UNIVERSITY OF DELAWARE
COLLEGE OF AGRICULTURE AND NATURAL RESOURCES

HANDBOOK FOR AGRICULTURAL ANIMAL CARE AND USE IN RESEARCH AND TEACHING

(Updated October 2021)

Dr. Annie Renzetti

Regarding Large Animals (Equine, Bovine, Porcine, Ovine) and Poultry

Preface

This Handbook for Agricultural Animal Care and Use in Research and Teaching has been developed to provide faculty, professionals and students with information necessary to comply with the voluntary guidelines established in the Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching (2020, 4th Edition), hereafter referred to as The Guide. This Handbook applies to all CANR agricultual animals used for teaching and research for agricultural processes. Agricultural animals that are used for biomedical research must follow the guidelines set out in the Guide for the Care and Use of Laboratory Animals (8th Edition).

Individuals requiring more detailed information than what is presented in this Handbook are directed to The Guide.

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Chapter 1 – Personnel, Roles and Responsibilities

Species	Farm manager	FM email	Faculty Liaison	FL email
Dairy Cattle	Jon Leith	jleith@udel.edu	Tanya Gressley	gressley@udel.edu
Horses	Larry Armstrong	larmstro@udel.edu	Amy Biddle	asbiddle@udel.edu
Swine	Larry Armstrong	larmstro@udel.edu	Lesa Griffiths	lesa@udel.edu
Sheep	Larry Armstrong	larmstro@udel.edu	Lesa Griffiths	lesa@udel.edu
Beef Cattle	Larry Armstrong	larmstro@udel.edu	Lesa Griffiths	lesa@udel.edu
Poultry	Karen Gouge	kgouge@udel.edu	Aditya Dutta	adidutta@udel.edu

Responsibilities of the Farm Manager

The farm manager for each species will be the primary person in charge of the maintenance and health of the animals in their care. This individual will be responsible for arranging for all management and meeting dietary needs of the animals as outlined in this Handbook. The farm manager is also the point of contact for anyone wanting to schedule interaction (teaching or research) with the animals. The farm manager will work with researchers to determine the distribution of care responsibilities for animals engaged in a protocol.

Responsibilities of the Faculty Liaison

The faculty liaison for each species will communicate and collaborate with the Farm Manager and Farm Superintendent to ensure the teaching, research and outreach goals of the department are met as they pertain to the care and management of their specific species.

Responsibilities of the Agricultural Attending Veterinarian (AAV)

The Agricultural Attending Veterinarian (AAV) should be trained and experienced in the proper care, handling, and use of each species of agricultural animal used at the University of Delaware (UD). The AAV will serve on the Institutional Animal Care and Use Committee (IACUC) committee to review protocols for research and teaching using agricultural animals. In her/his role on the IACUC, the AAV shall:

- Provide oversight of compliance with required regulatory regulations or guidelines for agricultural animals;
- Participate in training of personnel involved in agricultural animal research;
- Participate in oversight of the animal health care program for the agricultural animals; and
- Serve in an advisory capacity to the Dean.

Responsibilities of the Agricultural Farm Staff

The farm staff shall be responsible for the daily care and feeding of the animals as outlined in this Handbook (including those animals on research protocols) unless other prior arrangements have been made by an investigator.

Care of Agricultural Animals in Educational Exhibits

Sheep, dairy cattle, poultry and horses can be used in educational exhibits at events like Ag Day. The students are responsible for the care of the animals while they are part of the educational exhibit. The students should be familiar with the feed, water, and shelter requirements and be able to supply competent and accurate answers to questions from the general public. Students should have knowledge and skill to

properly restrain the animals. Farm professionals are required to assist students in transporting the animals.

Emergency Animal Care Policy

In the case of an emergency situation (disease outbreak, natural disaster or agro-terrorism), refer to the CANR Agricultural Animal Emergency Plan (2019).

Procedure to Initiate Teaching or Research with any of the Agricultural Animals

1. Complete either the non-invasive teaching (teaching) or research IACUC protocol form. This form is to be submitted to the UD IACUC for review and approval. This process may require a 2 month lead time. NO WORK (or teaching) may begin prior to full protocol approval. The forms can be found at: https://research.udel.edu/animal-subjects-resources/
2. Contact the farm manager and faculty liaison in charge of the unit where you are planning to teach/do research to discuss the specifics of your plans well in advance.
3. It must be made clear who will be responsible for the care and feeding of the animals while they are on a research protocol.

Procedure for Reporting Animal Welfare Concerns

The University of Delaware is committed to the proper care and humane treatment of all animals used in research and teaching at this institution. The IACUC will review, and if warranted, investigate all allegations, whether made by the public or an employee of this institution. Federal laws and regulations prohibit discrimination or reprisal for reporting any animal welfare concerns. Reports about animal welfare or non-compliance will be handled confidentially, if requested.
To report a concern, please contact any or all of the following:

Dr. Annie Renzetti (AAV)
302-893-5654
renzetti@udel.edu

Dr. Gwen Talham (Director, Animal Care Program)
302-831-2980 / cell-610-505-9572
gtalham@udel.edu

Dr. Jaclyn Schwarz (IACUC chairperson)
302-831-7623
jschwarz@udel.edu

Chapter 2 - General Overview of Animal Care and Healthcare

General Animal Care Policy

All agricultural animals housed at the UD facilities will be visually evaluated for illness and injury by adequately trained personnel on a daily basis. Any animal noticed to be in any kind of distress must be immediately attended to with appropriate care.

A veterinarian must be contacted by University faculty/professionals/staff when any large animal is sick or injured resulting in any of the following conditions: unrelenting or deteriorating pain/suffering, progressive and/or permanent disability. If said animal is not showing signs of improvement over a maximum period of 24 hours, then the animal must be euthanized. All euthanasia methods used should follow the 2020 American Veterinary Medical Association guidelines. Protocols for species specific appropriate euthanasia are contained in the species specific sections that follow in this Handbook.

Animal Procurement

All animals must be obtained and transported legally. Quality control for vendors and knowledge of the history of purchased animals is part of an adequate institutional veterinary care program. Animals of unknown origin or from stockyards should only be used if necessary; such animals may pose significant unknown health risks compared with animals of known origin, and therefore, should be handled appropriately. Newly acquired animals should undergo a quarantine and acclimation period for preventive and clinical treatments as appropriate for their species' health status.

Quarantine

Quarantine is the separation of newly received animals from those already in the facility or on the premises until the health of the new animals has been evaluated and found to be acceptable. The quarantine period should be long enough to observe signs of infectious disease or obtain diagnostic evidence of infection status. Animals should be observed in quarantine until they are cleared for introduction into a herd or facility. During the quarantine period, animals should be vaccinated and treated for diseases and parasites as appropriate to protect their health and maintain the health of animals in the home facility. In addition to having adequate quarantine procedures, research facilities and animal use protocols should be designed to minimize the risk of introducing or transmitting disease agents.

Preventative Medicine

Adequate agricultural animal health care in research and teaching involves a written and implemented program for disease prevention, surveillance, diagnosis, treatment, and endpoint resolution. The objectives of such a program are to ensure animal health and welfare, minimize pain and distress, utilize animal production practices, prevent zoonosis, assist investigators on study-related animal health issues, and avoid contaminants or residues in animal products. The program should include training for animal users regarding animal behavior, production practices, humane and appropriate restraint for the species involved, anesthesia, analgesia, surgical and postsurgical care, and euthanasia. A mechanism for direct, frequent, and regular communication must be established among personnel who are responsible for daily animal care and observation, animal users, and the AAV. This will help ensure that timely and accurate animal health information is effectively communicated.

Sick, Injured, or Dead Animals

Animal care personnel must be trained to recognize signs of illness and injury. When appropriate, sick or injured animals should be segregated from the main group to protect them and the other animals, observed at least once daily, and provided with veterinary care as appropriate. When animals are separated, a mechanism should be in place to communicate to staff the status of the animals and to ensure proper daily, weekend, holiday, and emergency care. Care should be taken to minimize spread of pathogens from ill animals to healthy animals by observing appropriate biocontainment measures. Incurably ill or injured animals with un-relievable pain or distress should be euthanized in the most humane way as soon as possible by trained personnel. Unexpected deaths should be reported to the AAV and IACUC. Dead animals are potential sources of infection and should be disposed of promptly by a commercial rendering service or other appropriate means (e.g., burial, composting, or incineration), following applicable state and local ordinances and regulations. Postmortem examination of fresh or well-preserved animals may provide important animal health information and research data, which can aid in preventing further losses. When warranted and appropriate, waste and bedding removed from a site once occupied by a dead animal should be made inaccessible to other animals, and the site disinfected appropriately.

Medical Records (UD Teaching and Research animals)

An important component of an agricultural animal health program is maintaining records that can be used to monitor animal health events. Medical records should comply with the American College of Laboratory Animal Medicine (www.aclam.org) statement on medical records. Group health records may be appropriate for animals that are kept as cohorts (e.g., in a colony, school, flock, herd, or room), particularly because the animals undergo daily observation or evaluation by trained individuals. The AAV and farm unit managers will determine the method by which medical records are maintained for each agricultural species. Oversight of medical records is the responsibility of the principal investigator (for research animals), the farm unit manager (for UD teaching animals), the AAV, and the IACUC.

The record system must be structured so that information is easily collected, gathered, analyzed, summarized, and available to the AAV, the principal investigator, and the IACUC. Notations in the medical record should be made by individuals who have administered treatments, or made direct observations or evaluations of the animal(s) or their diagnostic results, or their designee. All entries in the record should be dated, indicate the originator of the entry (e.g., initials, signature, and electronic signature), and be legible to someone other than the writer.

Surgeries

The Institute for Laboratory Animal Research (ILAR) Guide differentiates major from minor surgery as follows: major survival surgery (e.g., laparotomy, thoracotomy, joint replacement, and limb amputation) penetrates and exposes the body cavity, and may produce substantial impairment of physical or physiologic functions, or may involve extensive tissue dissection or transection. Minor survival surgery does not expose a body cavity, causes little or no physical impairment, and would include suturing, peripheral vessel cannulation, and percutaneous biopsy, routine agricultural animal procedures such as castration, and most procedures routinely done on an ‘outpatient’ basis in veterinary clinical practice. Minimally invasive surgery such as laparoscopy may benefit the animal relative to traditional surgical techniques.

Performance of more than one major survival surgery on a single animal is discouraged but may be necessary to ensure or maintain the health of the animal. Long-lived animals may undergo multiple major surgeries, such as a cow that requires surgery for correction of displaced abomasum and cesarean section for therapeutic purposes. Multiple major survival surgeries performed for nontherapeutic reasons should be performed only when justified, as reviewed and approved by the IACUC. Multiple major

surgeries that produce minor physiologic or physical impairment and reduce overall animal use, such as multiple endoscopic laparotomies in sheep for reproductive purposes, may be appropriate. Likewise, multiple surgical procedures may be justified when they are related components of the same project (e.g., cannulation of the digestive tract at several locations)

Surgery Personnel

Inappropriately performed surgical techniques or inadequate postoperative care will result in unnecessary pain and distress. Surgery on agricultural animals should be performed or supervised by an experienced veterinarian or their designee, or by research scientists who are trained, highly skilled, and experienced in performing surgery, in accordance with established protocols approved by the IACUC. Researchers should seek input from a veterinarian experienced in basic surgical techniques for the subject species when establishing surgical protocols to be approved by the IACUC.

Surgical Facilities and Aseptic Technique

Major survival surgeries should be performed in facilities designed and prepared to accommodate surgery whenever possible, and appropriate aseptic surgical procedures should be used. Good surgical practice includes the use of surgical caps, masks, gowns, and sterile gloves, as well as aseptic surgical site preparation and draping. Sterile instruments must be used. Manufacturers' recommendations must be followed for chemical sterilants. For non-survival surgeries, during which the animal is euthanized before recovery from anesthesia, it may not be necessary to follow all aseptic techniques, but the instruments and surrounding area should be clean.

Minor surgical procedures that do not penetrate a body cavity or produce substantial impairment (e.g., wound suturing, peripheral-vessel cannulation, and certain standard agricultural practices) may be performed under less stringent conditions in accordance with standard agricultural practices.

Therapeutic and emergency surgeries (e.g., caesarean section, treatment of bloat, repair of displaced abomasum) may sometimes need to be performed in agricultural settings that are not conducive to rigid asepsis. However, every effort should be made to conduct such surgeries in a sanitary or aseptic manner and to use anesthetics or analgesics commensurate with the risks to the animal's well-being. Research protocols that carry a high likelihood of the need for emergency surgery should contain provisions for handling anticipated cases. Surgical packs and equipment for such events should be prepared and readily available for emergency use.

Postsurgical Care

Appropriate facilities should be available for animals that are recovering from general anesthesia and major surgery. The following are recommended:

- Segregation from other animals until recovery from anesthesia;
- Clean and sanitary recovery area;
- Adequate space, with consideration for physical comfort and well-being of the animal, in a place suitable for recovery from anesthesia without injury (e.g., a room or stall with protective covering on floors and walls);
- Environmental controls sufficient to ensure maintenance of environmental temperature within the thermo-neutral zone and animal temperature within the normal range during postsurgical recovery; and
- Trained personnel for postsurgical observation to help ensure a safe recovery.
- Postsurgical observation should be provided until the animal is fully recovered from anesthesia, ambulatory, and able to return safely to its original housing location.

Anesthesia and Analgesia

Painful animal husbandry-related procedures (standard agricultural practices), such as castration, dehorning, and tail docking, should be conducted with the use of pain management protocols appropriate for the age and species of animal involved. Details of these procedures are provided in the species-specific chapters. The AAV should advise investigators about the choice and use of analgesics, anesthetics, or any other pain- or distress-relieving measure. After being trained and subsequently supervised by a qualified scientist or veterinarian, technical personnel may administer anesthetics and analgesics as part of a research or teaching protocol. If a painful or distressing experimental procedure must be conducted without the use of an anesthetic or analgesic because such use would prevent collection of useful data, this must be scientifically documented in the animal care and use protocol and approved by the IACUC. In such cases, appropriately validated pain assessment methods should be used in conjunction with analgesic protocols (rescue analgesia) to manage pain and ensure that animal distress and suffering are minimized.

Paralytic drugs (e.g., succinylcholine and other curariform drugs) are not anesthetics. They must not be used unless animals are in a surgical plane of anesthesia and thus are unconscious. Use of paralytic agents must be justified in the animal use protocol, and appropriate ventilation and monitoring for depth of anesthesia must be described.

Sedatives and tranquilizers are psychotropic sub-stances that alter mental processes or behavior but do not produce anesthesia or, in most cases, long-lasting analgesia. However, these medications can reduce the dose of anesthetic required. When used alone, tranquilizers should only be used to allay fear and anxiety. Their use may render restraint less stressful and enable animals to adapt more easily to novel situations. However, these compounds may not provide long-lasting pain relief, especially when pain is associated with tissue damage and inflammation.

Signs of Pain and Distress

Pain is an aversive feeling or sensation associated with actual or potential tissue damage resulting in physiological, neuroendocrine, and behavioral changes that indicate animal distress. Although pain and distress in animals can often be detected by an experienced observer, these conditions are sometimes unapparent, especially in stoic animals. When unanticipated pain or distress are detected, animal-care attendants or research staff should take immediate ameliorative action as necessary and contact the AAV.

Pain can be one of the earliest signs of disease or injury. Animals in pain may become less active, restless, reduce feed consumption, grind their teeth, vocalize, or appear frightened and agitated. Animals in pain may resist handling or favor the painful area by adopting an abnormal stance or abnormal behavior. In some cases, pain may not be noticed until a physiological act is induced, such as swallowing, coughing, chewing, or defecating. The observer should try to determine whether pain appears to be constant or associated with a provoking act. Sudden, severe pain is often associated with fractures, rupture or torsion of visceral organs, or acute inflammation, and should be considered an emergency.

Practices that minimize pain or distress in agricultural animals can be summarized using the 3S approach—suppress, substitute, and soothe. This involves removing or correcting the inciting cause of the pain (suppress), finding a less painful alternative (substitute), or administering appropriate analgesics, and other corrective steps (e.g., immobilizing a fracture, elevating an injured claw by securing a wood block under the opposite claw) to relieve the pain (soothe). Relief of pain should be one of the first tasks of the AAV, adhering to the following principles:

- Relief of pain is a humane act;
- Relief of pain must be initiated promptly once it is deemed necessary; and
- It may be necessary to protect animals in pain from self-injury.

The AAV must be familiar with analgesics labeled for use in specific agricultural animals and must be able to prescribe and establish withdrawal times for extra-label use of analgesics when indicated. Animals with severe or chronic pain that cannot be reduced or alleviated may need to be euthanized. When experimental outcomes involve pain or distress that cannot be alleviated, humane endpoints must be clearly defined in the approved IACUC protocol.

Zoonoses

Zoonotic diseases are defined as infectious diseases in animals that can be transmitted to humans, who, in turn, may transmit the infectious agent to another animal. Information pertaining to zoonotic diseases can be found online in the Merck Veterinary Manual (https://www.merckvetmanual.com/). A current list and incidence of notifiable diseases, such as Q-fever (Coxiella burnetii), may be obtained from the US Centers for Disease Control and Prevention (http://www.cdc.gov/). The AAV, working in collaboration with scientists or instructors of record, will establish appropriate preventive medicine programs and husbandry practices to decrease the likelihood of transmission of potential zoonotic agents.

Residue Avoidance

Administration of drugs to animals destined to enter the food chain requires special consideration. Before an animal may be slaughtered for human or animal food purposes, time must be allowed for medications, drugs approved by the Food and Drug Administration (FDA), or substances allowed by the FDA for experimental testing under the Investigational New Animal Drug (INAD) exemption to be depleted from the tissues. Such use is only permitted when it adheres to regulations in the Animal Medicinal Drug Use Clarification Act of 1994, Public Law 103-396. A record of the product used, dose, route of administration, duration of treatment, and period of withdrawal must be maintained. Adherence to proper withdrawal times must be ensured before animals are transported to the auction, market, or abattoir. Residues of 3 groups of chemicals must be prevented from occurring in research animals if these animals or their products are to enter the human food chain.

These groups are (1) approved drugs used according to directions on the label, (2) drugs used in an extra-label fashion, and (3) other chemicals such as herbicides, pesticides, and wood preservatives. The Food Animal Residue Avoidance Database (FARAD; http://www.farad.org/) is a project sponsored by the USDA National Institute of Food and Agriculture. The FARAD Compendium of FDA Approved Drugs provides information about drugs that are available for treating animal diseases, the withholding times for milk and eggs, and pre-slaughter withdrawal times for meat. Information about the drugs approved for use in food animals in the United States is included in this online database (http://www.farad.org/). The FARAD compendium allows selection of over-the-counter products that satisfy particular needs as well as alerts to the need for veterinary assistance with prescription drugs; FARAD also provides estimates of meat and milk withdrawal times for extra-label use of drugs.

Drug Storage and Control

Pharmaceuticals intended for use in food-producing animals must be managed responsibly. Storage should be in an area that is clean and dry and that offers protection from changes in temperature, sunlight, dust, moisture, and vermin. The manufacturer's labeling should be consulted for specific information regarding appropriate storage conditions and product shelf life. In addition, the integrity of product containers should be periodically evaluated to assess for potential leakage or contamination of the stored product. Products in damaged containers or with missing or illegible labels should be disposed of properly. In addition to dating the first use of the product, and to minimize the potential for treatment errors, products should be physically segregated according to indicated use. Lockable storage units should be used to prevent access by unauthorized persons.

Record Keeping

Records of all potentially harmful products used in the facility, their storage, their use, and their disposal should be maintained. If used in accordance with the label and with allowance for the correct withdrawal time, approved drugs should not result in violative residues. Record-keeping and management should confirm that drugs are not outdated and that the directions on the label have been followed. Records should be maintained for at least 2 years or in timelines consistent with state and federal requirements as they apply (21CFR530; https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?CFRPart=530).

In the event that animals are given an investigational drug, no meat, eggs, or milk from those animals may be processed for human consumption unless authorization has been granted by the FDA or the US Department of Agriculture and an appropriate INAD exemption from the FDA has been obtained for use of the investigational drug. In such cases, the investigator must follow specifications outlined in the INAD. The authorization to process meat, eggs, or milk from such animals will depend on the development of data to show that the consumption of animal products so treated is consistent with public health considerations and that the product does not contain the residues of harmful drugs or their metabolites. Proper methods of disposal of such meat, eggs, and milk may include incineration, burial, or other procedures ensuring safety, sanitation, and avoidance of the human food supply.

Extra-Label Use

The use of different dosages, formulations, or routes of administration or the treatment of animals for conditions not specifically mentioned on the product label constitutes extra-label drug use (ELDU). Such use may be considered by licensed veterinarians when the health of the animal is immediately threatened and when suffering or death would result from failure to treat the affected animal. Such use is only permitted when it adheres to the regulations promulgated by the FDA under the Animal Medicinal Drug Use Clarification Act (AMDUCA) of 1994, Public Law 103-396 (US Food and Drug Administration, 1994). The major principles guiding such use are that (1) there must be a valid veterinarian–client–patient relationship; (2) ELDU in feed is illegal; (3) the compound intended for ELDU must be manufactured in an FDA-inspected facility; (4) records of ELDU must be maintained for 2 years; and (5) there must be an adequate safety margin in the withdrawal time based on the most complete pharmacokinetic data available. The FARAD data-base or FDA should be contacted whenever guidance is needed. All personnel attending to food animals should be aware that the marketing status of medically important antimicrobials for use in feed or water for food animals changed from over-the-counter to prescription or to veterinary feed directive at the end of calendar year 2016.

Hazardous Chemicals

Many chemicals used on farms and in agricultural research establishments could result in residues in the meat, milk, or eggs of animals exposed to these chemicals. Examples are pesticides for insect control, herbicides, poisons for rodent control, wood preservatives, and disinfectants. Harmful products should be properly labeled and stored, and expiration dates should be kept. Personnel must be informed of all such potential hazards and be required to wear appropriate protective equipment. Chemicals must be stored, used, and disposed of in a manner that prevents contamination of animals and residues in milk, meat, or eggs.

Restraint

Physical restraint of agricultural animals involves the use of manual or mechanical means to restrict an animal's movements for the purpose of examination, collection of samples, administration of drugs, or a variety of other experimental and clinical manipulations. The period of restraint should be the minimum required to accomplish the objective. Physical restraint can be accomplished with devices such

as stocks, head gates, stanchions, halters, squeeze chutes, or snares with swine. Species-specific methods of restraint should always be used. It is important that such devices be suitable in size and design for the animal being held and be operated properly to minimize stress and avoid pain and injury. Personnel should be trained on the use of hydraulically operated restraint devices to prevent potential injury. Prolonged physical restraint involves the restriction of normal animal movements for an extended period, typically hours or days. Animals should be conditioned to restraint equipment by a gradual process such as increasing the time of restraint on each occasion. Extended physical restraint, including a description of the conditioning regimen and monitoring of the restraint, should be reviewed and approved by the IACUC. Less restrictive systems that do not limit an animal's ability to make normal postural adjustments should be used when compatible with protocol objectives.

Humane Endpoints - Euthanasia

Euthanasia is a method of killing that minimizes pain, distress, and anxiety experienced by the animal before loss of consciousness. Protocols for euthanasia should follow the specifications for "acceptable" or "acceptable with conditions" techniques as described in the American Veterinary Medical Association (AVMA) Guidelines for the Euthanasia of Animals and include the method for confirming that death has occurred. Copies of these protocols should be made available to all personnel who euthanize animals. The current edition of the AVMA guidelines should be considered the primary standard for euthanasia. Euthanasia must be carried out only by trained personnel in accordance with applicable regulations and policies.

Where possible, the method used should not interfere with postmortem evaluations. Proper euthanasia includes skilled personnel who ensure that the technique is performed humanely and effectively and that the risk of injury to personnel is minimized or averted. Personnel who perform euthanasia must have training and experience with the techniques to be used. This training must include familiarity with the normal behavior of agricultural animals and how handling and restraint affect that behavior. All equipment and materials required to perform euthanasia should be readily available, and the AAV familiar with agricultural animals or a qualified scientist or technician should ensure that all personnel performing euthanasia have demonstrated proficiency in the use of the techniques selected. No matter what method of euthanasia is performed, personnel must ensure that death has occurred. Assurance of death is most reliably confirmed with a combination of criteria including lack of pulse, breathing, corneal reflex, and response to firm toe pinch; inability to hear respiratory sounds and heartbeat by use of a stethoscope; graying of the mucous membranes; and rigor mortis.

Humane Endpoints – Depopulation

Depopulation refers to the rapid destruction of a population of animals in response to urgent circumstances with as much consideration given to the welfare of the animals as appropriate. Urgent circumstances may include emergency situations, such as the need for immediate disease control or a response to natural or human-made disasters. Protocols for depopulation should follow the AVMA Guidelines for the Depopulation of Animals. As much attention as possible should be shown to the needs and natures of animals that will be terminated. However, ensuring the welfare of animals is just one of many important considerations during an actual response to an emergency situation. Therefore, the emergency destruction of animals through depopulation techniques may not guarantee that the deaths of the animals are as painless and distress free as would be expected under other circumstances.

Biosecurity

In today's world of communicable diseases it is of utmost importance that the agricultural animals on the UD farms are protected from inadvertent exposures. With this tenant in mind, no unauthorized personnel are permitted on any of the UD farms. Unauthorized personnel include any students or member of the public that do not have a specific reason (class, for example) to be on the

farms. It is the responsibility of everyone who is involved with the agricultural animals to be vigilant and vocal with regards to biosecurity.

All Ag Ambassador tours to the agricultural facilities should be scheduled with the farm manager of the specific unit. There will be specific and agreed upon routes and locations for tours on each farm. At no time may any member of a tour physically touch any UD animal. Appropriate biosecurity precautions (i.e., disposable boots in the dairy) should be taken, specific to each unit. See the species specific section in this Handbook for the specific agricultural unit biosecurity measures and the identity of the farm manager.

No outside animals, of any kind, are permitted on the UD agricultural facilities.

Due to increased risk of disease, any persons known to have been on farms in foreign countries within the last month may be subject to heightened biosecurity measures. See each species specific section for individual heightened biosecurity measures for international personnel.

Any biosafety concerns should be reported to the AAV (Annie Renzetti (302) 893-5654 renzetti@udel.edu)

Chapter 3 – General Husbandry, Housing, and Biosecurity

Proper management is essential for the welfare of animals, the validity and effectiveness of research and teaching activities, and the health and safety of animal care personnel. Sound animal husbandry provides systems of care that permit animals to grow, mature, reproduce, and be healthy.

Macroenvironment and Microenvironment

Animal well-being is a function of many environmental variables, including physical surroundings, nutritional intake, and social and biological interactions. Environmental conditions for animals need to be managed such that stress, illness, mortality, injury, and behavioral problems are minimized. Particular components of the environment that need to be taken into account include temperature, humidity, light, air quality, space (including complexity of space), social interactions, microbe concentrations, noise, vermin and predators, nutritional factors, and water.

Physical conditions in the room, house, barn, or outside environment constitute the macroenvironment; the microenvironment includes the immediate physical and biological surroundings. Different microenvironments may exist within the same macroenvironment. Both the microenvironment and macroenvironment should be appropriate for the genetic background and age of the animals and the purpose for which they are being used. Domestic animals readily adapt to a wide range of environments, but some genetic strains have specific needs, of which the scientist should be aware and for which accommodation should be made. Even in relatively moderate climatic regions, weather events such as floods, winter storms, and summer heatwaves may require that animals have access to shelter.

Other methods of combating heat stress are direct wetting of the animals, evaporative cooling of the air, and providing fans. Intervention strategies should be based on individual animal responses. For example, open mouth panting and drooling are clear signs that cattle are experiencing heat stress. Cattle showing these signs have higher respiration rates and body temperatures than animals that are not heat stressed. Animals affected by hyperthermia or hypothermia should be treated accordingly.

Space Requirements

Floor area is only one of the components that determine the space requirements of an animal. Enclosure shape, floor type, ceiling height, location and dimensions of feeders and waterers, features inside the enclosure, and other physical and social elements also affect the amount of space sensed, perceived, and used by animals in intensive management systems. Determination of area requirements for domestic animals need to consider body size, head height, stage of life cycle, behavior, health, and weather conditions. Unless experimental or welfare considerations dictate otherwise, space should be sufficient for normal postural adjustments, including standing, lying, resting, self-grooming, eating, drinking, and eliminating feces and urine.

Temperature and Water Vapor Pressure

Air temperature, water vapor pressure, and air velocity are some of the most important factors in the physical environment of agricultural animals. In addition, factors related to animal health and genetics affect the thermal balance of animals and thus their behavior, metabolism, and performance. The range of environmental temperatures over which animals use the minimum amount of metabolizable dietary energy to control body temperature is termed the “thermo-neutral zone”. Homeothermic metabolic responses are not needed within this zone. The long-term welfare of an animal is not necessarily compromised each time it experiences cold or heat stress. However, the overall efficiency of metabolizable energy use for productive purposes is generally lower outside the thermoneutral zone than it is within the zone. The thermal environment that animals actually experience (i.e., effective

environmental temperature) represents the combined effects of several variables, including air temperature, vapor pressure, air speed, surrounding surface temperatures, insulative effects of the surroundings, and the age, sex, weight, infectious status, transgenic modification status, adaptation status, activity level, posture, stage of production, body condition, and dietary regimen of the animal. To overcome the shortcomings of using ambient temperature as the only indicator of animal comfort, thermal indices have been developed to better characterize the influence of multiple environmental variables on the animal.

The temperature-humidity index (THI), has been extensively applied for moderate to hot conditions, even with recognized limitations related to airspeed and radiation heat loads. At the present time, the THI has become the de facto standard for classifying thermal environments in many animal studies and selection of management practices during seasons other than winter. The THI or heat stress index describes categories of heat stress associated with different combinations of temperature and relative humidity for livestock and poultry exposed to extreme conditions. Categories requiring management actions are “alert,” “danger,” and “emergency”. Because different animal species have different sensitivities to temperature and relative humidity, conditions that constitute heat stress vary among species.

Ventilation and Air Quality

Appropriate ventilation of indoor barns is essential in providing acceptable air quality to both humans and animals. A ventilation system removes heat, water vapor, and air pollutants from an enclosed animal facility (i.e., a facility in which air enters and leaves only through openings that are designed expressly for those purposes) at the same time that it introduces fresh air. Adequate ventilation is a major consideration in prevention of respiratory and other diseases. Where temperature control is critical, cooling or heating may be required to supplement the ventilation system. For certain research projects, filtration or air conditioning may be needed as well. Typically, ventilation is the primary means of maintaining the desired air temperature and water vapor pressure conditions in the animal microenvironment.

The amount of ventilation needed depends on the size, number, type, age, and dietary regimen of the animals, the waste management system, and atmospheric conditions. Equipment and husbandry practices that affect heat and water vapor loads inside the animal house should be considered in the design and operation of the ventilation system. Ventilation rates in enclosed facilities should increase from a cold-season minimum (to remove water vapor, contaminants, and odors as well as modify inside temperature) to a hot-season maximum (usually around 10 times the minimum rate, to limit the increase in temperature inside the house that is due to the solar radiation load and sensible animal heat). Because the animals themselves are the major source of water vapor, heat, and (indirectly) odorous matter, ventilation rate calculated on the basis of animal mass is more accurate than that based on air exchange rate guidelines.

The goal of hot-weather ventilation is to remove heat, whereas during cold weather, the goal is to remove moisture. Relative humidity is ordinarily the metric used to describe the air moisture content. Hot-weather ventilation rates should be sufficiently high to maintain the relative humidity below 80% in an enclosed animal house, except in situations in which high relative humidity does not cause animal health concerns. Conversely, ventilation rate during cold weather should be sufficiently low to ensure that the relative humidity does not fall to a level that causes animal health concerns, unless needs for air quality or condensation control necessitate a higher rate. Atmospheric humidity does not ordinarily become a significant factor in determining effective environmental temperature until the air temperature approaches the temperature of the animal’s surface, in which case the animal will depend almost entirely on evaporative heat loss to maintain thermal equilibrium with the environment. The use of fans to promote air movement can be beneficial during hot weather if there is too little natural air movement.

Direct wetting is effective in decreasing heat stress on cattle, pigs, and poultry; however, it can cause death in poultry if inappropriately applied. Wetting is best accomplished by water sprinkled or dripped directly on the animals. Misters and evaporative coolers specifically designed to reduce air dry-

bulb temperature are also used to reduce heat stress on agricultural animals. Animals with outdoor access can be protected from heat stress by correctly designing and maintaining sunshades to reduce solar radiation load. Trees, if avail-able, are excellent sunshades. Artificial, roofed shades are acceptable as well. Mechanical ventilation requires proper design and operation of both air inlets and fans for proper distribution and mixing of the air and thus for creating uniform conditions throughout the animal living space.

Mechanical ventilation, with fans creating static pressure differences between inside and outside the house, brings in fresh air and exhausts air that has picked up heat, water vapor, and air pollutants while passing through the building. Mechanical ventilation, if properly designed, provides better control of air exchange for enclosed, insulated animal houses in colder climates than does natural ventilation. The effectiveness of natural ventilation in cold climates will depend on the design and orientation of the enclosure, as well as the species and number of animals housed and the stage of their life cycle.

Natural ventilation uses thermal buoyancy and wind currents to vent air through openings in outside walls or at the ridge of the building. Natural ventilation is especially effective for cold animal houses (i.e., houses in which no heat is supplied in addition to animal heat) in moderate climates; however, insulated walls, ceilings, and floors are often recommended to minimize condensation. The air exchange rate needed to remove the water vapor generated by animals and evaporation of water from environmental surfaces often brings air temperature inside such houses down to values near those outdoors.

Air quality refers to the nature of the air with respect to its effects on the health and well-being of animals and the humans who work with them. Air quality is typically defined in terms of the air content of certain gases, particulates, and liquid aerosols, including those carrying microbes of various sorts. Good ventilation, waste management, and husbandry usually result in acceptable air quality. Ammonia, hydrogen sulfide, carbon monoxide, and methane are the pollutant gases of most concern in animal facilities. In addition, OSHA has established allowable exposure levels for human workers having 8 hours of exposure daily to these gases. The concentration of ammonia to which animals are exposed ideally would be less than 10 ppm and should not exceed 25 ppm, but a temporary excess may not adversely affect animal health. Comparable concentrations for hydrogen sulfide are 10 and 50 ppm, respectively. The concentration of carbon monoxide (arising from unvented heaters) in air breathed by animals should not exceed 150 ppm and methane should not exceed 50,000 ppm.

The allowable dust levels specified by OSHA (2017) are based on exposure of human workers for 8 hours daily without facemasks; allowable dust levels are 5 mg/m^3 for respirable dust (particle size of 5 μm or less) and 15 mg/m^3 for total dust. Although animals can tolerate higher levels of inert dust with no discernible detriment to their health or welfare, the concentration of dust in animal house air should be minimized.

Lighting

Illumination should be sufficient to aid in maintaining good husbandry practices and to allow adequate inspection of animals, the welfare of the animals, and safe working conditions for personnel. Although successful light management schemes are used routinely in various animal industries to support reproductive and productive performance, precise lighting requirements for the maintenance of good health and physiological stability are not known for most animals. However, animals should be provided with both light and dark periods during a 24-hour cycle unless the research protocol requires otherwise. Long-day lighting schemes during lactation and short-day schemes during the dry period enhance lactation performance by dairy cattle. See the species specific chapters for references on lighting and photoperiod in individual species. Provision of variable-intensity controls and regular maintenance of light fixtures helps to ensure light intensities that are consistent with energy conservation and the needs of animals (as they are understood), as well as providing adequate illumination for personnel working in animal rooms.

Excreta Management and Sanitation

A complete excreta management system is necessary for any intensive animal facility. The goals of this system are as follows:

- To maintain acceptable levels of worker health and animal health and production through clean facilities;
- To prevent pollution of water, soil, and air;
- To minimize generation of odors and dust;
- To minimize vermin and parasites;
- To meet sanitary inspection requirements; and
- To comply with local, state, and federal laws, regulations, and policies.

Proper management of excreta should ensure that the animals are kept reasonably dry and clean. A quick assessment of animal cleanliness can provide insight into the quality of their housing environment (cleanliness and dryness). Good sanitation is essential in intensive animal facilities, and principles of good sanitation must be understood by animal care personnel and professional staff. Animals can harbor microbes that are pathogenic to humans and other species.

Waste containers should be emptied and implements cleaned frequently.

Feed and Water

Animals must be provided with feed and water in a consistent manner, on a regular schedule, in accordance with the requirements established for each species by the NRC and as recommended for the geographic area. Nutrient levels below NRC requirement listings may be necessary for proper evaluation in studies evaluating nutrient requirements or comparing the relative feed value of different diet and/or ration components. When exceptions are required by an experimental or instructional protocol, these must be justified in the protocol and require approval by the IACUC.

Feeders and waterers must be designed and situated to allow easy access without undue competition. Sufficient water must be available to meet the animals' daily needs under all environmental conditions. Water troughs, bowls, or other delivery devices must be cleaned as needed to ensure adequate intake and to decrease transmission of microbial- or contaminant-associated disease.

Large supplies of feed should be stored in appropriate, designated areas. Bulk feed storage containers and feed barrels should be well maintained to minimize entry of pests, water contamination, and microbial growth. Feed in sacks must be stored off the floor and away from the walls on pallets or racks, and each sack must be labeled, as recommended by the Association of American Feed Control Officials, with the contents and manufacture date. All feedstuffs should be maintained in such a manner as to prevent contamination by chemicals or pests.

Animal care personnel should routinely inspect feed to identify gross abnormalities such as mold, foreign bodies, or feces; such feed must not be fed until the abnormal components are removed or the feed is determined to be safe. Toxic compounds should be stored in a designated area away from feed and animals to avoid accidental consumption.

Social Environment

Agricultural animals are social by nature and social isolation is a stressor. A poor social environment has been linked to illness in farm animals such as cattle, swine, and chickens. Agricultural animals of different species are typically kept in different enclosures to reduce interspecies conflict, meet the husbandry and environmental needs of the animals, and facilitate research and teaching.

Animal Care Personnel

The principal scientist or farm unit supervisor must make all animal care personnel aware of their responsibilities during both normal work hours and emergencies. Personnel caring for agricultural animals used for research or teaching must be appropriately qualified or trained. Qualification by experience or training must be documented. Protocols for emergency care must be developed and made available to all personnel.

Animal Observation

Animals in intensive accommodations should be observed and cared for daily by trained and experienced caretakers. Illumination must be adequate to facilitate inspection. In some circumstances, more frequent observation or care may be needed (e.g., during parturition, postsurgical recovery, confinement in a metabolism stall, or recovery from illness). Refer to the CANR Agricultural Animal Emergency Plan (2019) for observing animals and providing care during emergency weather or health situations.

Regardless of accommodations, animal observations should be documented, and husbandry or health concerns reported to the animal facility manager or AAV as appropriate.

Emergency, Weekend, and Holiday Care

There must be a means for rapid communication in case of an emergency. In emergencies, facility security and fire personnel must be able to contact staff members responsible for the care of agricultural animals. Names and contact information for those individuals should be posted prominently in the animal facility and updated regularly. Emergency services can be contacted at any time by staff members. The institution must ensure continuity of daily animal care, to encompass weekends, holidays, unexpected absences of assigned personnel, and emergency situations. Staff assigned to weekends and holidays must be qualified to perform assigned duties.

Emergency veterinary care must be readily available after daily work hours, on weekends, and on holidays. In the event that weather conditions or natural disasters make feeding temporarily impossible, every attempt should be made to provide animals with a continuous supply of water. Absence of feed for up to 48 hours should not seriously endanger the health of normal, well-nourished juvenile or adult cattle, sheep, goats, horses, poultry, or swine. Feed should be provided within 24 hours to very young animals that are not nursing their dams.

Animal Identification and Records

Animals should be permanently identified by a method that can be easily read. Identification of individual animals is desirable but, in some circumstances, it is acceptable to identify animals by group, cage, or pen. Individual birds may be wing- or leg-banded, or wing- or neck-tagged with clothing tag fasteners. Cattle should be identified by methods that minimize pain; for example, ear tags or collars. Recently, biometric identification (e.g., nose prints, DNA profiling, iris scanning, and retinal scanning) has been investigated as a noninvasive tool that is less prone to fraud than the aforementioned alternatives. Any associated pain and distress should be considered when determining the method of identification.

Individual records are needed for many protocols that make use of animals. These records may include information about the animal (e.g., birth date, sex), its productivity, protocols the animal is assigned to, and ultimate disposition. Records for individual animals or groups may also include dates of vaccination, parasite control measures used, and blood testing dates and results. Applicable veterinary data to be recorded include dates of examination/treatment, clinical information/diagnosis, names of medications and amounts and routes of administration, descriptions of surgical procedures, and resolution of surgical procedures or illnesses.

Vermin Control

Programs should be instituted to control infestation of animal facilities by vermin (e.g., flies, cockroaches, mosquitoes, lice, mites, ticks, grubs, rodents, skunks, and pest birds such as starlings, pigeons, and sparrows). The most effective control in facilities prevents entry of vermin into the facility by screening openings and ceilings; sealing cracks; eliminating vermin breeding, roosting, and refuge sites; and limiting access of vermin to feed supplies and water sources. Pesticides should be used only as approved. Wildlife (e.g., skunks, raccoons, coyotes, and foxes) and stray cats and dogs may spread zoonotic diseases, including rabies, to agricultural animals. Scientific and animal care personnel should be

trained to recognize the signs of rabies in both wildlife and agricultural species and how to safely handle and report potentially rabid animals.

Standard Agricultural Practices

Sometimes procedures that result in temporary distress and even some pain are necessary to sustain the long-term welfare of animals or their handlers. These practices include (but are not limited to) comb-, toe-, and beak-trimming of chickens; bill-trimming of ducks; toenail removal, beak-trimming, and snood removal of turkeys; dehorning and hoof-trimming of cattle; tail-docking and shearing of sheep; tail-docking, neonatal teeth-clipping, hoof-trimming, and tusk-cutting of swine; and castration of males and spaying of females in some species. Some of these procedures reduce injuries to humans and other animals (e.g., cannibalism, tail-biting, and goring). Castration, for example, reduces the chances of aggression against other animals. Bulls and boars cause many serious injuries to humans. Standard agricultural practices for the different species are found in their respective chapters.

Sick, Injured, and Dead Animals

Sick and injured animals should be segregated from the main group when feasible, observed thoroughly at least once daily, and provided veterinary care as appropriate. Incurably ill or injured animals in chronic pain or distress should be euthanized as soon as they are diagnosed as such.

Dead animals are potential sources of infection. Their disposal should be accomplished promptly by a commercial rendering service or other appropriate means (e.g., burial, alkaline hydrolysis, composting, or incineration) and according to applicable ordinances and regulations. Postmortem examination of fresh or well-preserved animals may provide important animal health information and aid in preventing further losses. When warranted and feasible, waste and bedding that have been removed from facilities occupied by an animal that has died should be moved to an area that is inaccessible to other animals.

Biosecurity

The term “biosecurity” in an agricultural setting has historically been defined as the security measures taken to prevent the unintentional transfer of pathogenic organisms and subsequent infection of production animals by humans, vermin, or other means (i.e., bio-exclusion). Biosecurity is also applied in the same context to agricultural animals used in the field of agricultural research, teaching, and testing. With the advent of bioterrorism and the designation of select agents, “biosecurity” has acquired new definitions, depending on the field to which it is applied. Biosecurity is now used to define national and local policies and procedures that address the protection of food and water supplies from intentional contamination and is additionally used to define measures required to maintain security and accountability of select agents and toxins. It is important to understand these concepts when using the term and to clarify that, in this section, we are using the term in the context of preventing the unintentional transfer of pathogens to animals and humans through appropriate facility design, training, and precautions (e.g., immunizations).

Preventing the introduction of disease agents is a continuous challenge, particularly when teaching and research facilities allow public access. Herd and flock health and sanitation programs should be in place to minimize exposure to pathogens. Animal care personnel in research and teaching facilities should not be in contact with livestock and poultry elsewhere unless strict biosecurity precautions are followed. To reduce inter-building transmission of pathogenic microorganisms, careful attention should be given to traffic patterns of inter-building personnel and disease organisms in feed and transport vehicles. Barriers to microorganism transmission should be considered for personnel who move between houses.

In addition, if personnel need to go back and forth between different phases of production, it is critical that they work with younger animals first and then older animals, and work from clean to dirty phases of the farm.

Boot Cleaning and Disinfection

The use of boot baths, dry or wet, can prevent or minimize mechanical transmission of pathogens among groups of animals or operations. Visible organic material may be removed from boots using water and a brush or a specific boot-cleaning station. Boots may be disinfected by soaking in a clean bath of an appropriate disinfectant following the manufacturer's guidelines for dilution rate and exposure time. Personnel are recommended to step into and scrub their boots in the boot bath upon entry and when leaving the room or facility. It is important to frequently empty, clean, and refill the boot bath to prevent it from being contaminated with organic matter. Disposable boots may be used.

Chapter 4 - Horses

Location: Webb Farm (142 Webb Lane, Newark, DE 19716)
Farm Manager: Larry Armstrong (302 584 2799, larmstro@udel.edu)
Faculty Liaison: Amy Biddle (asbiddle@udel.edu)

Herd Size and Specific Facilities
Equine Capacity at Webb Farm: 8 Horses

Stalls

1. There are 6 horse stalls in the main horse barn
2. There are 2 horse stalls in the lower portion of the "old barn"

Pasture

1. The Webb Farm has over 16 acres of permanently fenced and dedicated equine pasture space.
2. There is an additional 2-3 acres fenced for equine use, but is designated as a seasonally limited use pasture.
3. The Animal and Food Sciences Department has determined that equine programming needs and pasture space limitations would dictate that we maintain an adult resident equine population of horses with no greater than 8 permanent resident horses.

Facility maintenance
Stalls (if in use)

1. Box stalls should be cleaned and bedded daily (if used).
2. The bedding used in the stalls should be wheat, oat or rye straw, grass hay, wood shavings or pellets, or sawdust. There should be sufficient bedding material present to adequately absorb urine deposited by the horses.
3. If horses need to be confined to the stalls for more than 12 continuous hours, then they should be checked at least twice a day to be sure they have access to water and adequate forage.
4. Alleys, Feed Room, Tack Room and Clinic Hall area, should be swept, washed (hosed down), or vacuumed when used.
5. Drums used for garbage or manure should be emptied 1 to 2 times /week
6. Area outside barns should be raked and cleaned weekly or more frequently as use dictates.

Turn-outs

1. The 5 outside pole sheds should be cleaned and re-bedded as needed.
2. Outside automatic waterers are to be washed 2 times/week. During winter months, waterers may require cleaning more often due to excessive bird droppings.
3. Daily observation of the fencing to ensure that it is intact. Any repairs should be done immediately.
4. Pole sheds and main barn should be repaired and painted as needed.

5. Any protruding objects in the area where horses are maintained should be removed immediately (objects such as nails, wire, splintered boards, rails cracked, bent water buckets and feed tubs).
6. Keep Feed Room, Tack Room and all perimeter gates secured.
7. All gates on fence perimeter and between lots should be secured and latched. These gates should be securely locked at the completion of each day.

General Care

1. Efforts should be made to maintain a normal body condition score (BCS 4-6) on all horses. Horses that become too thin (BCS of 3 or less) should have their nutrition modified. Also, horses that become too fat (BCS of 7 or better) should have their dietary intake restricted according to a veterinarian recommendation. Body condition scores based upon Henneke 1-9 visual appraisal scoring system.
2. All horses should be visually checked each morning and evening for general health:
    a. Alertness, feed consumption
    b. Soundness vs. lameness
    c. Body injuries (cuts, scrapes, kicks)
3. Check all waterers for function daily and water should be available at all times.
4. During extreme heat or cold, be sure all horses have adequate shelter.
5. All horses, when moved from barn to pasture should be led with a lead shank and halter. Halters are to be removed when the horse is turned out on pasture or left in a stall.
6. All new horses should be isolated from the main herd for at least 14 - 21 days.
7. By the use of a hoof pick, all horses should have their feet cleaned and inspected for infection at least once a week.
8. A single horse should not be isolated from all the other horses as this will cause undue stress. If injury or other need requires one horse to be stalled, then another "buddy" horse should also be stalled or otherwise kept where there can be social interaction.

Nutrition and Feeding

All horses are to be fed to provide nutrients that efficiently maintain the horse's body condition and well-being. These nutrients are to support functions related to body conditions, age, growth, pregnancy, lactation, environmental conditions and activity level. Nutritional and management practices that allow horses to eat throughout the day, have freedom of movement and allow socialization with other horses will generally enhance the horse's well-being.

1. High-quality roughages (pasture and hays) will form the foundational basis to meet nutrient requirements. Pasture nutrient databases and periodic nutrient analysis of all hay sources via a certified testing laboratory will be used to provide nutrient values for formulating equine diets.
2. Specifically, the NRC Guidelines for Horses (https://www.nap.edu/read/11653/chapter/10#144) gives the range for voluntary dry matter intake of forage at 1.5 - 3.1% of body weight.
3. Following forage nutrient content analysis, ration balancing feed-stuffs will be added to the daily diet to effectively meet varied dietary requirements. Ration balancer concentrates/supplements will be fed one or two times per day depending upon amounts required. No more than 0.4% body weight amount of ration balancer formulation will be fed at any given single meal; (0.4% calculates at a 4 lb. grain feeding maximum per 1000 lb. horse per single meal).

4. Ration balancing reinforcing feedstuffs may include concentrates, grains, vitamins, minerals, proteins, amino acids, salts, energetic compounds, fats and fiber. The decision about the ration balancer will be based on indicator nutrients (Ca:P ratio, Digestible energy, and/or crude protein).
5. Specific diets will be determined, formulated, and provided to meet supporting nutrient demands for varied production functions. Specific equine diets for each horse will be determined by the farm manager in consultation with the AAV and New Bolton veterinarian.
6. Horses will have free access to salt blocks while in turn out and if confined to stalls.
7. No more than four hours without forage access should elapse.
8. As much as possible throughout the day, all horses should be provided unlimited access to forages, i.e., pasture and/or hays.
9. All persons feeding horses must know quality feedstuffs. No moldy or musty hay should be fed. The use of "high-quality" feedstuffs- free of irritants that may cause ill effects, are palatable, and supply a nutrient profile that is aligned with requirements will be fed at all times.
10. During the harvest season each year, adequate quantity of high-quality hay and straw should be obtained from the University Farm and stored for use in the equine program.

Water

1. Horses should have free access to clean water at all times.
2. Horses require 5-7L/100kg (5-7 quart/ 220 pounds) of body weight per day at rest.
3. Signs of dehydration include: sunken eyes, tacky saliva, skin that tents and increase capillary refill time.
4. Automatic waterers (stalls and turn outs) must be functional, clean and able to be operated by the horses.
5. Automatic waterers should be inspected daily to be certain that they are operating properly and free of foreign material.
6. During times of freezing weather, waterers should be checked more frequently to be sure that they are continuing to provide fluid water for horse consumption.

Hoof Care

1. All horses should have their hooves picked and inspected for infection at least once a week.
2. If a horse is stalled for more than 2 consecutive days, then that horse will need its hooves cleaned at least once a day due to the increased likelihood of contamination in that situation.
3. Hooves should be evaluated weekly by the farm manager to determine when the hoof wall is becoming excessively long, cracked or broken so that a properly trained farrier can be summoned for trimming.
4. In general, horses will be maintained barefoot (without shoes), unless their condition dictates that shoes will improve their hoof condition.
5. The horses should have their hooves trimmed by a farrier approximately every 6-12 weeks depending on their condition.

Teeth Floating

1. The frequency of teeth floating depends on age, diet, housing, and environment. Horses should have their teeth inspected by a veterinarian or equine dentist at least once a year to determine if floating is required.

2. Any horse that appears unthrifty, slobber feed, or exhibit abnormal feeding behavior should have their teeth inspected and treated as needed.

General Preventative Medicine

1. All horses should receive the following core vaccinations annually in the spring:

   • Tetanus
   • Rabies
   • West Nile Virus Encephalitis
   • Eastern Equine Encephalomyelitis (EEE)
   • Western Equine Encephalomyelitis (WEE)
2. Non-core vaccinations will be given based upon disease risk assessment. These vaccines include but are not limited to: Equine Herpes Virus, Equine Influenza Virus, Botulism, and *Streptococcus equi*
3. A complete record of health care for each horse shall be maintained.

Parasite management

1. Internal parasite program: All horses will have their fecal egg counts analyzed at least twice a year. Anthelmintic administration will depend on the results of this testing but will not be less than 2 times /year (spring and fall).
2. Ticks, lice and mites will be monitored and controlled with medication under the consultation with a veterinarian
3. Flying insect control will center on sanitation. Elimination of insect breeding areas (standing water) will occur. Fly traps, fly baits and the use of pyrethroids will be used to aid in the control of flying insects.

Pasture Management

1. Fields will be treated with lime and fertilized for maximum forage production. Lime and fertilizer recommendation values should be based upon current soil test analysis data.
2. Pasture grass heights will be maintained at a height of about 4 - 6" throughout the year.
3. Horses will be rotated in the different pastures as directed by the farm manager.

Handling and Restraint

1. In general the horses will be handled with the use of halters and lead ropes. The halters will be constructed of rope, nylon webbing or leather.
2. Horses will not be turned loose in a paddock or stall with a halter in place unless the halter is equipped with a breakaway apparatus.
3. If a horse is to be tied with a lead rope attached to a halter several factors must be considered:
   - The horse should be tied at wither height or above
   - A quick release mechanism (or knot) should be in place
   - The horse should be tied to something that will not become detached or move
   - There should be no objects in the immediate area that could injure or entangle the horse

4. For short term restraint during a specific procedure, a twitch may be applied to the nose of a horse by trained personnel.
5. Extra control may be achieved by the use of a chain lead shank applied over the bridge of the horse's nose. This technique should only be attempted by trained personnel and in specific situations. Horses should never be tied with a chain lead shank in place on the horse's nose.
6. Horses that have been accustomed to standing on cross ties can be restrained in this fashion. Crossties should be equipped with panic snaps or safety releases.
7. Chemical restraint can be effective and should be administered by a qualified person (veterinarian).

Standard Agricultural Practices

1. Permanent identification of individual horses should be accomplished by insertion of a microchip in the nuchal ligament.

Euthanasia

1. The decision to euthanize a sick or injured horse can only be made by a licensed veterinarian or the farm manager in consultation with a licensed veterinarian.
2. Personnel that perform euthanasia of horses must be trained in appropriate protocols and in humane handling and restraint techniques.
3. Euthanasia of horses can be performed by the intravenous administration of pentobarbital, gunshot or captive bolt gun.
4. Confirmation of death is essential and should occur for at least 5 minutes after the euthanasia. This can be accomplished by monitoring for vital signs (lack of heartbeat, breathing and corneal reflex).
5. The location of the euthanasia should consider the removal of the carcass if possible.
6. Animal carcasses should be deposed of promptly and in accordance with all federal, state and local regulations.

Biosecurity

1. No unattended unauthorized visitors are permitted on the farm premises at any time.
2. Visitors that are part of a scheduled tour are restricted to the outside of any stalls or horse paddocks.
3. Personnel that are not trained students, staff or researchers should not have any direct contact with the animals.

Chapter 5 - Dairy Cattle

Location: The UD Dairy (243 Farm Lane, Newark, DE 19716)
Farm Manager: Jon Leith (302 304 6096, jleith@udel.edu)
Faculty Liaison: Tanya Gressley (gressley@udel.edu)

Herd Size and Specific Facilities
Approximately 60 - 90 milking cows at any one time.

Building	**H20**	**Area**	**Animals**	**Feed**
Heifer Barn	1 Trough	3024 Sq Ft	10-15 Weaned Calves	Feed bunk 36'x2 = 72'
Paired Calf Hutches	Bucket	56.25 Sq Ft (internal)	2 Calves	Feeder = 2 buckets/pen
Free Stall East	2 Large Troughs	3000 Sq Ft	71 Milking	Bunk Space = 79 feet
Free Stall West	1 Large Trough	3000 Sq Ft	48 Milking	Bunk Space = 48 Feet
Dry Cow Barn	2 large Troughs	3200 Sq Ft	42 Cows	
Calan Barn	1 Large Trough	2800 Sq Ft	30 milking	
Transition Calf Barn	1 Water Bowl	600 Sq Ft	10 Weaned Calves	
Replacement heifers - Stroud Pasture	1 Water Bowl	600 Sq Ft plus pasture	10-20	

Facility Maintenance
Milking Herd

1. All cows in the milking herd are housed in open free stall barns and have access to exercise lots and pasture (weather and ground condition permitting).
2. Dairy cattle free stalls should be stocked at 1:1 animal: stall or less.
3. Time out of the pen each day for milking should not exceed 3 hours per day.
4. Waterers should be accessible to cows at all times.
5. Free stalls should be sized to accommodate the resting imprint of the cow and provide sufficient space for normal rising and lying movements.
6. The stall surface should be kept deeply bedded and contaminated bedding should be removed daily.

Cows on Experimental Protocols (Tie –stalls)

1. Cows on experiments are housed in either tie-stalls or free stalls without access to pasture during the duration of the experiments.
2. Cows in tie-stalls are away from the tie-stalls for 2 hours in the morning (1 hour for milking and 1 hour for exercise) and 1 hour in the afternoon to allow for milking.
3. Cows in tie-stalls may have electric cow trainers overhead, but the trainers should not touch the cow while she stands in a normal position.

Heifers and Dry Cows

1. Heifers and dry cows are housed in groups, which are sorted according to size and available space.
2. Animals have access to pasture and are provided open shelter adequate for the number of animals in the group.
3. Animals have access to a dry, bedded manure pack and free stalls for rest.

Table 7-1. Resting space area for bedded packs based on approximate body weight (BW) estimates (based on industry best practice)

	Estimate of BW, kg (lb)								
Bedded space requirement	<181 (400)	181–272 (400–600)	273–363 (601–800)	364–453 (801–1,000)	454–544 (1,001–1,200)	545–635 (1,201–1,400)	636–725 (1,401–1,600)	726–816 (1,601–1,800)	817–907 (1,801–2,000)
m^2 ft^2	2.8–3.0 (30–32)	3.7 (40)	4.6 (50)	5.6 (60)	6.5 (70)	7.4 (80)	9.3 (100)	11.1 (120)	13.0 (140)

4. Heifers are transported to Cool-Rock-Stock for grow out and breeding. At least one month prior to calving, heifers are transferred back to the University of Delaware.

Calves

1. Calves are kept in paired hutches with another calf for the milk-feeding period. If calves are discovered to be sucking on each other, then the hutch will be divided with a wall.
2. Calves are fed a minimum of 4L of high-quality colostrum within 12 hours of calving
3. Calves have a spatial allowance of 2.8m^2 (30 ft^2) of bedding space per calf.
4. Calves have adequate ventilation and protection from inclement weather.
5. At weaning (approximately 8 weeks of age), the heifers are moved into a group pen with similar aged heifers.

Treatment (sick) and Calving Pens

1. Treatment pens are located in a quiet part of the dairy.
2. Maternity pens should have a minimum of 9.3m^2 (100ft^2) of area per cow.

General Animal Care

1. All animals are checked as early as possible each day. During feeding, barn cleaning and milking they are observed for any abnormalities and any problems are immediately treated or reported to personnel who can perform needed corrective action.
2. Every animal has sufficient space to move about at will. They have access to adequate feed, a dry resting site, shade, and the opportunity to remain reasonably clean. All animals have access to clean water at all times.
3. 1.Feed and water are given to animals in containers or equipment that minimizes contamination by animal waste and other materials. Fresh feed is usually provided twice daily; however sometimes fresh feed is only provided once a day when cows are part of an IACUC-approved research protocol. Feeding areas are monitored closely and spoiled or contaminated feed is removed.

4. Movement of animals, especially during hot weather or on excessively slippery surfaces is done in a calm manner with minimal use of animal movement aids.
5. Animals that are restrained for treatment, training or observation are held in a restraining device that exposes the animal to minimal stress. Stocks, chutes, halters or other animal restraint devices are used when possible. Animals held in such devices are observed regularly to avoid possible injury.
6. Normal vaccination, dehorning, castration, medication, drenching and parasite treatment are done as advised by the herd manager or a licensed veterinarian. These procedures are performed according to the recommendation of a licensed veterinarian.
7. Johnes disease (paratuberculosis) prevention and control:
   a. For replacement heifers, all the young stock are housed in a facility that does not commingle older, mature cows with young stock.
   b. Young stock are not allowed contact with manure from older cattle or the older cattle themselves.
   c. Feed bunks or watering facilities are not shared between youngsters and mature cattle
   d. Manure from mature cattle may not contaminate feed, water or feed spaces of young stock.
8. A record of health care for each animal is maintained electronically in herd management software (Dairy Comp).
9. General herd health is maintained by a licensed veterinarian in conjunction with the herd manager.

Reproductive Program

1. For research needs calving of the dairy herd takes place throughout the year with the main portion of that calving taking place during June - September and November - February.
2. All breeding of the dairy herd including cows and heifers is done through artificial insemination (AI) by trained personnel or a certified AI technician.
3. Calving takes place on pasture or in dry, bedded facilities.
4. Assistance is provided when dystocia occurs in cows by trained farm personnel using obstetrical aids. Veterinary assistance is obtained as needed.
5. Prostaglandin and other bovine reproductive medications are used under the advisement of a licensed veterinarian.

Diet

1. Silage, dry forages, concentrates, mineral supplements and salt are used in the diets of dairy animals. All diets are balanced by the faculty supervisor and/or by feed company representatives for the animals according to National Research Council standards.
2. Calves are fed a diet consisting of milk replacer, and concentrates until at least 6 weeks of age according to accepted standards of the National Research Council.
3. Fresh water is available to all animals at all times.

Hoof Care

1. Hoof trimming will be done at dry-off and again at 2-4 months after calving
2. A footbath system is in place to control infectious hoof disease.
3. Locomotion will be routinely assessed in both dry and milking cows.

Milking

1. All lactating dairy animals are milked in the university dairy milking parlor twice per day.
2. All animals have their teats pre-dipped, stripped, dried with an individual cloth towel and the milking machine attached. Following complete milk out, each cow is teat dipped with a product approved for post-milking teat dipping.
3. Animals are treated for mastitis by trained dairy personnel, or dairy farm manager using accepted standard procedures.
4. Antibiotic testing is performed on the milk of cows following calving or treatment with any medication that requires milk withholding.

Standard Agricultural Procedures

1. Removal of extra teats is conducted during the pre-weaning period. The procedure is performed by a veterinarian with appropriate pain mitigation.
2. Dehorning (disbudding) occurs before the calf is 8 weeks old. Prior to the procedure, a local nerve block is administered to numb the area.
3. All cows are handled in a calm and respectful manner at all times.
4. Movement of cattle is accomplished with non-electric methods except in extreme circumstances.

Dairy Animals on Research Trials

1. All Potential research studies must be reviewed with the farm superintendent, dairy manager, and faculty liaison at least 30 days before start date of the study to ensure availability of cows.
2. The primary investigator is responsible for: obtaining IACUC approval, submitting a farm labor request form (online), and making arrangements for data collection (e.g. feed, weigh-back; animal weights; blood sampling).
3. Prior notice must be given when the manager's assistance is required for animal restraint.
4. The dairy manager is responsible for the daily maintenance of the animals, making sure they are milked, and have adequate shelter, water, and clean, dry bedding.
5. Farm personnel should observe the animals daily for signs of distress and/or illness.
6. Farm personnel will treat any health problems as they would with non-research animals unless specifically dictated in the research protocol, and the research project leader must be notified as soon as possible.

Movement of Dairy Animals On/Off the Farm

1. Any and all movement of any dairy animals onto or off of the Newark Dairy farm must be documented.
2. This includes but is not limited to:
   - Weaned heifer calves going to Cool Rock Stock;
   - Bred heifers returning from Cool Rock Stock;
   - Bull calves shipping to sale; and
   - Cull cows going to sale.

Euthanasia

1. The decision to euthanize a sick or injured cow can only be made by a licensed veterinarian or the farm manager in consultation with a licensed veterinarian.
2. The approved methods for euthanizing cattle include:
   - Intravenous administration of an overdose of barbiturate by a licensed veterinarian; or
   - Captive bolt gun by trained farm personnel

Biosecurity

1. No unattended unauthorized visitors are permitted on the farm premises at any time.
2. Visitors that are part of a scheduled tour are restricted to specific areas of the dairy as designated by the dairy manager.
3. Personnel who are not trained students, staff or researchers should not have any direct contact with the animals
4. All persons who could have had contact with manure from other bovine facilities must either wear boots that have been disinfected or wear disposable boots.

Chapter 8 - Swine

Location: Nutrition Barn (314 Farm Lane, Newark, DE 19716)
Farm Manager: Larry Armstrong (302 584 2799, larmstro@udel.edu)
Faculty Liaison: Dr. Lesa Griffiths (lesa@udel.edu)

Sounder Size and Specific Facilities

Swine capacity at the Nutrition barn is 8 pregnant sows and their litters.
8 Farrowing crates with 2 nipple waterers and one feeder each.
2 nursery crates (4' x 8') with 1 nipple waterer.

Facility maintenance

1. All swine will be housed in the north end of the Nutrition Barn on the Newark Farm.
2. Pregnant and lactating sows will be housed in farrowing crates that have been disinfected prior to their arrival.
3. Thermoregulation of the environment of north end of the Nutrition Barn (pig facility) will adjusted based on the thermal needs of the pigs currently occupying the space. See the table 9-1 from the Guide below:

Table 9-1. Recommended thermal conditions for swine used in agricultural research and teaching[1]

Animal	Preferred range[2]	Lower extreme[3]	Upper extreme[4]
Lactating sow and litter: sow	15–26°C (59 to 79°F)	15°C (59°F)	32°C (90°F)
Lactating sow and litter: creep area for piglets	32°C (90°F)	25°C (77°F)	—
Pre-nursery, 3 to 15 kg (7 to 33 lb)	26–32°C (79 to 90°F)	15°C (59°F)	35°C (95°F)
Nursery, 15 to 35 kg (33 to 77 lb)	18–26°C (64 to 79°F)	5°C (41°F)	35°C (95°F)
Growing, 35 to 70 kg (77 to 154 lb)	15–25°C (59 to 77°F)	−5°C (23°F)	35°C (95°F)
Finishing, 70 to 100 kg (154 to 220 lb)	10–25°C (50 to 77°F)	−20°C (4°F)	35°C (95°F)
Sow or boar,[5] >100 kg (>220 lb)	10–25°C (50 to 77°F)	−20°C (4°F)	32°C (90°F)

[1]Although recommended air temperatures are given in this table; performance measures would more appropriately determine pig thermal comfort. When pigs are in a comfortable thermal setting, they will rest comfortably, not shiver or pile on one another, not have an elevated respiratory rate, and will generally rest touching other pigs. Some individual pigs may prefer to rest alone. Piling or spreading out widely may indicate the environment is too cold or too warm, respectively. Pig thermoregulatory behaviors are better indicators of the appropriate air temperature than a thermometer. PQA, 2019: https://lms.pork.org/Tools/View/pqa-plus/program-materials. It is important to realize that how the animal feels is based on temperature combined with radiant heat load, air speed, and relative humidity.

[2]Based on values given by NRC (1981), DeShazer and Overhults (1982), Curtis (1985), Hahn (1985), and Shao et al. (1997).

[3]Values represent lower extremes in air temperature when pigs are held in groups. Bedding is recommended when air temperature approaches the lower extreme.

[4]Except for brief periods above these air temperatures, cooling should be provided by means such as evaporatively cooled air for growing pigs or a water drip for lactating sows. There is no practical upper limit for the creep area for piglets.

[5]With the combination of "sow or boar" into one category, physiological changes (i.e., gestation and lactation) that can impact the preferred temperature range of a sow as metabolic heat production changes have not been considered. For example, metabolic heat production of ad libitum-fed lactating sows at 25°C may differ from early gestation sows fed at maintenance requirement, etc., which can alter thermal preferences. These and other differences should be considered. Therefore, these ranges do not consider the actual preferred range or upper extreme for gestating and/or lactating sows.

4. Flies and vermin will be controlled inside facility using approved products.
5. Facilities will be thoroughly cleaned and disinfected between groups of animals.
6. Spilled and stale feed will be removed daily.

7. Ventilation and heating equipment will be kept in functional condition at all times.
8. Manure buildup will be minimized by daily scraping and hosing, and by flushing the gutter system.

Transportation

1. Animals will be transported in clean, well-ventilated conditions.
2. Bedding and shade will be provided.
3. Transportation will have means to prevent chilling or heat stress.
4. Animals will be handled and moved calmly so as to avoid injury and minimize stress.

Restraint

1. Prolonged restraint should be avoided.
2. Snares should be avoided for most procedures and only used for situations where there is a concern for human safety.
3. Non-electric driving aids (panels, cattle paddles, and flags) should be used by properly trained personnel.

Enrichment

1. No pigs will be kept in isolation from other pigs.
2. When possible, occupational enrichment in the form of straw in a rack or the hanging of an unraveled rope for manipulation should be done.
3. Continuous loud noise (radios and loud human activity) should be kept to a minimum as these can disrupt the vocalizations between sow and piglet.

General Care

1. Fresh, clean drinking water will be provided daily without restriction to all animals
2. Ad libitum feed shall be provided daily to all animals with the exception of late term sows or animals with a specific feed restriction in an IACUC approved protocol. Late term sows' diet will be determined by the primary investigator in charge of the study or class in accordance with industry norms.
3. All animals will be monitored closely for signs of thermal distress. If signs of heat stress are noticed (extension of the body or open mouth breathing) then zone cooling will be initiated: animals will be wetted and ventilation will be increased with the use of fans.
4. Pigs will be observed daily for signs of illness, injury or unusual behavior. Sick or injured animals will be separated. Dead animals will be promptly and properly disposed of by incineration or composting.
5. When signs of infection (disease) are apparent in individual animals, a veterinarian will be consulted to determine the appropriate course of action.
6. Sterile needles should be used for all injections. Selection of needle size should correspond with size of animal: (14 ga = mature boars and sows, 16 ga = 50 to 300 lbs., 18 ga = 20 to 50 lbs., 20 ga = birth to 20 lbs.)
7. Presence of external parasites will be closely monitored and treated promptly.

Parturition

1. Sows will be closely monitored during parturition and assistance will be provided if dystocia is apparent.
2. Disposable sleeve/gloves will be used with sterile lubricant for obstetrical examination and assistance.
3. Oxytocin will be used only after parturition has already commenced with no apparent problem.
4. Hands should be washed prior to processing neonatal pigs.

Neonatal Pig Processing

1. Neonatal pigs will be routinely processed within 48 hours after birth
2. Processing will include:
    - Supplemental iron injection in the neck area muscle
    - Clip needle teeth with a sharp disinfected device (not more than half the tooth length)
    - Dock tail to 1.5-2.5cm from the body with a disinfected device
    - Dip navel in iodine
    - Notch ears for identification purposes
3. Castration should be conducted between 1 and14 days of age (Ideally within 7 days of birth). The castration site should be on the ventral scrotum and should not be sutured
4. Any piglets that are diagnosed as cryptorchid should wait to be castrated until the second testicle has descended. If both testicles are not descended by 14 days then the piglet will need surgical castration by a veterinarian.
5. Any piglets with evidence of scrotal hernia should be evaluated and castrated by a veterinarian that is prepared to treat the situation appropriately.

Euthanasia

1. The decision to euthanize sick or injured swine can only be made by a licensed veterinarian or the farm manager in consultation with a licensed veterinarian.
2. The approved methods for euthanizing swine are different for pigs of different sizes and are summarized below:

Pig Size (kg)	**Approved methods**
Less than 5.5kg	Blunt force trauma, overdose of anesthetic, injection with barbiturates
Less than 14kg	Carbon dioxide, overdose of anesthetic, injection with barbiturates
Any weight over 5.5kg	overdose of anesthetic, injection with barbiturates, Gunshot, captive bolt with exsanguination

Biosecurity

1. No unattended unauthorized visitors are permitted in the Nutrition barn at any time.
2. Visitors that are part of a scheduled tour are restricted to the concrete walkway outside of the pens.
3. Personnel that are not trained students, staff or researchers should not have any direct contact with the animals.

Chapter 7 - Sheep

Location: Webb Farm (142 Webb Lane, Newark, DE 19716)
Farm Manager: Larry Armstrong (302 584 2799, larmstro@udel.edu)
Faculty Liaison: Dr. Lesa Griffiths (lesa@udel.edu)

Flock size and Specific Facilities
Sheep capacity at Webb Farm: up to 65 Dorset ewes and 2 Dorset rams.
There may be additional ewe lambs and young rams saved as replacements.

Ram Lot/Shed
12'x16' area with a 20 gallon waterer. Capacity: 2 mature rams/pen.

Bays 1-4 in the sheep barn
25' x 25' per bay with two automatic waterers (located in the fence lines). Capacity: Maximum of 25 animals per bay.

Facility maintenance

1. The walkways in the barns should be swept daily and kept clean and free of clutter at all times. The open area of the sheep barn can be used to store small equipment (such as a scale) when needed. It may also be used for laboratory sections of some classes.
2. The office in the Sheep Barn should contain all records pertaining to the sheep flock. It should be maintained in a neat and orderly fashion with materials well labeled and easy to locate in the manager's absence.
3. Fences should be kept in good repair and have spaces either small enough to prevent animals from reaching through with their heads or large enough to allow them to withdraw the head easily.
4. Manure removal should be handled on a routine basis: at least twice a year the barn should be cleaned out.
5. The barn is ventilated by the opening of the large doors. Additional fans may be required during extreme heat.
6. If the bed pack in the barn becomes overly moist, it should be cleaned to prevent hoof issues.

General Care

1. All animals should be visually checked every morning. They should be observed prior to being disturbed by feeding and cleaning. Any abnormalities should be recorded on the animal's individual record and corrected.
2. Every animal should have sufficient space to move about at will, adequate access to feed, a dry resting site, and the opportunity to remain reasonably clean.
3. All sheep should have continuous access to fresh clean water.
4. Feed and water should be presented in ways that minimize contamination by urine, feces and other materials. Feed bunks should be monitored daily and contaminants removed.
5. During hot weather, handling or driving sheep should be restricted to the cooler portions of the day (early morning or late afternoon).

6. As sheep are highly social animals, if individuals require isolation it should be attempted to place them where they can at least see the other sheep. Or isolate in groups of 3 sheep.
7. Sheep should not be caught or restrained by holding on to the wool. Sheep may be restrained for short periods in trimming stands, by halter, or by tipping onto their rumps. They should be attended at all times while restrained.
8. All herd medical records including worming and vaccinations will be maintained by the farm manager. Any sheep requiring individual medical attention will have individual medical records maintained (treatment logs). These logs will be retained in the office of the farm manager for at least 2 years after treatment.
9. All sheep will have their hooves evaluated and trimmed by the farm manager bi-annually.
10. Newly purchased animals will be isolated from the flock no less than 14 days or until it is determined they are free of parasites and disease.

Breeding Protocol

1. The flock of sheep are bred annually to lamb in the late winter/early spring.
2. Rams are purchased through an annual sale and typically kept on farm for 3-4 years before new genetics are needed. Rams come with a Certificate of Veterinary Inspection as per State/Federal regulations.
1. One ram is used to service no more than 25 ewes as per industry standard.
2. Rams are fitted with breeding marking harnesses to track breeding and allow for projected due dates.
3. Rams are kept with ewes for breeding for a minimum of 34 days (2 estrous cycles) to ensure all ewes are serviced.
4. Ewes should be boostered against *Clostridium perfringens* types C and D and *Clostridium tetani* about 2 weeks before the start of lambing to provide protection against enterotoxemia via colostrum.
5. It is preferred that lambs nurse their dams within 6 hours of birth to obtain colostrum.

Parasite Control

1. One month prior to lambing all pregnant ewes are administered an anthelmintic.
2. In August-September all sheep are evaluated by the farm manager using the FAMACHA eye color chart system and treated for internal parasites if needed.
3. Sheep will be regularly evaluated for external parasites and treated appropriately.

Shearing

1. Shearing will occur in a location that is clean and dry.
2. The shearing equipment will be disinfected between flocks (if applicable) and between individual animals if infectious disease conditions are present.
3. Shearing will be done by a skilled professional sheep shearer.
4. Shearing will occur annually for all sheep.
5. Animals that are recently sheared will be monitored for sunburn and allowed access to shade.

Tail Docking

1. Tail docking can be accomplished by application of rubber rings, hot-iron cautery, surgical removal after application of an emasculator.
2. Tails should be docked when lambs are as young as possible, preferably before 2 weeks of age.
3. The AVMA recommended length for docking is variously expressed as visibility of 0.7 inch of tail, docking at the 3rd or 4th coccygeal vertebrae or docking at the end of the caudal fold/hairless under-tail area.

Castration

1. There are three method for castration of a ram lamb: application of rubber ring, crushing the spermatic cord with an emasculator (Burdizzo method) and surgical removal of the testicles.
2. Rams should be castrated when they are between 24 hours and 7 days old.

Vaccination Protocol

1. Adult Sheep (ewes and rams): 1 dose of CDT and Rabies administered annually
2. Lambs: Initial dose of CDT vaccine at 2-3 weeks old. Second dose of CDT vaccine administered 21 days after the first dose.
3. Lambs: Initial dose of rabies vaccine at 6 months old. Second dose of rabies vaccine given at 1 year old.

Euthanasia

1. The decision to euthanize a sick or injured sheep can only be made by a licensed veterinarian or by the farm manager in consultation with a licensed veterinarian.
2. The approved methods for euthanizing a sheep include: intravenous administration of an overdose of barbiturate by a licensed veterinarian or captive bolt gun.

Biosecurity

1. No unattended unauthorized visitors are permitted on the farm premises at any time.
2. Visitors that are part of a scheduled tour are restricted to the concrete walkway outside of the pens.
3. Personnel that are not trained students, staff or researchers should not have any direct contact with the animals.

Chapter 8 - Beef Cattle

Location: Webb Farm (142 Webb Lane, Newark, DE 19716)
Farm Manager: Larry Armstrong (302 584 2799, larmstro@udel.edu)
Faculty Liaison: Dr. Lesa Griffiths (lesa@udel.edu)

Herd size and Specific Facilities
Beef cattle capacity at the Webb Farm is 20 cow/calf pairs

Facilities:

				Capacity			
Bay	**Area**	**waterer**	**Feeder space**	**Calves**	**Feeders**	**Cows**	**Cow/calf**
East	810	Single	36	36	18	15	15
Middle	810	Twin	15	15	7	6	6
West	648	Single	64	32	25	21	12

Facility maintenance

1. Manure removal should be scheduled on a regular basis in the shed (manure pack should not exceed 12-18 inches). The concrete apron should be scraped at least weekly.
2. The office in the Large Animal Teaching Pavilion should contain all production and health records for the herd. They should be updated routinely, well labeled and easy to locate in the manager's absence.
3. Maintenance of facilities (corral fences, working chute, head gate and scale) should be timely and continuous.

General Animal Care

1. All animals should be visually checked every morning prior to being disturbed by feeding and cleaning. Any abnormalities should be recorded on the animal's individual record and addressed.
2. Every animal should have sufficient space to move about at will, adequate access to feed, a dry resting site, and the opportunity to remain reasonably clean.
3. All beef cattle should have continuous access to water.
4. Feed and water should be presented in ways that minimize contamination by urine, feces and other materials. Feed bunks should be monitored and contaminants removed.
5. Cattle are social animals. When there are large differences in size or other traits related to position in the social order, some animals may be able to prevent others from gaining access to feed, water, and resting sites. All animals should have equal access to the resources necessary for optimal comfort and performance.
6. All beef animals will be handled using appropriate cattle handling facilities and restraint.The head gate should be used to restrain individual cattle. The sorting pen, corral, crowding gates and chute should be used when handling the herd.
7. The herd is used for teaching purposes and will be handled extensively by students during laboratory periods. Students working with cows and bulls in class will be closely supervised by farm staff and faculty.
8. All herd medical records including worming and vaccinations will be maintained by the farm manager. Any cattle requiring individual medical attention will have individual medical records

maintained (treatment logs). These logs will be retained in the office of the farm manager for at least 2 years after treatment.

9. Proper individual animal identification will be accomplished by the insertion of visual ear tags in every animal. This will be supplemented with more permanent tattooing or freeze branding.
10. Newly purchased animals will be isolated from the herd at least 14 days or until determined to be free of parasites and disease.

Breeding Protocol

1. The herd of Angus cows synchronized and bred so that calving occurs in spring.
2. Breeding begins with a veterinarian prescribed synchronization program:
    - Cows are administered Gonadotropin-releasing hormone (GnRH) via intramuscular injection on day 0.
    - They then receive an intramuscular injection of prostaglandin (PG) on day 7.
    - This is followed by artificial insemination when heat is detected on days 7-13.
3. The farm staff are trained in proper intramuscular injection technique and certified in cattle artificial insemination.
4. Cows will be artificially inseminated by trained personnel using semen from bulls selected on the basis of performance data.
5. Clean up Bull: A bull will be leased from known breeders in the region. Bulls will be selected based upon the quality/performance of the animals, the ability to select animals that will improve our herd goals and our familiarity with the animal health and management practices of the bull's owner. The bull will be maintained on pasture during the 30 - 90 day breeding season. Handling will be minimal; however, when handled, there will always be trained personnel present.
6. After a minimum of 42 days (two estrous cycles) with the cow herd, the bull is then returned to his home farm.

Vaccination Protocol

Adult cows- Annually:
Alpha 7 way (7 way clostridial vaccine)
Bova shield 9 (bovine virus diarrhea (BVD) Types 1 and 2 and Infectious bovine rhinotracheitis (IBR))
Rabies

Calves- at 6 months and 12 months:
Alpha 7 way (7 way clostridial vaccine)
Bova shield 9 (bovine virus diarrhea (BVD) Types 1 and 2 and Infectious bovine rhinotracheitis (IBR))
Rabies

Worming Protocol

Adult Cows: Treatment with anthelmintics will occur for all cows prior to calving. Cows will be body score conditioned and treated for internal parasites at other times of the year when determined necessary by the farm manager.

Calves: Treatment with anthelmintics will occur for all calves at the time of weaning. Calves will be body score conditioned and treated for internal parasites at other times of the year when determined necessary by the farm manager.

Nutritional Protocol - Mature Breeding Cows

1. Mid-gestation: Nutrient requirements are relatively low and pasture should be sufficient for most of the herd. (Over-conditioned cows will be assessed and should lose weight in this period.
2. 60-90 days prior to calving: Herd and individual cows will be evaluated. Cows need to not be overweight going into calving but should be maintaining their weight or gaining slightly.
3. Calving to rebreeding: Nutrient demands are greatest and require supplemental feeding. Aim is to have each cow at the weight prior to calving by 90-120 days after calving.
4. Rebreeding to weaning: Slightly elevated nutrient demands on the cow (milk production and maintenance) Plan is to use whatever feed is readily available such as temporary or permanent pasture.
5. Free choice minerals (loose) will be provided to all cows at all times.

Nutritional Protocol - Replacement Heifers

1. Heifers will be fed separately from the mature cow herd during their 1st and 2nd winter to make sure that they have access to and consume the proper amount of nutrition.
2. The goal is to have the heifers reach 65% of their mature weight at 14-15 months of age when they are first bred to then calve as 2-year-olds.
3. During the breeding season (12-16 months) heifers will be fed to ideally gain 1.3 pounds/day.
4. After breeding and until mid-gestation heifers will be fed to ideally gain about 0.5 pound/day.
5. During the last 120 days of gestation heifers will be fed to ideally gain 0.9-1.3 pounds/day.
6. During the period from first calving to rebreeding heifers will be fed to make sure they continue to gain weight.

Castration

1. Castration will be routinely accomplished at approximately 2-3 days of age (but not more than 2 months of age).
2. Castration of young calves will be accomplished using a specially designed elastic band (elastrator). This band may be applied by the farm manager or other trained farm personnel.
3. Calves will be monitored in the days following castration for signs of discomfort or infection. If detected, a veterinarian will be contacted for further treatment.
4. Castration can also occur just after weaning (approximately 6-7 months). Castration at this time interval must occur via surgery by a licensed veterinarian.

Euthanasia

1. The decision to euthanize sick or injured cattle can only be made by a licensed veterinarian or the farm manager in consultation with a licensed veterinarian.
2. The approved methods for euthanizing cattle include: intravenous administration of an overdose of barbiturate by a licensed veterinarian or the use of a captive bolt gun by properly trained personnel.

Biosecurity

1. No unattended unauthorized visitors are permitted on the farm premises at any time.
2. Visitors that are part of a scheduled tour are restricted to outside of the animal enclosures.
3. Personnel that are not trained students, staff or researchers should not have any direct contact with the animals.

Poultry

Newark Poultry Facilities
Location: Newark Poultry Farm (314 Farm Lane, Newark, DE 19716)
Farm Manager: Karen Gouge (302-275-7261, kgouge@udel.edu)
Faculty Liaison: Dr. Aditya Dutta (adidutta@udel.edu)

Elbert N. and Ann V. Carvel Research and Education Center and Lasher Lab
Location: 16483 County Seat Highway, Georgetown, DE 19947
Farm Manager: Stephen Collier (slc@udel.edu)
Faculty Liaison: Dr. Aditya Dutta (adidutta@udel.edu)

Flock sizes and Specific Facilities
These are delineated at the end of this chapter in detailed tables for each specific space.

Facilities

The proper physical environment will be provided for poultry housed on the Poultry Farm and the Allen Laboratory. Facilities housing poultry will be supplied with appropriate feeders, drinkers, nest boxes, ventilation, lighting, heat, etc. depending on whether the birds are to be housed on litter or in cages. The specific Standard Operating Procedures for the set-up, cleaning and disinfecting of the Poultry Farm and the Allen Laboratory are available upon request.

General Husbandry

1. All animals will be observed daily and will be checked to assure adequate feed and water are present. Proof of daily welfare check on research animals will be recorded and retained for as long as the study continues. Any adjustments to ventilation, temperature, lighting, etc. will be made as needed. If any poultry are found to be ill or injured, this will be recorded and reported and veterinary care provided as necessary. When necessary, poultry will be euthanized by cervical dislocation or CO_2 gas (approved euthanasia methods, current AVMA Guidelines on Euthanasia).
2. In relatively large groups, the optimal ratio of mature males to mature females will be used. However, when small groups are used, and the size of the genetic pool is important, the ratio of males to females may be increased. Additional space per bird will be provided for these flocks to decrease the risk of aggressive behavior. If individuals are observed to be abused, those individuals will be removed and either housed separately until they recover, or humanely euthanized, if necessary.
3. Poultry kept on the Poultry Farm and the Allen Laboratory will be housed following recommendations in the most current version of this guide. To assist instructors and researchers the capacities of each specific building, room, cage and isolators have be calculated and are listed at the end of this chapter of this handbook. The maximum stocking densities and feeder equipment requirements (space) are included based on bird type, age and/or weight.
4. Poultry kept on the Poultry Farm and the Allen Laboratory will have continuous access to clean drinking water. This will be provided according to the most current version of this guide.
5. Poultry will be kept on solid floors with litter or in cages with mesh wire floors. Usually sawdust or shavings will be used as litter in floor pens. Litter will be changed at least once per year and top dressed as needed. Poultry kept in cages will have their litter paper changed on a regular basis

depending on the age and number of the birds. Litter will be properly maintained to prevent the build-up of ammonia.

6. Ventilation will depend upon the type of housing used and exterior environmental conditions. Less ventilation will be given to young poultry stock as compared to older stock as suggested in the most current version of this guide. The brooding temperatures used will follow the recommendations in The Guide.

Care of Poultry in Teaching

The Poultry Research Coordinator should be notified in writing of the need for poultry equipment and facility space for teaching at least 2 weeks prior to the designated start date by completing and submitting the Poultry Farm Project Request Form available online: https://docs.google.com/forms/d/1rRSQGbe3vExlJMPRzPFQW-5yje7-Hap47UyrEaVFv5I/edit. The professor teaching the class must also submit a completed application to use animals in non-invasive teaching and demonstration form to the University IACUC. These forms can be found at: https://research.udel.edu/animal-subjects-resources/. This protocol must be approved by the University IACUC prior to the start of the class. If possible, a laboratory schedule should be submitted. The instructor is responsible for the care of animals during the teaching section. The manager's assistance may be required for animal transportation and/or animal restraint. The animals should be returned to their normal environment immediately following the teaching session.

Care of Poultry in Research

The Poultry Research Coordinator should be notified in writing of the need for poultry facilities and equipment for research at least 2 weeks prior to the designated start date. This is accomplished by submitting one of the following forms (Appendix A) depending on where and what level of research in being requested: Poultry Farm Project Request Form, CCABL BSL2 project request form, or CCABL BSL3 project request form that are all available online:https://docs.google.com/forms/d/1rRSQGbe3vExlJMPRzPFQW-5yje7-Hap47UyrEaVFv5I/edit. The primary investigator must also submit a completed application to use animals in research form to the University IACUC. These forms can be found at: https://research.udel.edu/animal-subjects-resources/. This protocol must be approved by the University IACUC prior to the start of acquisition or use of animals. The Principle Investigator is responsible for the full care of their birds unless specified on the project form.

Biosecurity and Health Care

1. Of prime concern is the health and well-being of our poultry stock. As part of this care, veterinary services are available 24 hours per day in addition to the general care provided by the poultry farm staff.
2. Depending on the age, length of project and facilities, poultry are vaccinated for common pathogens, beak trimmed, and toe dubbed.
3. Disposable footwear, or footbath with disinfectant, and protective clothing are used where deemed necessary and chickens are reared in isolation to prevent the spread of disease.
4. All waste materials (such as dead birds, litter, etc.) presenting a disease threat are burned in the Poultry Farm incinerator or composted in the Poultry Farm Composter.
5. Sanitation is another important aspect of poultry care. In general, after each project, each facility is completely cleaned and disinfected; all litter, feed, trash, etc. are removed. Then the room and

equipment are washed and disinfected with a liquid disinfectant. Where possible the rooms are further disinfected by the use of formaldehyde gas.

6. Given the nature of the research that occurs, it is paramount that birds are attended to in a specific order to prevent contamination. “Clean" (UD resident flock) birds are maintained in the East-West building. Therefore the East-West building should be visited first each day and that the East-West building not be entered after entering any other poultry buildings. Prior to re-entry of the East-West building personnel are required to completely change their personal protective equipment and shower.

LASHER LABORATORY - BROILER FLOOR-PEN FACILITIES

1. Broiler Floor pen facilities are a shed-type structure with one curtain sidewall – Tunnel ventilation with two wings of 30 pens each for a total of 60 pens.
2. Source of Chicks
    a. International broiler breeds derived from a single source at a local commercial hatchery are used.
    b. Straight-run or sexed (vent or feather sexed at the hatchery) day-old chicks are vaccinated at the hatchery for Marek’s Disease, Newcastle Disease, and infectious bronchitis using standard practices.
3. Litter
    a. Pine shavings or sawdust obtained from a uniform source is placed at a minimum depth of 2 ½” on concrete floors.
    b. Reused or built-up litter from a previous flock may be used for those experiments not requiring fresh litter.
    c. Wet litter is removed and replaced with fresh litter if there is a major flood.
4. Bird Density
    a. 60 birds/pen at 0.75 ft^2/bird of usable floor pen is used for a 7-week broiler experiment.
5. Water: A four-foot Chore Time® nipple drinker having 5 button nipples is used per pen (12 birds per nipple). Drinker height and water pressure is adjusted according to manufacturer’s recommendation.
6. Waste Management and Sanitation
    a. Routine mortality losses and those from the diagnostic lab are incinerated or composted.
    b. Experiments in which the broilers are non-salable are euthanized.
    c. These birds are either carried to a sanitary landfill or a protein conversion plant.
    d. Between flocks, the houses are washed down with a high-pressure prayer and disinfected.
7. Animal Care Staff
    a. Three professional/technical staff employees have the major responsibility for day-to-day animal care. Two of these individuals reside on the University's property. In addition, one of two utility workers provides routine checks on ventilation during the night.
    b. To ensure the well-being of poultry using existing equipment and facilities, environmental conditions in the houses are monitored a minimum of every three to four hours pending weather conditions.
    c. Not less than 1 - 2 weeks prior to the start of the experiment, the Research Associate should be contacted and a protocol provided, to determine with the researcher, the best date to start the experiment. The Research Associate will coordinate all details of each experiment with the staff and monitor poultry care management.
8. Temperature
    a. Room temperature read on Thermoalarm in each house.
    b. Room temperature 90 degrees F. (1 - 7 days)

c. Room temperature lowered 5 degrees F. per week until 70 degrees F. room temperature is obtained.
d. One forced draft box type gas heater per house used during conventional bird studies.
e. One radiant type gas heater per pen used during pen studies.

9. Ventilation
    a. Tunnel ventilated system is equipped with a microprocessor based controller. Temperature and static pressure are used to provide the mechanism for achieving a consistent bird comfort zone throughout the grow out cycle. Tunnel ventilated system is also equipped with manual thermostats and manual 10-minute timers.
    b. Ventilation adjustments are made automatically to meet day and night temperature requirements. Ventilation adjustments can be made manually as needed.
    c. All deviations from pre-established standards should be recorded and the main researcher should be notified when this event occurs.
    d. Any modifications, changes, adding or withdrawal of equipment should be consulted with the Research Associate's supervisor and main researcher before any change occurs, unless it is done under emergency situation.
10. Lighting
    a. First 2 weeks of age, 20-24 hours of fluorescent lighting is provided (1 - 2 foot-candles).
    b. After 2 weeks a minimum of 0.5 to 1 foot-candles is provided with 20 - 24 total light hours.
    c. If a lighting program different than above is to be used, it should be provided with the protocol.
11. Disease Prevention
    a. Chicks are derived from the same source. It is desirable for both wings to be placed on the same date to provide all-in, all-out system.
    b. A floor mat saturated with disinfectant is placed at entrance of each wing
    c. No visitors are allowed without prior approval, protective clothing and footwear.
    d. Rodent control is provided by licensed applicator. No bait is placed inside the pen area.
12. Culling/Mortality
    a. Severely stunted and birds with leg disorders are culled (cervical dislocation) daily.
    b. Mortality losses are recorded on pen charts daily. A tag is placed on each bird to identify the house, date, pen, and reason for culling. Body weight and necropsy reports are provided upon request.
    c. Unexpected illness or death is reported to the Research Associate and the poultry pathologist is consulted immediately.
    d. Before culling above normal levels, in high numbers, the pathologist should be consulted so a thorough post-mortem exam can be done properly. Large number of birds cannot be properly done.
13. Processing
    a. A commercial company catches and processes saleable broilers.
    b. Total live weight and approximate head count are determined for each trailer load.
    c. Carcass quality and condemnation data may be available at processing plant if desired. Treatment groups must be greater than 400 birds (data not guaranteed).
14. Data Collection
    a. Chicks are counted twice upon placement in each pen.
    b. Broiler performance data is generally obtained 3 times/flock (coincides with change in feed type). In consecutive pen order, feeders are removed from the pens and weighed, the birds are penned near the pen front and counted by groups of 5 onto a container mounted on a platform scale. Net pen weight and total number of birds is recorded. If the head count agrees with pen charts, all broilers are placed back into the pen. If the head count is

incorrect, birds are recounted out of the container. After all pens have been weighed, all feed is removed from the feeders and new feed type weighed into the feeder.

c. Measure; retrieve hourly temperature, relative humidity and static pressure data and transfer daily profile to computer.

15. Waste Management and Sanitation
    a. Routine mortality losses are incinerated or composted. Experiments in which the broilers are non-saleable, birds are euthanized (carbon dioxide or cervical dislocation). These birds are carried to a sanitary landfill, protein conversion plant, or composted.
    b. Manure removed from the houses is spread on cropland by a qualified applicator or is stockpiled in the manure shed.
    c. Between flocks, the house is washed down with a high-pressure sprayer, additionally, each wing is properly disinfected following a total clean out of litter.

LASHER LABORATORY
Building #2

1. Building #2 is a clear-span structure with metal roof and walls, concrete drained floors - power ventilation equipped with ducted air inlet with motorized louver air inlets and 8 total rooms, 6 rooms with floor and raised floor pens or without pens. One room contains 13 Horsfall isolators.
2. Source of Chicks
    a. International broiler breeds derived from a single source at a local commercial hatchery are used.
    b. Straight-run or sexed (vent or feather sexed at the hatchery) day-old chicks are vaccinated at the hatchery for Marek's disease, Newcastle disease, and infectious bronchitis using standard practices.
3. Litter
    a. Pine shavings or sawdust obtained from a uniform source is placed at a minimum depth of 2 ½" on concrete floors.
    b. Reused or built-up litter from a previous flock may be used for those experiments not requiring fresh litter.
    c. Wet litter from leaky drinkers is removed from the house and replaced with fresh litter if there is a major flood.
4. Bird Density
    25 birds/pen at 0.72 ft^2/bird of usable floor pen is used for a 7- week broiler experiment.
5. Water
    Val® nipple drinker having 6 pin nipples is used per pen (15 birds per nipple). Drinker height and water pressure adjusted according to manufacturer's recommendation.
6. Feed
    a. One floor feeder (1-49 days of age) and one feed lid (1-5 days of age) is used per pen of 25 birds (1.3 circular inches feeder space/bird).
    b. All feed is weighed and the weight is recorded on each pen chart.
    c. Pelleted or mash feed from a commercial source is delivered in bulk or 50 lb. bags.
    d. Feeder height is adjusted according to bird size.
    e. The feed should be the type recommended for the type of bird (broiler) and age.
    f. Supervisors should be consulted before using feed left from previous flocks.
7. Temperature
    a. Brooding temperature is 88-90 degrees F the first week, reducing 5°/week until at 65 degrees F (temperature adjusted to meet bird comfort).

b. Centralized hot water recirculation system and heat exchanger used per room. In addition, Room 5, 6, and 7 use radiant tube heat. Electric heat lamps are used for supplemental heat.

8. Ventilation
    a. Power ventilation on timer and thermostat controls are used in each room.
    b. Ventilation adjustments are made periodically day and night.
9. Lighting
    a. First 2 weeks of age, 20 - 24 hours of fluorescent lighting is provided (1 - 2 foot-candles). Incandescent bulbs can also be used on separate switches.
    b. After 2 weeks a minimum of 0.5 to 1 foot-candles is provided.
    c. If a different lighting program than above is to be used, it should be provided with the protocol.
10. Disease Prevention
    a. Chicks are derived from the same source. It is desirable for all pens to be placed on the same date to provide all-in, all-out system.
    b. A floor bath with disinfectant is placed at entrance of each room.
    c. No visitors are allowed without prior approval and protective clothing and footwear.
    d. Rodent control is provided by licensed applicator. No bait is placed inside the pen area.
11. Culling/Mortality
    a. Severely stunted and birds with leg disorders are culled (cervical dislocation) daily.
    b. Mortality losses are recorded on pen charts daily. A tag is placed on each bird to identify the house, date, pen, and reason for culling. Body weight and necropsy reports are provided upon request.
    c. Unexpected illness or death is reported to the Research Associate and the poultry pathologist is consulted immediately.
    d. Before culling above normal levels, in high numbers, the pathologist should be consulted so a thorough post-mortem exam can be done properly. Large number of birds cannot be properly done.
12. Data Collection
    a. Chicks are counted twice upon placement in each pen.
    b. Broiler performance data is generally obtained 3 times/flock (coincides with change in feed type). In consecutive pen order, feeders are removed from the pens and weighed, the birds are penned near the pen front and counted by groups of 5 onto a container mounted on a platform scale. Net pen weight and total number of birds is recorded. If the head count agrees with pen charts, all broilers are placed back into the pen. If the head count is incorrect, birds are recounted out of the container. After all pens have been weighed, all feed is removed from the feeders and new feed type weighed into the feeder.
13. Waste Management and Sanitation
    a. Routine mortality losses and birds euthanized at the end of projects are incinerated or composted.
    b. Between projects, the pens are washed down with a high-pressure sprayer, and disinfected properly.

COLONY HOUSES

1. Twelve colony houses (CH), 11' x 11' usable floor space with power ventilation.
2. Source of Chicks
   Most chicks are non-vaccinated from multiple breeder flocks.

3. Litter
    a. Pine shavings or sawdust obtained from a uniform source is placed at minimum depth of 2 ½" on concrete floors. (Five 30-gal. garbage cans per house)
    b. Reused or built-up litter from a previous flock may be used for those experiments not requiring fresh litter.
    c. Wet litter from leaky drinkers is removed from the house and replaced with fresh litter if there is a major flood.
4. Bird Density
    a. Up to 300 birds per CH @ 0.4 sq. ft. of floor space per bird for a period of 1 to 28 days.
    b. Up to 150 birds per CH @ 0.8 sq. ft. of floor space per bird for a period of 1 to 49 days.
    c. Up to 120 birds per CH @ 1.0 sq. ft. of floor space per bird for a period of 1 to 60 days.
5. Water
    a. Two 6' nipple lines with 7 nipples per line (14 total) per Colony House.
    b. Maximum of 30 chicks per nipple for brooding, 12 to 15 chicks per nipple for growout.
    c. Drinker height adjusted regularly (at least 3-4 times / week) using manufacturer's "yardstick" as a measuring device.
    d. Water column or pressure adjusted 1 time each week, using a "yardstick" as measuring device.
    e. Instructions and recommended heights and water column are printed on yardstick.
6. Feed
    a. 6 ft. Kraft paper with feed under each heater (removed after 3 days).
    b. Two feeder lids per Colony House (removed after 7 - 8 days).
    c. Three hanging tube feeders per Colony House (47" feed space per feeder).
    d. Commercial feed, proper for the type of bird and age, delivered in bulk is to be used (2.2 ton bid capacity).
7. Temperature
    a. Room temperature read on alarm head in each house.
    b. Room temperature 90 degrees F. (1-7 days)
    c. Room temperature lowered 5 degrees F. per week until 70 degrees F. room temperature is obtained.
    d. One 'Shenandoah' gas brooder per Colony House.
8. Ventilation
    a. One fan on timer with thermostat over-ride provides power ventilation thru air inlets in door (2) and ceiling (1).
    b. Obtain 650 CFM of free air per fan.
    c. Ventilation adjustments made as needed.
9. Lighting
   Two 13-watt fluorescent lights provide lighting 24 hours a day.
10. Alarm System
    Alarm system consists of an AgrAlarm located in the chick tagging room, hard wired to each of the twelve colonies, recognizing a power outage and high / low temperatures from a thermoalarm setting in each colony house and calls out on a land line phone to multiple programmed phone numbers.
11. Culling/Mortality
    a. All mortality is to be recorded daily on house flock charts.
    b. No culling necessary unless instructed by Diagnostic Lab personnel.
    c. All daily mortality must be tagged with house number and date and then submitted to the lab for necropsy.

d. Any abnormal mortality or problems must be reported immediately.
e. Before culling above normal levels, in high numbers, the pathologist should be consulted so a thorough post-mortem exam can be done properly. Large number of birds cannot be properly done.

12. Data Collection
    a. Chicks for many experiments are wing banded at placement.
    b. All birds are necropsied during or at the conclusion of experiments.
    c. Follow protocol on data collection. This is important as all experiments may differ.
13. Bio-Security
    Traffic patterns, sanitation, and other bio-security measures will vary according to each individual test. Protocol must be followed at all times.
14. Waste Management/Sanitation
    a. Routine mortality losses are incinerated or composted daily.
    b. At harvest, birds euthanized by cervical dislocation are carried to a protein conversion plant, sanitary landfill, incinerated or composted.
    c. Houses are cleaned out as required and manure stored in the manure storage shed.
    d. Between flocks, houses are washed down by high-pressure sprayer and disinfected properly.

POULTRY FACILITIES AND CAPACITES

BROILER CAPACITY

BUILDING	BIRD WEIGHT lbs./grams	BIRD AGE	REQUIRED FLOOR AREA/BIRD	MAXIMUM BIRDS/ PEN
Newark **BLOCK HOUSES** **7 & 9** **GROW-OUT CAGES** **(2 CAGES/RM)** **(6 PENS/CAGE)** 29.5" X 30" = 885 SQ. IN. = 885 SQ. IN. (feeder space removed)	≤.12/55	1 day	38"	23*
	.35/160	1 week	38"	23*
	.89/405	2 weeks	53"	17
	1.6/735	3 weeks	67"	10
	2.5/1150	4 weeks	80"	10
	3.6/1625	5 weeks	109"	6
	4.7/2145	6 weeks	135"	5
	5.9/2675	7 weeks	147"	4
	7.1/3215	8 weeks	158"	4
	>7.1	≥9 Weeks	170"	4

*Based on 2 feeders per cage.

LEGHORN CAPACITY

BUILDING	BIRD AGE (Weeks)	REQUIRED FLOOR AREA/BIRD SQUARE INCH	MAXIMUM BIRDS/PEN*
Newark **BLOCK HOUSES 7 & 9** **GROW-OUT CAGES** **(2 CAGES/RM)** **(6 PENS/CAGE)** 29.5" X 30" = 885 SQ. IN. = 885 SQ. IN. (feeder space removed) * Bird numbers based on 2 feeders per cage.	0-1	17.5" S/R 15" female 20" male	50 S/R 60 female 45 male
	1-3	17.5" S/R 15" female 20" male	30 S/R
	3-6	27.5 S/R 24" female 31" male	S/R or 20 female
	6-12	41.5" S/R 36" female 47" male	S/R or 15 female
	12-18	55" S/R 48" female 62" male	S/R or 10 female
	18-22	69" S/R 60" female 78" male	S/R or 8 female
	>22	83" S/R 72" female 94" male	S/R or 5 female

BROILER CAPACITY

BUILDING	BIRD WEIGHT lbs./grams	BIRD AGE	REQUIRED FLOOR AREA/BIRD	MAXIMUM BIRDS/ PEN*
Newark	≤.12/55	1 day	38”	7
BROODER HOUSE (1-4 brooders)	.35/160	1 week	38”	7
PETERSIME BROODER UNIT	.89/405	2 weeks	53”	5
20” X 14” =	1.6/735	3 weeks	67”	4
280 SQ. IN. =	2.5/1150	4 weeks	80”	3
280 SQ. IN. (feeder space removed)				

* Bird numbers based on 4 pens per level and 6 levels per brooder unit.

LEGHORN CAPACITIES

BUILDING	BIRD AGE (Weeks)	REQUIRED FLOOR AREA/BIRD SQUARE INCH	MAXIMUM BIRDS/ PEN*
Newark **BROODER HOUSE (1-4 brooders)** **PETERSIME BROODER UNITS** **24 PENS/BROODER** 20" X 14" = 280 SQ. IN. = PER PEN	0-3	17.5" S/R 15" female 20" male	16 S/R 17 female 14 male
	3-6	27.5" S/R 24" female 31" male	10 S/R 12 female 9 male
	6-12	41.5" S/R 36" female 47" male	7 S/R 8 female 6 male

* Bird numbers based on four pens per level, six levels per brooder.

BROILER CAPACITIES

BUILDING	BIRD WEIGHT lbs./grams	BIRD AGE	REQUIRED FLOOR AREA/BIRD	MAXIMUM BIRDS/ PEN	MINIMUM # OF FEEDERS	MINIMUM DRINKERS
Newark **EAST/WEST BUILDING** **FLOOR PENS** 18.33' X 6.79' = 125 SQ. FT. = 18,000 SQ. IN. -(4" X 144"= 576) feeders = 17,425 SQ. IN. (feeder space removed)	≤.12/55	1 day	38"	200	2 chick & 2 small hanging	8' trough
	.35/160	1 week	38"	150	1 chick & 2 small hanging	8' trough
	.89/405	2 weeks	53"	90	2 small hanging	8' trough
	1.6/735	3 weeks	67"	90	2 small hanging	8' trough
	2.5/1150	4 weeks	80"	75	2 small hanging	8' trough
	3.6/1625	5 weeks	109"	70	2 small hanging	8' trough
	4.7/2145	6 weeks	135"	70	2 small hanging	8' trough
	5.9/2675	7 weeks	147"	70	2 small hanging	8' trough
	7.1/3215	8 weeks	158"	50	2 small hanging	8' trough
	>7.1	≥9 weeks	170"	25	2 small hanging	8' trough

LEGHORN CAPACITIES

BUILDING	BIRD AGE (Weeks)	REQUIRED FLOOR AREA/BIRD SQUARE INCH	MAXIMUM BIRDS/ PEN	MINIMUM # OF FEEDERS	MINIMUM DRINKERS
Newark **EAST/WEST BUILDING** **FLOOR PENS** 18.3' X 6.8' = 125 SQ. FT.= 18,000 SQ. IN. -(144" x 4" = 576) feeders = 17,425 SQ. IN.	0-6	83" S/R	200	3 chick & 3 small hanging or 4 small hanging	8' trough
	6-18	166" S/R 144" female 187" male	100 S/R 120 female 90 male	2 small hanging feeders	8' trough
	>18	290" S/R 252" female 328" male	60 S/R 70 female 50 male	2 small hanging feeders	8' trough

BROILER CAPACITIES

BUILDING	BIRD WEIGHT lbs./grams	BIRD AGE	REQUIRED FLOOR AREA/BIRD	MAXIMUM BIRDS/ PEN	MINIMUM # OF FEEDERS	MINIMUM DRINKERS
Newark & Georgetown **LARGE COLONY HOUSES & PALMER HOUSE** **FLOOR PENS** 11' X 13' = 143 SQ. FT.= 19,000 SQ. IN. (feeder & drinker space removed)	≤.12/55	1 day	38"	200	3 chick & 3 small hanging	2 round hanging or 5' nipple
	.35/160	1 week	38"	150	3 chick & 3 small hanging	2 round hanging or 5' nipple
	.89/405	2 weeks	53"	100	2 small hanging	1 round hanging or 5' nipple
	1.6/735	3 weeks	67"	100	2 small hanging	1 round hanging or 5' nipple
	2.5/1150	4 weeks	80"	80	2 small hanging	1 round hanging or 5' nipple
	3.6/1625	5 weeks	109"	80	2 small hanging	1 round hanging or 5' nipple
	4.7/2145	6 weeks	135"	80	2 small hanging	1 round hanging or 5' nipple
	5.9/2675	7 weeks	147"	80	2 small hanging	1 round hanging or 5' nipple
	7.1/3215	8 weeks	158"	50	1 small hanging	1 round hanging or 5' nipple
	>7.1	≥9 weeks	170"	25	1 small hanging	1 round hanging or 5' nipple

LEGHORN CAPACITIES

BUILDING	BIRD AGE (Weeks)	REQUIRED FLOOR AREA/BIRD SQUARE INCH	MAXIMUM BIRDS/ PEN	MINIMUM # OF FEEDERS	MINIMUM DRINKERS
Newark & Georgetown **LARGE COLONY HOUSES & PALMER HOUSE** **FLOOR PENS** 11' X 13' = 143 SQ. FT. = 19,000 SQ. IN. (feeder & drinker space removed)	0-3	83" S/R	200	4 chick & 2 small hanging	1 gal drinker & 1 round hanging or 5' nipple
	3-6	83" S/R	100	4 chick & 2 small hanging	1 gal drinker & 1 round hanging or 5' nipple
	6-12	166" S/R 144" female 187" male	80 S/R or female	2 small hanging	1 round hanging or 5' nipple
	>12	290" S/R 252" female 328" male	50 S/R or female	2 small hanging	1 round hanging or 5' nipple

BROILER CAPACITIES

BUILDING	BIRD WEIGHT lbs./grams	BIRD AGE	REQUIRED FLOOR AREA/BIRD	MAXIMUM BIRDS/ PEN	MINIMUM # OF FEEDERS
Newark **ALLEN LAB** **Rms: 123, 131 & 164** **PIU Rm B** **LARGE GLOVEPORT ISOLATORS** 49.2" X 25.5" = 1,255 SQ. IN. = 1,086 SQ. IN. (feeder space removed)	≤.12/55	1 day	38"	30	2 feeders + paper
	.35/160	1 week	38"	30	2 feeders + paper
	.89/405	2 weeks	53"	21	2 feeders
	1.6/735	3 weeks	67"	16	2 feeders
	2.5/1150	4 weeks	80"	14	2 feeders
	3.6/1625	5 weeks	109"	10	2 feeders
	4.7/2145	6 weeks	135"	8	2 feeders
	5.9/2675	7 weeks	147"	7	2 feeders
	7.1/3215	8 weeks	158"	7	2 feeders
	>7.1	≥9 weeks	170"	6	2 feeders

LEGHORN CAPACITIES

BUILDING	BIRD AGE (Weeks)	REQUIRED FLOOR AREA/BIRD SQUARE INCH	MAXIMUM BIRDS/ PEN BY SQ INCHES	MINIMUM # OF FEEDERS	RECOM. BIRD CAPACITY BY FEEDERS
Newark **ALLEN LAB** **Rms: 123, 131 & 164** **PIU Rm B** **LARGE GLOVEPORT ISOLATORS** 49.2" X 25.5" = 1,255 SQ. IN. = 1,086 SQ. IN. (feeder space removed)	0-3	17.5" S/R	60	2 feeders = 28"	60
		15" female	70		70
		20" male	55		55
	3-6	27.5" S/R	40	2 feeders	30
		24" female	45		35
		31" male	35		28
	6-12	41.5" S/R	26	2 feeders	20
		36" female	30		23
		47" male	23		18
	12-18	55" S/R	20	2 feeders	12
		48" female	23		14
		62" male	18		11
	18-22	69" S/R	16	2 feeders	8
		60" female	18		9
		78" male	14		7
	>22	83" S/R	13	2 feeders	6
		72" female	15		7
		94" male	12		5

BROILER CAPACITIES

BUILDING	BIRD WEIGHT lbs./grams	BIRD AGE	REQUIRED FLOOR AREA/BIRD	MAXIMUM BIRDS/ PEN	MINIMUM # OF FEEDERS
Newark & Georgetown **NORTH BLOCK HOUSES: 3 & 4** **SOUTH BLOCK HOUSES: 8 & 10** **LASHER BLDG #2 & PIU RM A** **MODIFIED HORSFALL ISOLATORS** 32" X 29" = 928 SQ. IN. = (804)/896 SQ. IN. (2 feeders space removed)	≤.12/55	1 day	38"	24(21)	1 feeder & 1 chick feeder
	.35/160	1 week	38"	24(21)	1 feeder & 1 chick feeder
	.89/405	2 weeks	53"	15	1 feeder
	1.6/735	3 weeks	67"	10	1 feeder
	2.5/1150	4 weeks	80"	10	1 feeder
	3.6/1625	5 weeks	109"	5	1 feeder
	4.7/2145	6 weeks	135"	5	1 feeder
	5.9/2675	7 weeks	147"	5	1 feeder
	7.1/3215	8 weeks	158"	4	1 feeder
	>7.1	≥9 weeks	170"	4	1 feeder

LEGHORN CAPACITIES

BUILDING	BIRD AGE (Weeks)	REQUIRED FLOOR AREA/BIRD SQUARE INCH	MAXIMUM BIRDS/ PEN BY SQ. INCHES	MINIMUM # OF FEEDERS	RECOM. BIRD CAPACITY BY FEEDERS
Newark & Georgetown **NORTH BLOCK HOUSES: 3 & 4** **SOUTH BLOCK HOUSES: 8 & 10** **LASHER BLDG #2 & PIU RM A** **MODIFIED HORSFALL ISOLATORS** 32" X 29" = 928 SQ. IN. = (804)/896 SQ. IN. (feeder space removed)	0-1	17.5" S/R 15" female 20" male	50(45) 60(55) 45(40)	1 feeder (& 1 chick feeder)	26(50) 29(60) 23(45)
	1-3	17.5" S/R 15" female 20" male	30	1 feeder (& 1 chick feeder)	30
	3-6	27.5" S/R 24" female 31" male	20	1 feeder	13 14 12
	6-12	41.5" S/R 36" female 47" male	15	1 feeder	8 10 7
	12-18	55" S/R 48" female 62" male	10	1 feeder	5 6 4
	18-22	69" S/R 60" female 78" male	8	1 feeder	3 4 3
	>22	83" S/R 72" female 94" male	5	1 feeder	3 3 2

LEGHORN CAPACITIES

BUILDING	BIRD AGE (Weeks)	REQUIRED FLOOR AREA/BIRD SQUARE INCH	MAXIMUM BIRDS/ PEN	MINIMUM # OF FEEDERS	MINIMUM DRINKERS
Newark **OLD BROILER HOUSE** **CENTER FLOOR PEN** 10.5' X 23.5' = 247 SQ. FT. = 35,563 SQ. IN. -(144" x 5" = 720) feeders = 34,843 SQ. IN.	0-6	83" 166" S/R	420	30 chicks per chick feeder or 60 per small hanging feeder	8' trough per 275 chicks
	6-18	166" S/R 144" female 187" male	210 S/R 240 female 185 male	60 chickens per small hanging or 65 per large hanging feeder	8' trough per 200 S/R
	>18	2 x 290" S/R 2 x 252" female 2 x 328" male	60 S/R 70 female 50 male	45 chickens per large hanging feeder	8' trough per 85 S/R

LEGHORN CAPACITIES

BUILDING	BIRD AGE (Weeks)	REQUIRED FLOOR AREA/BIRD SQUARE INCH	MAXIMUM BIRDS/ PEN	MINIMUM # OF FEEDERS	MINIMUM DRINKERS
Newark **OLD BROILER HOUSE** **EAST FLOOR PEN** 19.5' X 23.5' = 458 SQ. FT. = 65,950 SQ. IN. -(144" x 5" = 720) feeders = 65,230 SQ. IN.	0-6	83" 166" S/R	785	30 chicks per chick feeder or 60 per small hanging feeder	8' trough per 275 chicks
	6-18	166" S/R 144" female 187" male	390 S/R 450 female 350 male	60 chickens per small hanging or 65 per large hanging feeder	8' trough per 200 S/R
	>18	2 x 290" S/R 2 x 252" female 2 x 328" male	110 S/R 130 female 100 male	45 chickens per large hanging feeder	8' trough per 85 S/R

LEGHORN CAPACITIES

BUILDING	BIRD AGE (Weeks)	REQUIRED FLOOR AREA/BIRD SQUARE INCH	MAXIMUM BIRDS/ PEN	MINIMUM # OF FEEDERS	MINIMUM DRINKERS
Newark **OLD BROILER HOUSE** **WEST FLOOR PEN** 29.5' X 23.5' = 693 SQ. FT. = 99,828 SQ. IN. -(144" x 48" = 6,912) feeders/roost = 92,916	0-6	83" 166" S/R	1020	60 chicks per small hanging or 40 per large hanging feeder	8' trough per 275 chicks
	6-18	166" S/R 144" female 187" male	560 S/R 645 female 495 male	60 chickens per small hanging or 65 per large hanging feeder	8' trough per 200 S/R
	>18	2 x 290" S/R 2 x 252" female 2 x 328" male	160 S/R 185 female 140 male	45 chickens per large hanging feeder	8' trough per 85 S/R

BROILER CAPACITIES

BUILDING	BIRD WEIGHT lbs./grams	BIRD AGE	REQUIRED FLOOR AREA/BIRD	MAXIMUM BIRDS/ PEN	MINIMUM # OF FEEDERS
Newark **ALLEN LAB** **Rms: 127 & 128** **POLYCARBONATE ISOLATORS** 31" X 30" = 930 SQ. IN. = 844 SQ. IN. (feeder space removed)	≤.12/55	1 day	38"	22	1 feeder + paper
	.35/160	1 week	38"	22	1 feeder + paper
	.89/405	2 weeks	53"	15	1 feeder
	1.6/735	3 weeks	67"	10	1 feeder
	2.5/1150	4 weeks	80"	10	1 feeder
	3.6/1625	5 weeks	109"	5	1 feeder
	4.7/2145	6 weeks	135"	5	1 feeder
	5.9/2675	7 weeks	147"	4	1 feeder
	7.1/3215	8 weeks	158"	4	1 feeder
	>7.1	≥9 weeks	170"	4	1 feeder

LEGHORN CAPACITIES

BUILDING	BIRD AGE (Weeks)	REQUIRED FLOOR AREA/BIRD SQUARE INCH	MAXIMUM BIRDS/ PEN BY SQ. INCHES	MINIMUM # OF FEEDERS	RECOM. BIRD CAPACITY BY FEEDERS
Newark **ALLEN LAB** **Rms: 127 & 128** **POLYCARBONATE ISOLATORS** 31" X 30" = 930 SQ. IN. = 844 SQ. IN. (feeder space removed)	0-1	17.5" S/R 15" female 20" male	50 55 40	1 feeder = 11.5"	22 29 23
	1-3	17.5" S/R 15" female 20" male	30	1 feeder = 11.5"	22 29 23
	3-6	27.5" S/R 24" female 31" male	20	1 feeder	13 14 12
	6-12	41.5" S/R 36" female 47" male	15	1 feeder	8 10 7
	12-18	55" S/R 48" female 62" male	10	1 feeder	5 6 4
	18-22	69" S/R 60" female 78" male	8	1 feeder	3 3 3
	>22	83" S/R 72" female 94" male	5	1 feeder	3 3 2

BROILER CAPACITIES

BUILDING	BIRD WEIGHT lbs./grams	BIRD AGE	REQUIRED FLOOR AREA/BIRD	MAXIMUM BIRDS/ PEN	MINIMUM # OF FEEDERS
Newark **NORTH 1-14** **SOUTH 1-4** **SMALL COLONY HOUSES** **FLOOR PENS** 7.4' X 7.4' = 55 SQ. FT. = 7,420 SQ. IN. (feeder & drinker space removed)	≤.12/55	1 day	38"	100	1 chick & 1 small hanging feeder
	.35/160	1 week	38"	75	1 chick & 1 small hanging feeder
	.89/405	2 weeks	53"	50	1 small hanging feeder
	1.6/735	3 weeks	67"	50	1 small hanging feeder
	2.5/1150	4 weeks	80"	40	1 small hanging feeder
	3.6/1625	5 weeks	109"	40	1 small hanging feeder
	4.7/2145	6 weeks	135"	30	1 small hanging feeder
	5.9/2675	7 weeks	147"	30	1 small hanging feeder
	7.1/3215	8 weeks	158"	15	1 small hanging feeder
	>7.1	≥9 weeks	170"	6	1 small hanging feeder

LEGHORN CAPACITIES

BUILDING	BIRD AGE (Weeks)	REQUIRED FLOOR AREA/BIRD SQUARE INCH	MAXIMUM BIRDS/ PEN	MINIMUM # OF FEEDERS	MINIMUM DRINKERS
Newark **NORTH 1-14** **SOUTH 1-4** **SMALL COLONY HOUSES** **FLOOR PENS** 7.4' X 7.4' = 55 SQ. FT. = 7,420 SQ. IN. (feeder & drinker space removed)	0-3	83" S/R	100	2 chick feeders & 1 small hanging feeder	1 round hanging
	3-6	83" S/R	50	2 chick feeders & 1 small hanging feeder	1 round hanging
	6-12	166" S/R 144" female 187" male	40 S/R or female	1 small hanging	1 round hanging
	>12	290" S/R 252" female 328" male	25 S/R or female	1 small hanging	1 round hanging

BROILER CAPACITIES

BUILDING	BIRD WEIGHT Lbs./grams	BIRD AGE	REQUIRED FLOOR AREA/BIRD	MAXIMUM BIRDS/ PEN	MINIMUM # OF FEEDERS
Newark **ALLEN LAB Rms: 124 & 163** **SMALL GLOVEPORT ISOLATORS** 39.5" X 25.5" = 1,007.2 SQ. IN. = 839 SQ. IN. (feeder space removed)	≤.12/55	1 day	38"	22	2 feeders + paper
	.35/160	1 week	38"	22	2 feeders + paper
	.89/405	2 weeks	53"	15	2 feeders
	1.6/735	3 weeks	67"	10	2 feeders
	2.5/1150	4 weeks	80"	10	2 feeders
	3.6/1625	5 weeks	109"	5	2 feeders
	4.7/2145	6 weeks	135"	5	2 feeders
	5.9/2675	7 weeks	147"	4	2 feeders
	7.1/3215	8 weeks	158"	4	2 feeders
	>7.1	≥9 weeks	170"	4	2 feeders

LEGHORN CAPACITIES

BUILDING	BIRD AGE (Weeks)	REQUIRED FLOOR AREA/BIRD SQUARE INCH	MAXIMUM BIRDS/ PEN BY SQUARE INCHES	MINIMUM # OF FEEDERS
Newark **ALLEN LAB** **Rms: 124 & 163** **SMALL GLOVEPORT ISOLATORS** 39.5" X 25.5" = 1,007.2 SQ. IN. = 839 SQ. IN. (feeder space removed)	0-1	17.5" S/R 15" female 20" male	50 55 40	2 feeders = 28"
	1-3	17.5" S/R 15" female 20" male	30	2 feeders
	3-6	27.5" S/R 24" female 31" male	20	2 feeders
	6-12	41.5" S/R 36" female 47" male	15	2 feeders
	12-18	55" S/R 48" female 62" male	10	2 feeders
	18-22	69" S/R 60" female 78" male	8	2 feeders
	>22	83" S/R 72" female 94" male	5	2 feeders

LEGHORN CAPACITY

BUILDING	BIRD AGE (Weeks)	REQUIRED FLOOR AREA/BIRD SQUARE INCH	MAXIMUM BIRDS/ PEN
Newark **LAYER HOUSE** **Layer Cages** **60 pens/level** **2 levels per cage** **2 cages per house =** **240 total pens** **16" X 18.5" =** **296 SQ. IN** **PER PEN**	12-18	55" S/R 48" female 62" male	5 S/R 6 female 5 male
	18-22	69" S/R 60" female 78" male	4 S/R 5 female 4 male
	>22	83" S/R 72" female 94" male	3 S/R 4 female 3 male

BROILERS
UNDER
COMMERCIAL PRODUCTION CONDITIONS
Newark

BROILER HOUSE: **37' X 44' = 1628 SQUARE FEET**

Broilers up to 7 weeks of age placed at .75 sq. ft. per bird = 2200 birds

Roasters up to 9 weeks of age placed at 1.2 sq. ft. per bird = 1350 birds

End-House brooding used for the first two weeks. Nipple drinkers and pan feeders are placed according to manufacturer recommendations. The house is operated as close to field conditions as possible to simulate commercial production practices.