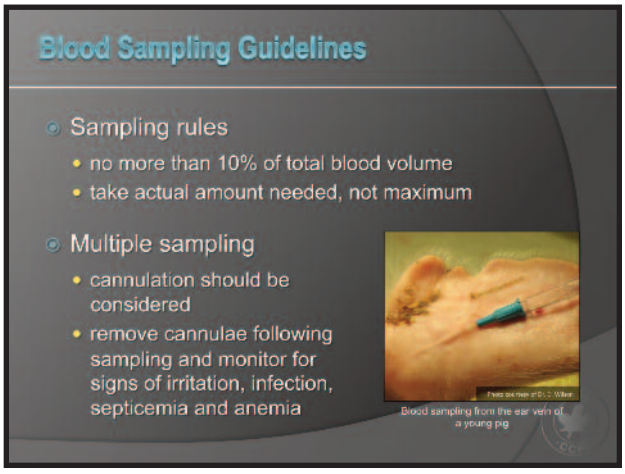
Slide 39 Minimizing the Welfare Effects of Blood & Tissue Sampling



Blood and tissue sampling are invasive and require significant interaction between humans and the farm animals involved. **All invasive procedures and handling can be stressful. Proper training for personnel, preconditioning of animals, and using remote sampling when possible can minimize animal stress during sampling**. Anesthetic use should be considered depending on restraint method, physical condition of animal and the amount of blood and/or tissue required.

Investigators should remember that the attending veterinarian is an essential part of the research team and can provide valuable insight into how sampling impacts animals. The veterinarian should be consulted when deciding on the most appropriate sampling methodology.

Slide 40 Blood Sampling Guidelines



The general sampling rule is to never take more than 10% of the blood volume; however, it is important to consider how much blood is actually needed. **Only the amount needed to achieve experimental goals should be sampled, not the maximum possible**.

Prolonged blood sampling places animals at risk of developing anemia; therefore, animals should be closely monitored throughout the procedure. When multiple blood samples are required, cannulation should be considered. Using the smallest effective diameter minimizes discomfort. To keep the site open for repeated sampling, the cannulae should be flushed regularly with anticoagulant solution. If cannulae are to be in place for long periods and the animal must be restrained, the merit of keeping cannulae open should be balanced with the potential welfare impact of long-term restraint.

Upon removal of cannulae, the animal must be closely monitored for signs of irritation, infection and septicemia. Monitoring for signs of anemia should continue as well.

Septicemia:

- abrupt increases or decreases in body temperature;
- rapid breathing;
- low blood pressure; and
- decreased feed intake.

Anemia:

- lowered haematocrit indicates dropping red blood cell counts.

Additional References and Resources:

Morton D.B., Abbot D., Barclay R., Close B.S., Ewbank R., Gask D., Heath M., Mattic S., Poole T., Seamer J., Southee J., Thompson A., Trussell B., West C. and Jennings M. (1993) Removal of blood from laboratory mammals and birds. First Report of the BVA/Frame/RSPCA/UFAW Joint Working Group on Refinement. *Laboratory Animals* 27:1–22.

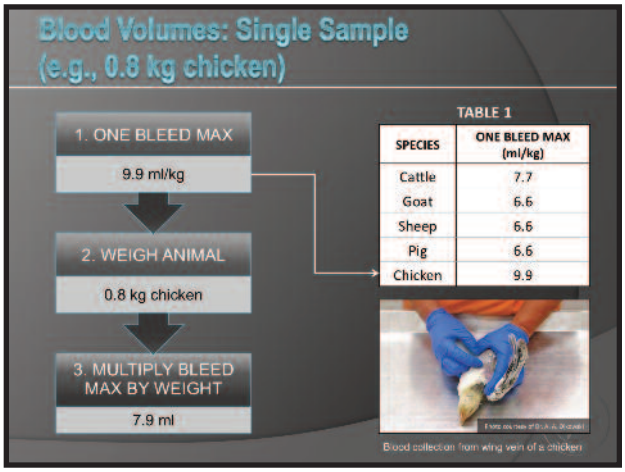
Slide 41 Blood Volumes: Single Sample

Maximum single blood sample volumes based on body weight have been established for each species (Table 1).

To obtain the maximum volume that can be sampled in a single bleed for a specific animal, multiply the one bleed maximum (ml/kg) in Table 1 by the animal's weight (kg).

Example #1: **0.8 kg chicken** (methodology on slide 41, "Blood Volumes: Single Sample")

Example #2: **30 kg pig**
6.6 ml/kg x 30 kg = 198 ml one bleed max



Additional References and Resources:

Sampling methodology adapted from: Hawk C.T., Leary S.L. and Morris T.H. (2005) *Formulary for Laboratory Animals*, 3rd ed. Ames IA: Blackwell Publishing.

Mitruka B.M. and Rawnsley H.M. (1977) *Clinical, Biochemical and Haematological Reference Values in Normal Experimental Animals*. Tunbridge Wells UK: Abacus Press.

Table 1: Maximum single blood volume samples

Species	Bleed Max (ml/kg)
Cattle	7.7
Goat	6.6
Sheep	6.6
Pig	6.6
Chicken	9.9

Adapted: Mitruka and Rawnsley, 1977.

Slide 42 Blood Volumes: Multiple Samples

To calculate the maximum volume when performing multiple bleeds, the blood volume mean per kilogram (Table 2) is used in conjunction with animal weight and frequency of re-sampling.

Multiply the appropriate blood volume mean in Table 2 by the animal weight, to calculate the total blood volume. Then multiply the total blood volume by the percent of blood removed (corresponding to recovery time) (Table 3).

Example #1: **40 kg goat, sampled every 2 weeks** (methodology on slide 42, "Blood Volumes: Multiple Samples")

Example #2: **30 kg pig sampled every week**
65 ml/kg x 30 kg = 1950 ml total blood volume
1950 ml x 7.5% = 146 ml per sample

Additional References and Resources:

Altman P.L. and Ditmer D.S. (1974) *The Biology Data Book*, 2nd ed. Bethesda MD: Federation of American Societies for Experimental Biology.

Diehl K.H. Hull R., Morton D., Pfister R., Rabemampianina Y., Smith D., Vidal J.M. and van de Vorstenbosch C. (2001) A good practice guide to the administration of substances and removal of blood, including routes and volumes. *Journal of Applied Toxicology* 21:15–23.

Sampling methodology adapted from: Hawk C.T., Leary S.L. and Morris T.H. (2005) *Formulary for Laboratory Animals*, 3rd ed. Ames IA: Blackwell Publishing.

Morton D.B., Abbot D., Barclay R., Close B.S., Ewbank R., Gask D., Heath M., Mattic S., Poole T., Seamer J., Southee J., Thompson A., Trussell B., West C. and Jennings M. (1993) Removal of blood from laboratory mammals and birds. First Report of the BVA/Frame/RSPCA/UFAW Joint Working Group on Refinement. *Laboratory Animals* 27:1–22.

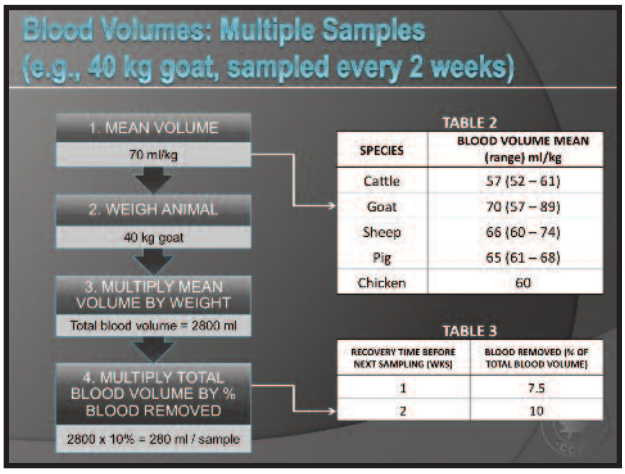


Table 2: Mean blood volume per species

Species	Blood volume mean (range) ml/kg
Cattle	57 (52-61)
Goat	70 (57-89)
Sheep	66 (60-74)
Pig	65 (61-68)
Chicken	60

Adapted from Altman and Dittmer (1974) and Morton et al. (1993)

Table 3: Percent blood removed based on recovery time

Recovery time before next sampling (weeks)	Blood removed (% of total blood volume)
1	7.5%
2	10%

Adapted from Diehl et al. (2001)

Slide 43 Surgery

The welfare of the animal should be a primary concern during all surgical procedures; even in the case of non-survival surgeries, proper pre-operative treatment and anesthesia practices are essential for maintaining good animal welfare. Therefore, surgical procedures are to be performed by experienced and competent individuals only.

Minor surgery refers to surgical procedures which do not puncture the body cavity and which create little or no physical or physiological impairment (e.g., wound suturing or peripheral vessel cannulation).

Major surgery consists of any procedure that results in any of the following:

- penetration or direct access to a major body cavity, such as the cranium, spinal canal, thorax, abdomen or pelvis;
- exposure of major vascular, muscular, skeletal, neural, lymphatic or glandular structures;
- substantial impairment to physical or physiological functioning; and
- removal or alteration of a functionally significant amount of tissue.

Animals undergoing major surgery require significant care prior to, during and, in the case of survival surgery, following the procedure. Personnel caring for farm animals involved in major surgeries must have special training, in line with SOPs describing the necessary skills required to care for animals involved. In particular, personnel should be skilled in the early identification of any potential concerns associated with the surgery, so remedial treatment can be administered as quickly as possible.

Additional References and Resources:

Detailed information about most common surgical techniques in cattle, goats, sheep and swine: Fubini S.L., and Ducharme N. (eds.) (2007) *Farm Animal Surgery*. New York NY: Inc.

Canadian Council on Animal Care (1993) *CCAC Guide to the Care and Use of Experimental Animals*, vol. 1, 2nd ed. Ottawa ON: CCAC.

Slide 44 Requirements for Major & Non-Survival Surgeries

In addition to their invasiveness, surgeries are classified according to their end result:

- **survival**: animal recovers from anesthesia; and
- **non-survival**: animal is euthanized prior to recovery from anesthesia.

Any major survival surgery should be performed in surgery-specific facilities, following standard aseptic surgical procedures. This includes the use of surgical caps, masks, gowns, sterile gloves and equipment. To prevent septic conditions impacting research outcomes, any long (over 30 minutes) non-survival surgeries should also follow strict aseptic surgical procedures.

For short, non-survival surgeries, strict aseptic standards do not need to be met, however equipment and surgery area should be clean.

Detailed records should be kept for all surgeries. Animals undergoing a major, survival surgery for research purposes (e.g., not a major emergency surgery) should only do so once in their lifetime, unless scientifically justified within the protocol.

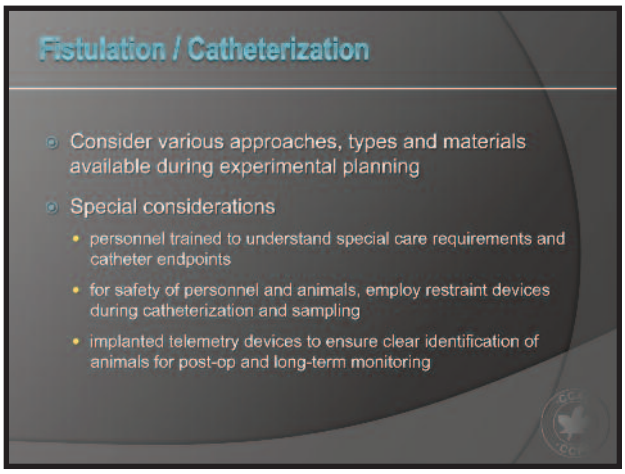
Slide 45 Requirements for Minor & Therapeutic Surgeries

Minor surgeries (e.g., wound suturing) may be performed under less stringent conditions (compared to major surgeries), providing standard veterinary practices are followed.

Therapeutic and emergency surgeries (e.g., caesarian sections, bloat treatment, correcting displaced abomasums, etc.) often need to be performed in standard agricultural settings; however, sanitary and aseptic techniques should be used as much as possible. The animal's welfare is of utmost importance; therefore, pain mitigation (sedatives, anesthetics and analgesics) must be used appropriately.

Within a research setting, two surgical situations occur – planned surgery (where the surgery itself is being studied) and emergency surgery (where the research conducted may or may not be a factor in triggering the condition requiring surgery). When emergency surgeries are highly probable within a specific scientific application, details of the surgeries must be included in the protocol. Required materials (e.g., emergency sanitary surgical packs) should be prepared prior to the commencement of the research activity.

Slide 46 Fistulation / Catheterization



Fistulated or catheterized farm animals require special care in addition to the requirements for other farm animals used for scientific purposes. Investigators must ensure their protocol outlines special care requirements and references any applicable SOPs. These SOPs must cover established endpoints for the removal of catheters, and complications that may arise. Personnel should be trained in the necessary additional care required of fistulated and catheterized animals, including initial post-operative monitoring and appropriate maintenance and care of the devices. Any animals with implanted telemetry devices must be clearly identified so they can be monitored for short and long-term complications. For the safety of both animals and humans, animals should be restrained during the catheterization process, as well as during sampling.

A review by Harmon and Richards (1997) covers the various approaches of gastrointestinal fistulation of ruminants. The authors discuss the materials used in, and the placement of, five cannula types (Reentrant, Simple-T, Closed-T, Omasal, and Abomasal). Suggestions are made as to which cannula types are best suited for various applications. The size of fistulae used should be appropriate for the application; larger sizes may impact rumen contraction and feed passage (Hirayamaa and Katoh, 2005). **Investigators should carefully consider what type of cannula would best meet protocol requirements**.

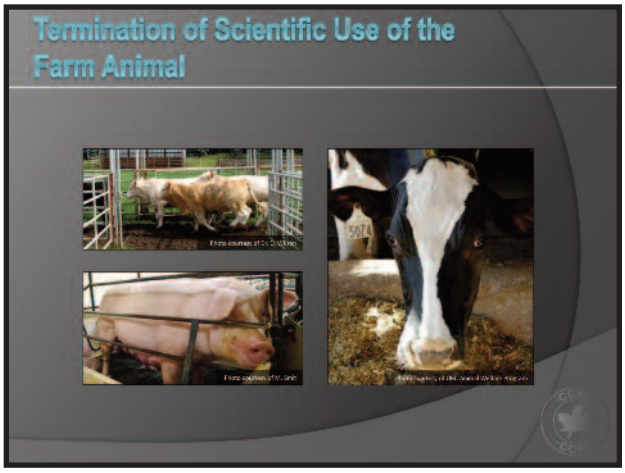
Additional References and Resources:

Harmon D.L. and Richards C.J. (1997) Considerations for gastrointestinal cannulations in ruminants. *Journal of Animal Science* 75:2248–2255.

Hirayamaa T. and Katoh K. (2005) Effects of fistula size on rumen internal pressure and passage rate of feed in goats. *Small Ruminant Research* 56:277–280.

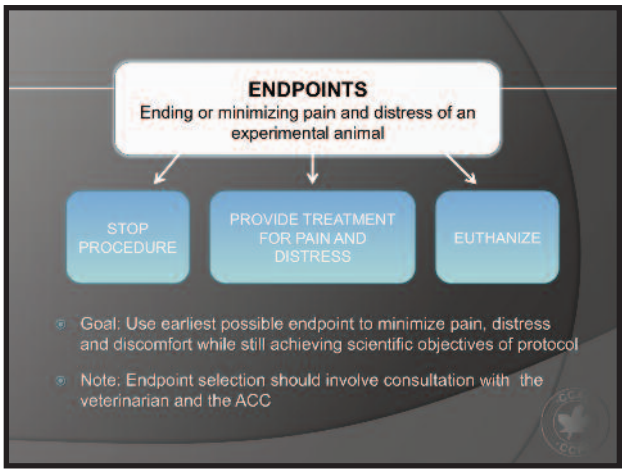
Slide 47 Termination of Scientific Use of the Farm Animal

All animal care and use protocols must outline the fate of animals following scientific use, how endpoints are determined as well as euthanasia methodology specific to the species and experiment. The disposal of animal carcasses should also be considered, particularly when food chain disposal is not an option.



Slide 48 Endpoints

An endpoint is the point at which the pain and/or distress experienced by an animal is terminated, minimized or reduced by stopping a procedure, providing treatment for the pain and distress or euthanizing the animal.



Choosing the earliest endpoint compatible with the scientific objectives of the approved protocol will alleviate or minimize the pain, distress or discomfort experienced by the animals. The veterinarian and the ACC should be involved in the selection of endpoints.

The CCAC provides guidelines to assist in the selection of appropriate endpoints:

- the *CCAC guidelines on: choosing an appropriate endpoint in experiments using animals for research, teaching and testing* (1998). Visit the CCAC website at www.ccac.ca to access and consult this guidelines document; and
- section 9.6 in *CCAC guidelines on: the care and use of farm animals in research, teaching and testing* (2009). Visit the CCAC website at www.ccac.ca to access and consult this guidelines document.

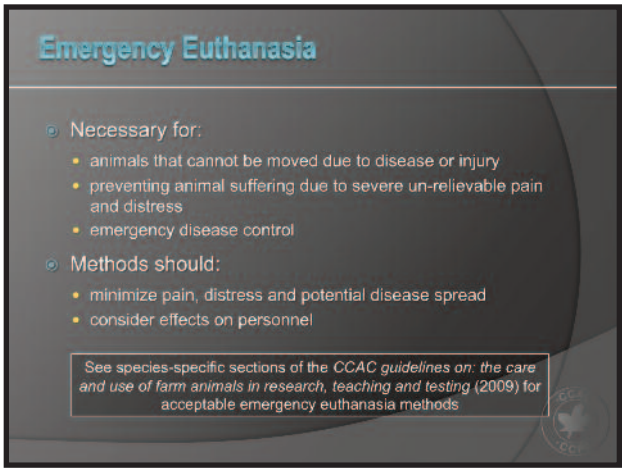
These guidelines summarize monitoring procedures as well as the use of pilot studies for determining endpoints. Also discussed are the specifics for frequency of observation, the responsibilities of personnel and the ACC, as well as examples of endpoint determination in specific types of research.

Slide 49 Return to Herd or Flock

In many instances, particularly when scientific use is non-invasive (e.g., evaluating play behaviour of group housed dairy calves), **farm animals may be reintroduced into a previously existing herd or flock upon the end of their scientific use**. Depending on the species, age, sex, housing and new group size, some farm animals may find readjustment difficult; animals should be monitored closely upon reintroduction. The principles outlined in slide 24, "Importance of Acclimation" apply when animals are being returned to the main farm animal population.

Records of all treatments to which the animals are exposed should be kept to ensure past scientific use does not impact future scientific use.

Slide 50 Emergency Euthanasia



The euthanasia of farm animals not entering the food chain must be performed in accordance with *CCAC guidelines on: euthanasia of animals used in science* (in prep.).

SOPs must be developed for emergency, on-farm euthanasia and disposal situations. These should include:

- animals that cannot be moved to slaughter facilities;
- prevention of animal suffering due to un-relievable pain and/or distress; and
- emergency disease control.

The intention of euthanasia is to make the animal's death as distress-free and painless as possible. **The most important criteria for acceptance of a euthanasia method is that it have a rapid initial depressive action on the central nervous system to ensure immediate insensitivity to pain, and that steps are taken to minimize fear and psychological stress in the animal prior to the procedure**. There should be SOPs outlining euthanasia methods that will cause the least distress and pain to the animal. The methods used should be suited to the species, age and health status of the animal. When possible, the animal should be euthanized in its home environment, as moving and mixing animals creates further stress and increases the chances of disease transmission.

If restraint is necessary in order to carry out euthanasia safely, personnel should be knowledgeable in handling and restraint practices that minimize fear, distress, injury and pain; if restraint methods will cause these aversive states, tranquilizers, sedatives and anesthetics must be considered.

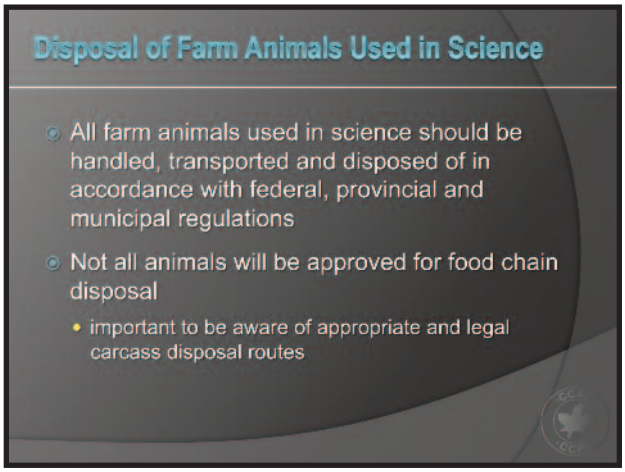
Developing the emergency disease control SOP will allow for evaluation of euthanasia methods which minimize pain, distress and disease spread, as well as provide consideration for the individuals required to carry out the procedures. **Personnel must be properly trained to perform the methods of euthanasia** outlined in the SOPs. Training should include:

- recognizing animal pain and distress using behavioural measures;
- safe and stress-minimizing handling and restraint techniques;
- performing the euthanasia procedure (including the preferred method, as well as an alternative method);
- recognizing and assessing unconsciousness; and
- accurate confirmation of death.

Species-specific methods are outlined in the subsections of Section 10 in *CCAC guidelines on: the care and use of farm animals in research, teaching and testing* (2009). Additionally, see applicable species-specific CCAC training modules (to come in 2011). Visit the CCAC website at www.ccac.ca to access and consult this guidelines document and training module.

Slide 51 Disposal of Farm Animals Used in Science

Food Chain Disposal



In some cases, farm animals used in science are accepted into the food chain. Standard withdrawal periods must be followed when any commonly utilized antibiotics or hormones have been administered. It should be noted that cannulated and fistulated animals are not usually suitable for food chain disposal.

Animals that are accepted into the food chain should be transported according to standard federal regulations and national recommended codes of practice (see slide 22 "Transporting Farm Animals for Use in Science").

Although investigators do not have control over how animals are slaughtered off-site, investigators can ensure that the slaughter facilities to which animals are sent comply with humane slaughter practices, use approved methods, and comply with the following acts and regulations:

- Agriculture Canada's *Meat Inspection Act* R.S., 1985 c.25 [1st Supp.]: http://laws.justice.gc.ca/eng/SOR-90-288/page-4.html;
- Federal *Health of Animals Act*, 1990 c.21: http://laws.justice.gc.ca/en/showdoc/cr/C.R.C.-c.296/bo-ga:l_XII//en; and
- provincial legislation, municipal and local by-laws.

(Note: if any of the above links are broken, search for: Department of Justice Canada and then use the "Browse Statutes by Title" to locate specific act and regulation.)

Additionally, the national industry *Recommended Codes of Practice for the Care and Handling of Farm Animals* (http://www.nfacc.ca/code.aspx) should be followed. (Note: if link is broken, please search: NFACC codes)

Non-Food Chain Disposal

Farm animals used in scientific applications testing new drugs and vaccines, or that have been challenged by pathogens or radioisotopes are typically not allowed into the food chain (either as food, or rendered food by-product). The reasoning for this is two-fold. First, potential exists for pathogen contamination. Second, the media which new vaccines and pathogens are grown on is not always certified free of Transmissible Spongiform Encephalopathies (TSEs). Both these reasons make the animals unsuitable food sources. However, if the previous situations can be avoided, it is possible to receive approval for food chain disposal in some cases, by contacting the appropriate regulatory bodies:

- for new vaccines: Veterinary Biologics Section of the CFIA: http://www.inspection.gc.ca/english/anima/vetbio/vbpbve.shtml (Note: if link is broken, search: CFIA veterinary biologics);
- for new drugs: Veterinary Drugs Directorate of Health Canada
    - Emergency Drug Release: http://www.hc-sc.gc.ca/dhp-mps/vet/edr-dmu/index-eng.php (Note: if link is broken, search: Health Canada emergency drug release); and

- Experimental Studies Certificate: http://www.hc-sc.gc.ca/dhp-mps/vet/applic-demande/form/esc-cee_08-2002-eng.php (Note: if link is broken, search: Health Canada experimental studies certificate for veterinary drugs).

Investigators should be aware of and comply with the stipulations for appropriate and legal disposal routes for carcasses containing drugs and radioisotopes; SOPs should be followed closely to prevent such carcasses from entering the food chain. Contingency plans should be in place to address the disposal of animals when the primary disposal route is not available (e.g., failure of incinerator or digester). In some cases, temporary storage of animals (e.g., freezing) while a disposal route is found may be necessary, and should therefore be planned for in advance.

Slide 52 Summary

The purpose of this training module was to provide individuals working with farm animals in science an introduction to the care, housing, and handling practices which promote good welfare. **The key towards effectively meeting farm animal needs in a welfare-focused manner is to understand that good welfare stems from three components: biological functioning, natural living and affective states**. All three factors must be balanced in order to achieve good farm animal welfare. Balance can be achieved by ensuring the fundamental needs of the animals are met, and by focusing on appropriate husbandry and treatment before, during and after their use in science.

Animal users should strive to achieve their scientific goals in line with the best possible animal welfare standards.