

OAKLAND CUSD #5

**BSAA**  
**APRIL 27-MAY 1, 2020**

JEFF COON

# Week of April 27-May 2, 2020

All of these assignments are on google classroom. You must pick one of the 3 listed and complete by next Monday, May 4th for credit. If you would like to use google docs to complete the work that would be most efficient, just remember to start a new copy with your own work please. Paper copies can be returned to the school.

| <b>Class</b>     | <b>Choice 1</b>  | <b>Choice 2</b>        | <b>Choice 3</b>       |
|------------------|------------------|------------------------|-----------------------|
| Ag Science       | CDE              | Animal Reproduction #2 | FFA Journal           |
| Ag Business Mang | Advertising      | Borrowing Money        | car Insurance         |
| BSAA             | Animal Health    | Respiration            | Domestic Animals      |
| Landscape Design | Managing grasses | Landscape areas        | Landscape Power tools |
| Intro To Ag      | CDE              | Consumer Trends        | Maintaining your SAE  |
| Ag Mech.         | Land measurement | coolants               | Remote sensing        |
|                  |                  |                        |                       |

Part One: Matching Instructions: Match the word with the correct definition.

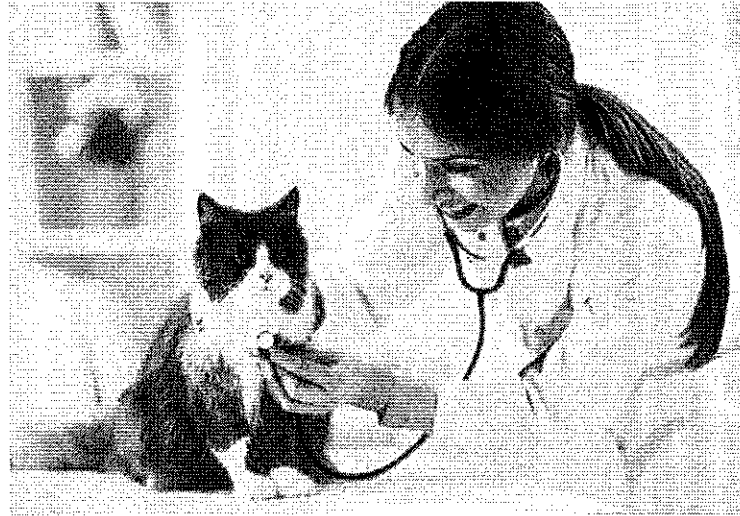
|          |            |             |         |
|----------|------------|-------------|---------|
| Docking  | rickets    | biosecurity |         |
| Immunity | colostrum  | Sulfonamide |         |
| Dorsal   | castration | Pulse       | Vaccine |

- \_\_\_\_\_ 1. a substance full of antibodies that is secreted with milk shortly after giving birth
- \_\_\_\_\_ 2. the rhythmic expansion of blood through an artery
- \_\_\_\_\_ 3. the removal or destruction of testicles
- \_\_\_\_\_ 4. the ability of an animal to resist a disease
- \_\_\_\_\_ 5. the removal of an animal's tail
- \_\_\_\_\_ 6. a prepared substance that utilizes a weakened version of a disease to stimulate the production of antibodies within the recipient
- \_\_\_\_\_ 7. a set of procedures for protection against harmful biological or biochemical agents
- \_\_\_\_\_ 8. the direction toward the upper side or back of a body
- \_\_\_\_\_ 9. a bone disease caused by a vitamin D deficiency
- \_\_\_\_\_ 10. an antibacterial pharmaceutical created from sulfonic acid

**E-UNIT  
C4-1**

# Animal Health

The greatest threat to the well-being of animals is disease. It is estimated that one in five farm animals dies each year due to an entirely preventable disease. Many others suffer the effects of an illness. When caring for animals, healthcare is an important part of your daily routine.



**Objective:**

Explain practices used to maintain animal health.



**Key Terms:**

- |                       |                           |                  |
|-----------------------|---------------------------|------------------|
| antibiotic            | disinfectant              | respiration rate |
| antibody              | docking                   | rickets          |
| biological medication | dorsal                    | sanitation       |
| biosecurity           | hyperthermia              | stethoscope      |
| caudal                | hypothermia               | sulfonamide      |
| castration            | immunity                  | vaccine          |
| colostrum             | medication                |                  |
| dehorning             | pharmaceutical medication |                  |
| dietary supplement    | pulse                     |                  |

## Keeping Animals Healthy

Animals need good health for growth and productivity. Disease prevention and health maintenance are both important factors in animal care.

## DISEASE PREVENTION PRACTICES

Animal keepers should use appropriate practices to maintain good animal health. Proper strategies for health management not only provide for an animal's well being, but also improve an animal's ability to produce. Your strategies for maintaining animal health should factor in environmental conditions, sanitation, biosecurity, nutrition, vaccinations, medications, and overall maintenance. These factors may be useful in controlling, treating, and preventing disease.

### Environmental Conditions

The environment in which an animal lives impacts its health and must be inspected regularly. Environmental conditions include temperature, humidity, ventilation, and adequate space. Proper temperature and humidity levels help improve feed efficiency. If the animal's comfort zone is met, then less energy is needed to regulate body temperature; hence, the feed efficiency is higher than in an uncomfortable environment.

Many livestock species are raised in confinement facilities, where they are kept indoors in a controlled environment. Ventilation and cleanliness are necessary in confinement facilities for animals to receive adequate levels of fresh air.

Providing enough space is critical in reducing stress on animals. Be sure to not overcrowd them. An animal should always have a clean, dry place to lay, allowing for less susceptibility to infections.

### Sanitation

Proper sanitation reduces the possibility of an animal becoming diseased. **Sanitation** is the act of cleaning and disinfecting. Sanitizing an environment will kill (or prevent the development of) disease-causing bacteria and viruses. Proper sanitation includes the removal and disposal of dead animals, the routine cleaning of facilities, and the proper removal of animal waste.

Most importantly, pathogens are destroyed through the disinfection of surfaces. Disinfection is the most effective method for reducing infectious diseases. A **disinfectant** is a cleaning substance that destroys the microbial causes of disease. Disinfectants include alcohol, iodine, lime, soap, and chlorine bleach. People should always follow safety precautions when using disinfectants.

Sanitation is especially important in facilities where young animals are kept. As with humans, young animals are more susceptible to bacteria, viruses, and other pathogens than older animals, because their immune systems have not fully developed. Disinfection prior to housing will help protect the young from bacteria or viruses.

### Biosecurity

**Biosecurity** is a set of procedures for protection against harmful biological or biochemical agents. Humans may bring disease with them as they travel from farm to farm. If a farm has enacted biosecurity procedures, visitors must abide by those regulations.

Producers go to great lengths (and cost) to keep animals healthy and productive, which can be destroyed by one careless person.

On many farms, everyone should disinfect footwear before entering confinement facilities. Producers may have shoes or boots that they wear in only one building. They simply change their footwear before entering a different building. This keeps the diseases or sickness that may be present in one building from passing through an entire farm.

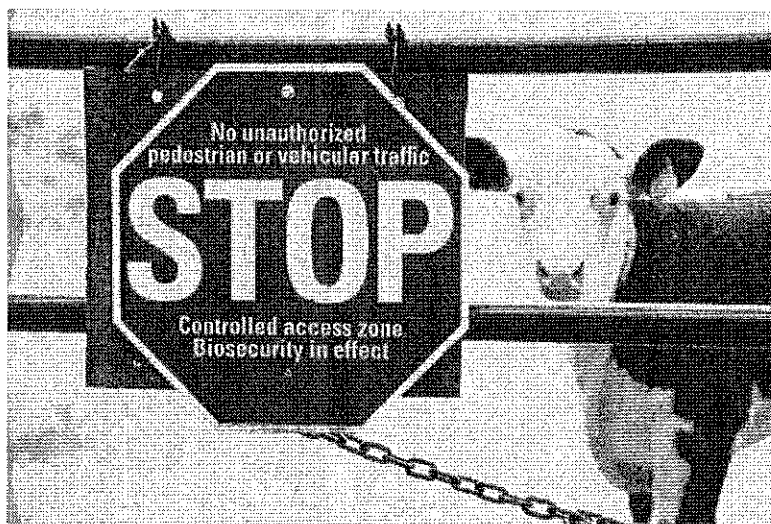
### **Shower-in/Shower-out**

Many facilities have “shower-in/shower-out” policies in which you must shower on-site before entering—only wearing the clothes provided. Upon leaving, you shower and put on your original clothes. Shower-in/shower-out is a broad term: It may not refer to an actual shower, but a change of outerwear, such as boots, gloves, and coats. This can include protective suits for disease prevention. In many cases, visitors are strictly prohibited from entering livestock facilities.

### **Vehicle Safety**

Pathogens can be brought onto farms by trucks, farm equipment, and other vehicles. Access by vehicles that are around other livestock, such as feed trucks, veterinary vehicles, and trucks that haul animals to market, must also be monitored carefully. Many producers require the drivers of these vehicles to disinfect their trucks and wear disposable plastic boots over their shoes to keep any disease from being brought in from another farm.

Although this seems excessive, the disinfection of a vehicle is generally an easy process of hosing the vehicle down before entering the property. Some properties have a visitor parking area away from the livestock, enabling an easy control for biosecurity.



**FIGURE 1.** Here, a sign is posted in an attempt to keep germs and disease from entering the farm area.

### **Nutrition**

Animals that have proper, balanced nutrition are more resistant to disease and stress. Malnourished animals do not have the resistance needed to fend off disease. Nutritional requirements for animals are based on their use and stage in life. Many confinement owners use additives and antibiotics in their feed rations.

### ***Antibiotics in Feed***

For a period of time, confinement operations regularly used feed with a low-grade antibiotic additive. An **antibiotic** is a medication that reduces or kills antigenic microorganisms. Although this is a short-term fix for disease prevention, many government agencies and private-sector groups have been focusing on studies concerning the use of antibiotics in feed. Many believe that the overuse of antibiotics in meat- or milk-producing animals weakens the effectiveness of antibiotics for humans—creating antibiotic-resistant viruses. According to the CDC, antibiotics can kill a lot of bacteria, but leave the resistant bacteria in an animal’s gut. When the animal is processed or its manure gets into soil and water, the resistant bacteria can be released into the environment, affecting an entire ecosystem—including humans.

### ***Dietary Supplements***

Additives generally include minerals that are not easily obtained by the animal, such as zinc, magnesium, and salt. These dietary supplements are commonly used to prevent or treat multiple diseases. A **dietary supplement** is an oral substance made of ingredients that provide additional vitamins, minerals, or other nutrients to a diet. A lack of certain vitamins and minerals can cause deficiencies that foster an illness. **Rickets** is a bone disease caused by a vitamin D deficiency. It affects the growth plate, which causes deformities in young, growing animals. The lack of vitamin D also causes a depletion of calcium and phosphates.

### ***Vaccinations and Medications***

**Immunity** is the ability of an animal to resist a disease. An animal often develops its immunity to a disease after it has been affected; however, vaccinations can be used to help prevent infections. Immunity can be artificially developed for multiple diseases, allowing animals to withstand exposure to disease even after they have come in contact with it.

Animals that get a disease may need a medication to help fight it. A **medication** is a drug used to prevent, cure, or control a disease. Antibiotics are common medications in the livestock industry. General types of medications are either biological or pharmaceutical. A **biological medication** is a medication derived from organic tissue. A **pharmaceutical medication** is a synthetically manufactured medication.

### ***Vaccines***

Vaccines are used to help animals develop artificial immunity to a disease. A **vaccine** is a prepared substance that utilizes a weakened version of a disease to stimulate the production of antibodies within the recipient. An **antibody** is a specialized protein produced in the body to fight off a specific pathogen.

Mothers often pass their immunities to newborn young through the placenta and colostrum. The placenta is the organ that unites a fetus with the uterus and provides nourishment during fetal development. **Colostrum** is a substance full of antibodies that

is secreted with milk shortly after giving birth. The presence of colostrum quickly drops after the first few secretions. Therefore, it is important that the young animal nurses within the first few hours of birth to receive the antibodies from its mother.



FIGURE 2. A newborn goat nurses, receiving colostrum from its mother.

### **Antibiotics**

Pharmaceuticals generally prevent or reduce the growth of antigens. As you've already learned, an antibiotic is a medication that reduces or kills

antigenic microorganisms. Although antibiotics are created with pharmaceutical drugs, they generally come from a biological source. Penicillin, streptomycin, and terramycin are commonly used antibiotics. The overuse of antibiotics may result in pathogens becoming disease resistant. Therefore, to maintain their effectiveness, antibiotics should only be used when needed. When antibiotics are not an option, sulfonamides can be used.

### **Sulfonamides**

Sulfonamides or sulfa drugs are the oldest drugs in use. A **sulfonamide** is an antibacterial pharmaceutical created from sulfonic acid. Not only are they inexpensive, but they are also effective in treating common bacterial issues (such as a urinary tract infection).

### **Pesticides**

Pesticides (insecticides, miticides, and dewormers) are used on internal and external parasites, and animals should be carefully monitored after their use. Dewormers are also called anthelmintics.

Anthelmintics are a class of pesticides that target internal parasites. Internal parasites can live in an animal's digestive system, robbing the animal of the nutritional value of its feed, causing sickness, and limiting growth. Another internal parasite would be a heartworm, which infests the valves of the heart and

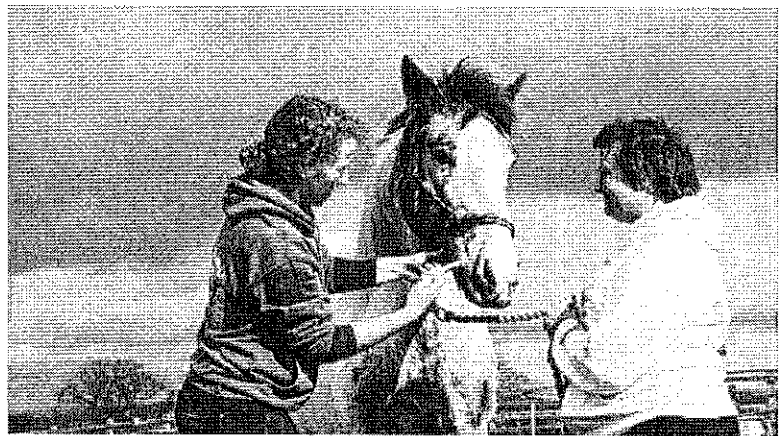


FIGURE 3. This horse is receiving a routine dewormer.



suppresses its functions. External parasites are found on the skin and body of an animal. Generally, they are treated with miticides.

## HEALTH MAINTENANCE

The maintenance of an animal's health is important. Checking vital signs, castration, docking, dehorning, and descenting are all factors of health maintenance.

### Vital Signs

The vital signs are temperature, respiration rate, and pulse. Changes in vital signs can signal distress from an unseen injury or disease.



**FIGURE 4.** This cat shows clinical signs of sarcoptic mange on its face and ears. Sarcoptic mange (scabies) is a contagious disease caused by mites. Scabies can affect animals and people.

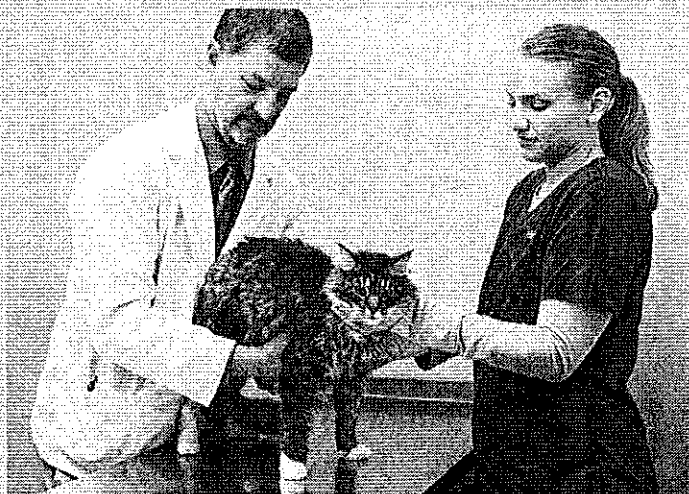


## On the Job... CAREER CONNECTION

### Veterinary Technician

A veterinary technician works under the direction of a veterinarian. He or she assists the veterinarian in restraining animals, preparing the surgery suite, sanitizing instruments and facilities, monitoring vital signs during surgery, caring for animals in recovery, overseeing the veterinary pharmacy, and taking radiographs. The veterinary technician may also greet patients and relay instructions from the veterinarian.

Veterinary technicians are often qualified with a two-year college degree (AAS) or a four-year degree (BS). Potential employers include veterinary hospitals, clinics, colleges, zoological parks, and laboratories. Go to <https://www.youtube.com/watch?v=-rBdnfXzZEw> to see a day in the life of a vet tech.



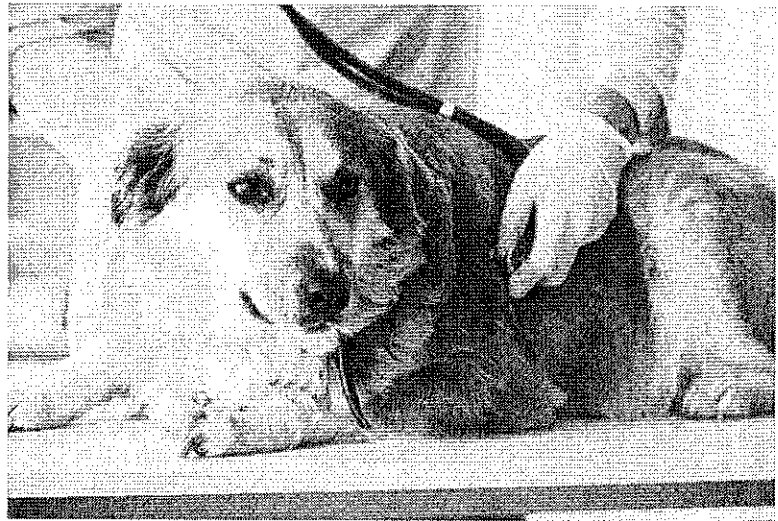
### **Temperature**

An animal's temperature is important in indicating the presence of an infection, and it can be measured with a thermometer. Traditionally, a rectal thermometer has been used for an accurate reading; however, newer infrared thermometers now allow no contact.

When using a rectal thermometer, insert the thermometer  $1\frac{1}{2}$  to 2 inches into the rectum for one minute. Unhealthy animals, like humans, will run a high temperature if they are fighting an illness. **Hyperthermia** is a dangerously high temperature, while **hypothermia** is a dangerously low temperature. Always check with a veterinarian if temperature readings are above or below normal standards.

### **Respiration Rates**

A **respiration rate** is a measure of inhaled and exhaled breaths within one minute. To calculate a respiration rate, count the number of breaths in 15 seconds, and multiply that number by 4. Respiration rates will decrease as an animal's size increases. Rapid and shallow breathing or extremely slow respiration is a sign of an unhealthy animal. Respiration can also be monitored by holding a stethoscope to the animal's chest and listening to its lung sounds. A **stethoscope** is an instrument that enables internal body sounds to be heard.



**FIGURE 5.** A veterinarian is using a stethoscope to listen to internal body sounds.

### **Pulse Rates**

Heart rates are important factors in animal health. The **pulse** is the rhythmic expansion of blood through an artery. A pulse can be felt with a finger, generally on the surface of large arteries, like those at the neck or "wrist." The pulse correlates with the animal's heart rate (the rapidity of a heartbeat). A heart rate is commonly determined by counting the number of heartbeats per minute. It is essential to keep accurate time and count.

| TABLE 1. The Location of the Pulse on a Variety of Livestock |   |
|--|---|
| Animal   | Pulse Location  |
| Cattle   | <ul style="list-style-type: none"> <li>• Outside of the jaw</li> <li>• The soft place above inner dewclaw</li> <li>• Just above hock joint</li> </ul>                           |
| Sheep, goats, and pigs                                       | <ul style="list-style-type: none"> <li>• The inside of the thigh, where the femoral artery lies closest to skin</li> </ul>  |
| Horses   | <ul style="list-style-type: none"> <li>• At the margin of the jaw, where an artery winds around from the inner side</li> <li>• Inside of elbow</li> <li>• Under tail</li> </ul> |

To find the pulse rate of a dog, feel the caudal and dorsal sides of the elbow while it is standing. **Caudal** is the direction toward a tail or rear of a body, and **dorsal** is the direction toward the upper side or back of a body. The pulse can also be felt on the inside of the dog's thigh, about level with the knee. Count the number of beats in one minute. This is the dog's resting pulse, or heart rate. The pulse happens at the same rate as the beating of the heart, because the heart is pumping the body's blood supply. As more blood is pumped, the arteries expand, and blood is cycled back to the heart. The sound of a heart-beat is caused by the opening and closing of the valves of the heart. Because the heart is a muscle that contracts, considerable force is involved in closing the valves. Two valves separate the chambers of the heart and give off the "lub-dub" sound (heard with a stethoscope).

It is important to know that pulse rates will be higher in young, small, and nervous animals. Pulse rates will also increase with exercise, excitement, digestion, and high temperatures.

| TABLE 2. Normal Vital Signs for Various Animals |                    |      |                  |            |
|---|--------------------|------|------------------|------------|
| Animal  | Rectal Temperature |      | Respiration Rate | Pulse Rate |
|   | °F                 | °C   |                  |            |
| Cattle  | 101.5              | 38.6 | 30               | 50         |
| Sheep   | 102.3              | 39.1 | 19               | 75         |
| Swine   | 102.5              | 39.2 | 16               | 60         |
| Horses  | 100.0              | 37.8 | 12               | 45         |
| Goats   | 102.3              | 39.1 | 15               | 80         |
| Chickens  | 107.1              | 41.7 | 25               | 275        |
| Dogs  | 102.0              | 38.9 | 22               | 100        |

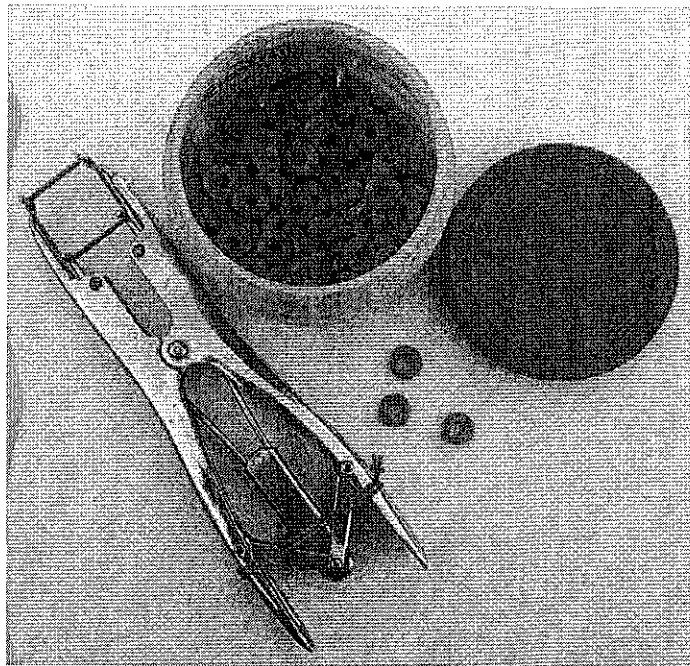
## Castration

**Castration** is the removal or destruction of testicles. This procedure is to end the breeding abilities of male animals. Castration is an approved practice in animals bred for meat production. Castrated males grow at a faster rate than other males, and they produce lean, high-quality meat. Generally, these animals are more feed efficient, less aggressive, and easier to handle than intact males. Castrating should be done when animals are young, because the procedure is less stressful on them. Young animals are easier to restrain, and success is assured by keeping stress at a minimum.

Castration methods involve the use of a scalpel or sharp knife, a ring (elastator), or a clamp.

- ▶ The use of a scalpel (or a sharp knife) involves making an incision in the scrotum and physically removing the testicles.
- ▶ Elastration can be utilized by placing a small, elastic ring on the scrotum (well above the testicles) to cut off the blood circulation. As a result, the lower part of the scrotum containing the testicles falls off after a couple of weeks.
- ▶ A clamp can be used to pinch blood vessels that lead to the testicles on young males. This cuts off blood flow, so the testicles shrink and never mature.

The animals should be kept under observation after castration for several days. Any change in vital signs or appearance could be an indication of a complication.



**FIGURE 6.** This picture shows the elastic bands for elastration. The specialized pliers stretch the bands, allowing space for the testicles to be pushed through. Then, the band is released. (Courtesy of Cgoodwin. Licensing at <https://creativecommons.org/licenses/by-sa/3.0/deed.en>.)

## Docking

Docking is commonly practiced on piglets and lambs. **Docking** is the removal of an animal's tail. Docking may appear to be harsh; however, it is a management technique that is widely accepted in pigs to prevent tail biting—a common problem in confinement. The tails of lambs are docked to prevent the buildup of feces and the contamination of wool. Lambs should be docked before 14 days of age, and piglets should be docked within the first few days of birth. Docking involves the use of an elastator or a clamp.

## Dehorning

Dehorning cattle, goats, and sheep is a common measure for livestock owners. This ensures that the animals do not hurt each other, themselves, or humans. **Dehorning** is the removal of horns or the prevention of horn development.

Dehorning is done in older cattle with hot dehorning irons or a mechanical device (a Barnes dehorner). In young livestock, a caustic paste can be used to prevent the development of horns. Prior to removing horns from an animal, you need the proper knowledge and equipment. Also, you should consult with your local veterinarian. When possible, dehorning should be done at an early age.

An alternative to dehorning is to select breeds that do not develop horns, such as polled (hornless) Herefords and Black Angus cattle.



**FIGURE 7.** Polled Herefords are a type of breed that are horn polled (hornless).

## Descending

Some species of livestock develop glands that release undesirable odors. Descending is the removal of these glands. Amongst the livestock species, goats are the most likely to have these scent glands removed. A male buck can sometimes have a musty, offensive odor that emanates from glands at the top of their head.

Descending should be done at an early age, and can be done alongside dehorning. The goat's scent glands are located behind the horns and toward the middle of the head. When the area is shaved, the yellow scent glands are easy to see. They can be destroyed with the same hot iron used for the dehorning process. It can be difficult to remove all of the scent glands, and the assistance of a trained professional is preferable.



## Summary:

Animal keepers should use appropriate practices to maintain good animal health. Proper strategies for health management can improve an animal's ability to produce and provide for an animal's overall well-being. Strategies for maintaining animal health relate to environmental conditions, sanitation, biosecurity, nutrition, vaccinations, medications, and overall maintenance. These strategies may be useful in controlling, treating, and preventing disease.

The maintenance of an animal's health is important. Checking vital signs, castration, docking, dehorning, and descending are all vital parts of health maintenance.



## Expanding Your Knowledge:

Research biosecurity as it relates to livestock production. Why is it important that livestock producers limit the people who come onto their farms? How is livestock biosecurity related to homeland security? The Australian government has done multiple studies on biosecurity. Go to <https://nifa.usda.gov/program/animal-plant-biosecurity> for the USDA's information on biosecurity. Talk with your instructor about leading a class discussion on your findings.



## Checking Your Knowledge:

### ■ Part One: Matching

*Instructions:* Match the word with the correct definition.

- |                |                |
|----------------|----------------|
| a. docking     | f. rickets     |
| b. biosecurity | g. immunity    |
| c. colostrum   | h. sulfonamide |
| d. dorsal      | i. castration  |
| e. pulse       | j. vaccine     |

- \_\_\_\_\_ 1. a substance full of antibodies that is secreted with milk shortly after giving birth
- \_\_\_\_\_ 2. the rhythmic expansion of blood through an artery
- \_\_\_\_\_ 3. the removal or destruction of testicles
- \_\_\_\_\_ 4. the ability of an animal to resist a disease
- \_\_\_\_\_ 5. the removal of an animal's tail
- \_\_\_\_\_ 6. a prepared substance that utilizes a weakened version of a disease to stimulate the production of antibodies within the recipient
- \_\_\_\_\_ 7. a set of procedures for protection against harmful biological or biochemical agents
- \_\_\_\_\_ 8. the direction toward the upper side or back of a body
- \_\_\_\_\_ 9. a bone disease caused by a vitamin D deficiency
- \_\_\_\_\_ 10. an antibacterial pharmaceutical created from sulfonic acid

## ■ Part Two: Completion

*Instructions:* Complete the following statements.

1. \_\_\_\_\_ is the removal of horns or the prevention of horn development.
2. The \_\_\_\_\_ is the measure of inhaled and exhaled air within one minute.
3. A/an \_\_\_\_\_ is a synthetically manufactured medication.
4. \_\_\_\_\_ an environment will kill (or prevent the development of) disease-causing bacteria and viruses.
5. A/an \_\_\_\_\_ is a medication that reduces or kills antigenic microorganisms.
6. The \_\_\_\_\_ is the organ that unites a fetus with the uterus and provides nourishment through development.
7. A/an \_\_\_\_\_ is a cleaning substance that destroys the microbial causes of disease.
8. \_\_\_\_\_ is the direction toward a tail or rear of a body.
9. \_\_\_\_\_ is a method of castration that can be utilized by placing a small, elastic ring on the scrotum to cut off the blood circulation.
10. \_\_\_\_\_ is a dangerously high body temperature.

## ■ Part Three: True/False

*Instructions:* Write *T* for true or *F* for false.

- \_\_\_\_\_ 1. The vital signs are temperature, respiration rate, and pulse.
- \_\_\_\_\_ 2. Descending is a common practice with cattle.
- \_\_\_\_\_ 3. Four valves separate the chambers of the heart and give off the "lub-dub" sound that can be heard with a stethoscope.
- \_\_\_\_\_ 4. Docking involves the use of an elastrator or a clamp.
- \_\_\_\_\_ 5. The pulse correlates with the animal's heart rate.
- \_\_\_\_\_ 6. Good ventilation is necessary in areas of confinement.
- \_\_\_\_\_ 7. Dewormers are commonly called sulfonamides.

Part One: Matching Instructions: Match the word with the correct definition. a. larynx (voice box)  
d. bronchus b. expiration (exhalation) e. inspiration (inhalation) c. diaphragm f. trachea  
(windpipe)

- \_\_\_\_\_ 1. the movement of air into the lungs
- \_\_\_\_\_ 2. the tube air travels through, from the throat to the lungs
- \_\_\_\_\_ 3. a dome-like, thin muscle that separates the thoracic cavity and abdomen
- \_\_\_\_\_ 4. a large air passage that connects the trachea to the lungs
- \_\_\_\_\_ 5. the exiting of air from the lungs
- \_\_\_\_\_ 6. an organ made of cartilage that utilizes air traveling through its vocal cords to create sound

Instructions: Write T for true or F for false.

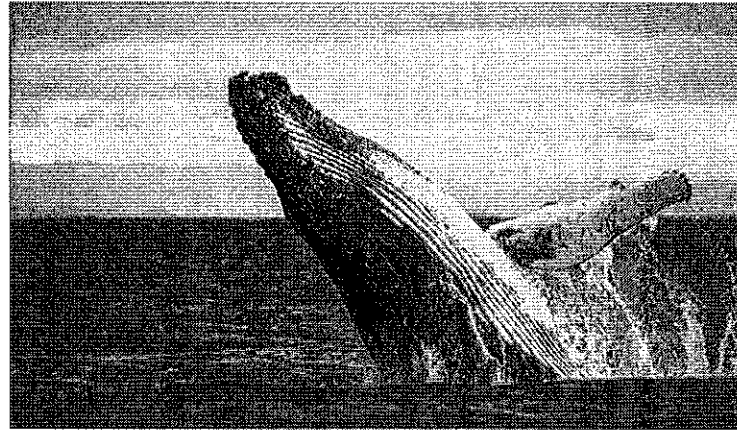
- \_\_\_\_\_ 1. Air moves out of the lungs through inspiration.
- \_\_\_\_\_ 2. Air entering the lungs mixes with used air remaining in the lungs.
- \_\_\_\_\_ 3. Diffusion is responsible for the movement of oxygen into cells and CO<sub>2</sub> out of cells.
- \_\_\_\_\_ 4. Air moves into the lungs through expiration.
- \_\_\_\_\_ 5. Cellular respiration is a form of internal respiration.
- \_\_\_\_\_ 6. The trachea and the larynx only open at certain times to allow for breathing.



# E-UNIT A1-7

# Respiratory System Structures

Most of us know how the lungs work. We understand that they are essential to breathing. Mammals have lungs that take in air full of oxygen and then release air full of carbon-dioxide waste. This process usually happens within seconds, but there are exceptions. In the animal world, there are whales that can hold their breath from 90 to 120 minutes!



## Objective:

Explain the structures of the respiratory system in mammals.



## Key Terms:

|                         |                          |                         |
|-------------------------|--------------------------|-------------------------|
| alveolus                | external respiration     | pharynx (throat)        |
| bronchus                | glottis                  | respiration             |
| bronchiole              | inspiration (inhalation) | respiratory system      |
| diaphragm               | internal respiration     | tidal ventilation       |
| diffusion               | larynx (voice box)       | trachea (windpipe)      |
| expiration (exhalation) | lungs                    | ventilation (breathing) |

## The Animal's Respiratory System

The **respiratory system** is a system of organs responsible for gas exchanges, specifically oxygen and carbon dioxide. **Respiration** is the chemical process of gases being exchanged within cells, like oxygen and carbon dioxide. **Ventilation (breathing)** is the physical exchange of air in and out of the lungs. Breathing happens when air is inhaled

and exhaled. The movement of air into the lungs is **inspiration (inhalation)**, and the exiting of air from the lungs is **expiration (exhalation)**.

## RESPIRATORY SYSTEM STRUCTURES

The animal's respiratory system includes many structures that conduct air in a continuous pathway to and from the lungs. Breathing starts with nasal passages and the mouth.

Most mammals have a hard and soft palate (roof of the mouth) that are similar to those found humans. These palates separate the nasal cavity from the oral cavity.



FIGURE 1. Breathing starts with nasal passages and the mouth.

### Pharynx

The **pharynx (throat)** is a membrane-lined cavity behind the nose and mouth that connects to the top of the esophagus. This is where air and food passages (or paths) cross each other (except in horses).

### Larynx

The **larynx (voice box)** is an organ made of cartilage that utilizes air traveling through its vocal cords to create sound. The larynx is at the top of the trachea and is made up of different parts, including the glottis and vocal folds.

- ▶ As air passes from the pharynx, it moves through the **glottis** (the vocal apparatus of the larynx).
- ▶ Near the edges of the glottis are folds of connective tissue and cartilage that are covered by mucous membranes. These are called vocal folds (a.k.a. vocal cords). The vocal cords are flexible, pliable bands that vibrate with air flow. The vibrations of vocal folds allow an animal to make a noise, such as a whine or growl.

### Trachea, Bronchi, and Bronchioles

The **trachea (windpipe)** is the tube air travels through, from the throat to the lungs. The trachea and the larynx stay open to receive air at all times. The trachea eventually divides into two bronchi that lead to the right and left lungs. A **bronchus** is a large air passage that connects the trachea to the lungs. Bronchi break down into multiple, smaller passages called bronchioles. A **bronchiole** is a small passage branched from a bronchus. Each bronchiole ends in an elongated space which contains alveoli.

COONBAAA 4-22-#1

## Alveoli

An **alveolus** is a tiny air sac in the lungs. There are millions of alveoli in the lungs. Their walls are extremely thin and are surrounded by a film of fluid. This fluid is composed of proteins, polysaccharides, and phospholipids. Outside the alveoli are numerous capillaries. Alveoli allow gas exchange to occur in the blood found in capillaries. The alveoli inflate with air and oxygen moves into the capillaries. This allows oxygenated blood to travel to the heart and other parts of the body.

## Lungs

In a mammal's respiratory system, the lungs are the primary set of organs. The **lungs** are a pair of sac-like organs used for breathing. The lungs are located in an animal's chest

# CAT RESPIRATORY SYSTEM

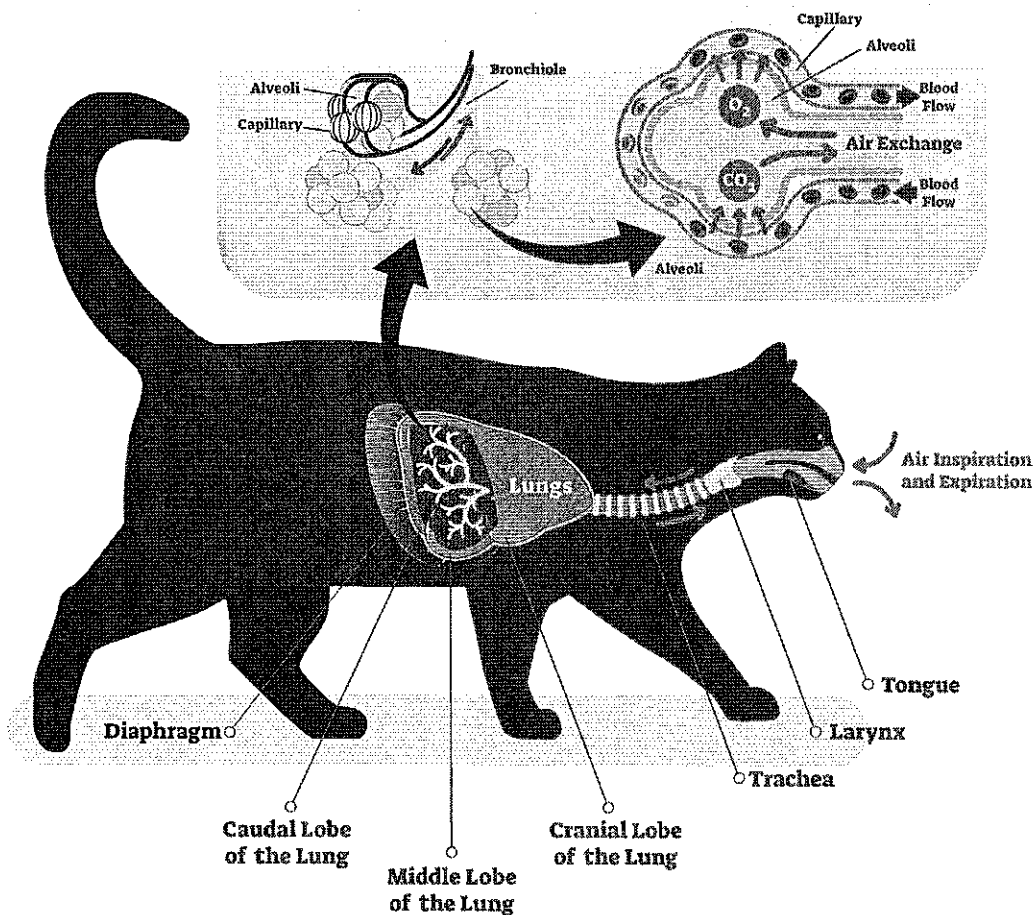


FIGURE 2. A cat's respiratory system labeled with structural terms.

BSAA COON 4-27 #2

region, one on each side. They are elastic, meaning they are able to fill with oxygen during inhalation and deflate during exhalation. They lie deep in the thoracic cavity (beneath the rib cage) where they are protected. This location also allows for constant blood flow, allowing them to pass oxygen into the bloodstream quickly and not dry out. As air is taken in (through the nose and mouth) and travels to the lungs, it is filtered from debris, warmed, and humidified.

## Diaphragm

Mammals ventilate their lungs by moving air in and out through the nasal area, mouth, or both, but other body parts assist in breathing. The **diaphragm** is a dome-like, thin muscle that separates the thoracic cavity and abdomen. The diaphragm contracts and releases, moving the rib cage up and out. This allows for ventilation. Intercostal muscles (muscles located between the ribs) also help enlarge the chest cavity. When the animal is expiring, the diaphragm relaxes and moves upward into the chest cavity. The intercostal muscles between the ribs also relax to reduce the space in the chest cavity.

## RESPIRATORY PROCESSES

As you learned earlier, respiration is an exchange of gases at a cellular level. This can be further broken down into external and internal respiration. **External respiration** is the processing of gas exchanges involving air, oxygen and carbon dioxide. In this phase, oxygen is taken in and carbon dioxide is released. Blood takes in the oxygen and transports it from the lungs to the tissues for internal respiration. **Internal respiration** is the processing of gases within the cells at a metabolic level. Cellular respiration would be an internal respiration.

## Tidal Ventilation

During respiration, mammals use a mechanism called tidal ventilation. **Tidal ventilation** is a ventilation system in which air flows into the alveoli, gases are exchanged, and then air is pumped back out. To keep lungs partially inflated, not all of the air is pumped out. Essentially, this means that the air entering the lungs mixes with the used air remaining in the lungs. The amount of remaining air versus new air contributes to gas-exchange efficiency.

## Diffusion

Through diffusion, gases move in and out of blood vessels. This occurs in the animal's lungs, capillaries, and tissues. **Diffusion** is the movement of a molecule toward a more open space. Diffusion occurs when the concentration of

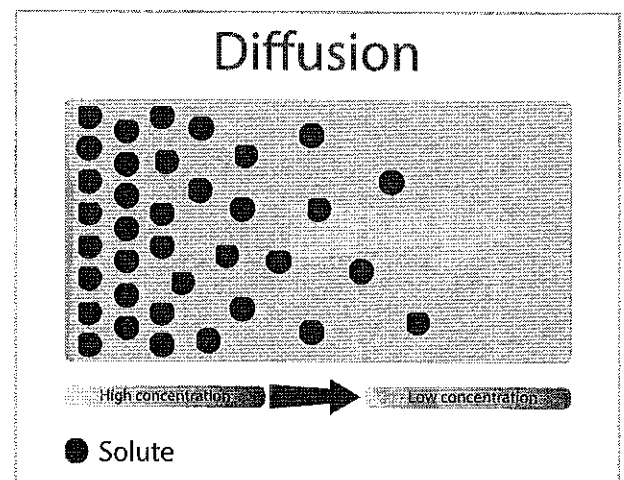
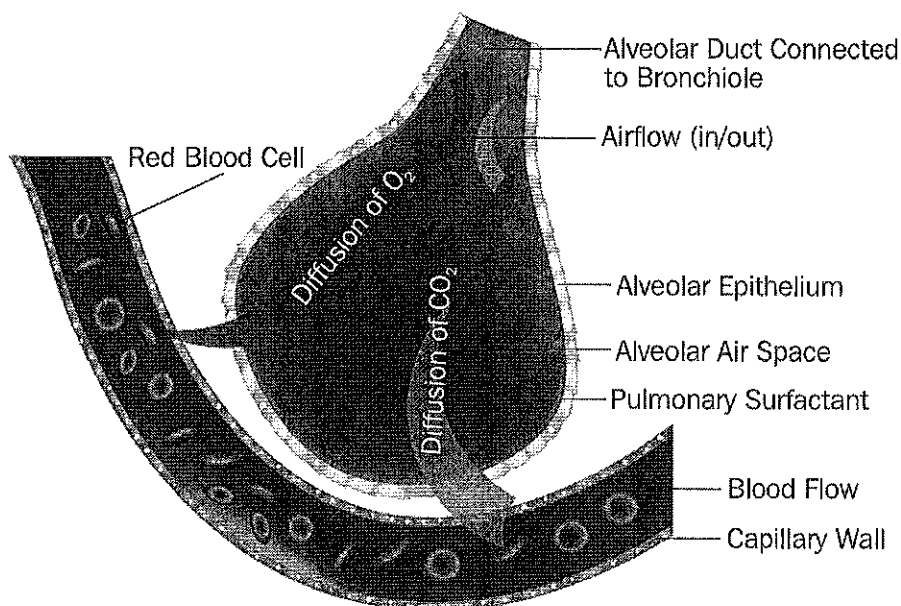


FIGURE 3. Diffusion diagram.

## GAS EXCHANGE WITHIN ALVEOLI



**FIGURE 4.** Diffusion allows for gas exchange within alveoli.

molecules outside a cell is greater than the concentration of molecules inside that cell. In respiration, gases are the molecules moving in and out of cells. Diffusion is relevant, because oxygen and carbon dioxide (CO<sub>2</sub>) are often highly concentrated on either side of a cell's membrane. They must be exchanged so that oxygen is taken in and CO<sub>2</sub> is let out.

### Cellular Respiration

The exchange of CO<sub>2</sub> leaving cells and oxygen entering cells allows for cellular respiration. Cellular respiration is the process of cells creating energy from food. This occurs through a set of metabolic reactions and processes whereby living cells extract energy (ATP) from organic (carbon-based) molecules for use in cellular activities that require energy. In cellular respiration, oxygen is used in several of the processes to release energy from the carbon-based molecules that are bound with hydrogen. As the oxygen is used, it eventually bonds with leftover hydrogen to form water molecules (H<sub>2</sub>O) or with carbon to be released as CO<sub>2</sub>. The body can utilize the H<sub>2</sub>O, but the CO<sub>2</sub> is waste that must be expelled. As new oxygen molecules enter the cell, the CO<sub>2</sub> molecules exit, allowing for the process to begin again.

## VENTILATION AND RESPIRATION SYSTEMS OF DIFFERENT ANIMALS

While all animals breathe in air that contains oxygen and exchange it with CO<sub>2</sub>, there are some physiological differences regarding how they take air in. Since most livestock

COON BSA 4-27 #1

live their lives in either close quarters or outdoor environments, proper care should be taken to prevent respiratory diseases.

## **Poultry**

Birds do not have noses. They do have nostrils (with a nasal chamber) in the upper mandible that open and allow air to pass into the mouth. From there, the air moves into the pharynx, the trachea, and eventually the lungs. At the base of the trachea is a structure called the syrinx. This is a lower larynx that allows a bird to make sounds such as chirping, cackling, and crowing.

Birds also have bronchi that branch out in a similar manner to other nonfeathered animals. While they do not have alveoli, they do have small air sacs that extend out from the bronchi and extend into their bones. In addition, there are capillaries in their lungs in which air and gas circulate, allowing for gas exchange to occur. Interestingly, most poultry do not have a diaphragm. Their breathing is aided through muscles in their chest. For example, when a chicken flaps its wings, it is most likely to aid the breathing process.

There are many avian respiratory diseases, including avian influenza (bird flu), mycoplasma, infectious sinusitis, and chronic respiratory disease. Once diagnosed, it is imperative that these animals are isolated so that they may be observed and treated by a veterinarian. Cleanliness of their environment, fresh water and food, and proper air circulation are essential maintenance practices to keep avian respiratory systems healthy.

## **Swine**

Pigs breathe and have respiratory systems that closely resemble those of humans. Their breathing rate (per minute) is also extremely close to humans. As a human, you should have a respiratory rate of 12 to 18 breaths per minute. Pigs are about the same. [NOTE: Older numbers were somewhere in the 8 to 20 bpm range, but modern humans (and pigs) average about 15 bpm.] Like humans, pigs are omnivores who breathe through their snout or mouth.

Today, many pigs are kept in confinement systems, so they live in close proximity to each other. Some confinement systems might find 100 to 500 pigs being raised together. These pigs have a lot of close contact with each other's breathing and waste, so circulation of fresh air must be maintained at all times. Sanitation, clean water, and proper light sources are also essential in keeping swine at optimal health.

Respiratory diseases, such as swine respiratory disease (SRD), influenza, and atrophic rhinitis, can be major problems for your pigs being raised as livestock.

## **Ruminants and Pseudo-ruminants**

Ruminant animals, such as cattle, sheep, and goats, and pseudo-ruminants, such as llamas or alpacas, follow the same breathing and respiratory system as other mammals. Major physiological differences are the sizes of the lungs, bronchi, and alveoli of each species.



These livestock animals are prone to contracting respiratory diseases that can be fatal if not managed properly. Keeping ruminants and pseudo-ruminants in good living environments, dewormed, and up-to-date on all vaccinations will contribute to lower developments of respiratory diseases.

### Horses

Horses, as well as other equines (donkeys and zebras), can only breathe through their nostrils. This is due to a soft palate that blocks the pharynx. Once air reaches the trachea from the nasal passage, it moves through the respiratory system similarly to other mammals.

Horses are prone to many respiratory diseases and should be monitored accordingly. Keeping vaccinations current, providing clean living areas, supplying fresh water, and providing proper nutrients are all excellent strategies to keep your equine healthy.

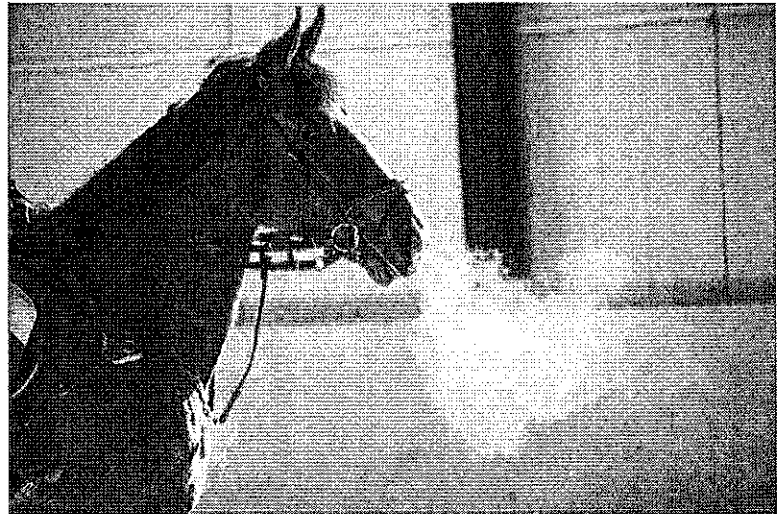


FIGURE 5. Horses can only breathe through their nostrils.

### Dogs and Cats

Dogs and cats breathe primarily through their nostrils; however, dogs will sometimes pant to cool off (i.e.,



## Further Exploration... ONLINE CONNECTION

### Respiratory Patterns and Diseases

It is interesting to learn about animals and how they breathe. Being aware of normal breathing rates or patterns can help you when caring for an animal. Have you ever had a dog or cat breathe heavily? Pant too much? Cough?

On dvm360, Bernie Hansen wrote an article, "Making Sense of Respiratory Patterns," that touches on breathing patterns and the diseases associated with them. Go to <http://veterinarycalendar.dvm360.com/making-sense-respiratory-patterns-proceedings?id=&pageID=1&sk=&date=>, and read about the breathing patterns of your dog or cat.



Dogs pant to release excess heat, but what if they can't stop panting?

COON

BSAA 4-27 # 2

breathe through their mouths). Generally, cats only pant when they are in respiratory distress.

Dogs and cats need proper living conditions to fight the problems of respiratory diseases. Proper sanitation, clean water, and nutritious food are essential for good health. Keeping up-to-date on all vaccinations is vital in fighting many respiratory diseases.



## Summary:

The respiratory system is a system of organs responsible for gas exchanges, specifically oxygen and carbon dioxide. Respiration is the chemical process of gases being exchanged within cells, like oxygen and carbon dioxide. Ventilation (breathing) is the physical exchange of air in and out of the lungs. Breathing happens when air is inhaled and exhaled. The movement of air into the lungs is inspiration (inhalation), and the exiting of air from the lungs is expiration (exhalation). In a mammal's respiratory system, the lungs are the primary set of organs.

Respiration is an exchange of gases at a cellular level. This can be further broken down into external and internal respiration. External respiration is the processing of gas exchanges involving air, oxygen and carbon dioxide. In this phase, oxygen is taken in and carbon dioxide is released. Blood takes in the oxygen and transports it from the lungs to the tissues for internal respiration. Internal respiration is the processing of gases within the cells at a metabolic level. Cellular respiration would be an internal respiration.

While all animals breathe in air that contains oxygen and exchange it with carbon dioxide, there are some physiological differences regarding how they take air in. Since most livestock live their lives in either close quarters or outdoor environments, proper care should be taken to prevent respiratory diseases.



## Expanding Your Knowledge:

To review and widen your knowledge of the respiratory system, watch the Crash Course videos, "Respiratory System, Part 1" and "Respiratory System, Part 2," on YouTube at <https://www.youtube.com/watch?v=bHZsvBdUCzI> and <https://www.youtube.com/watch?v=Cqt4LjHnMEA>.



COON  
BSEA 4-27 #2



## Checking Your Knowledge:

### ■ Part One: Matching

*Instructions:* Match the word with the correct definition.

- |                            |                             |
|----------------------------|-----------------------------|
| a. larynx (voice box)      | d. bronchus                 |
| b. expiration (exhalation) | e. inspiration (inhalation) |
| c. diaphragm               | f. trachea (windpipe)       |

- \_\_\_\_\_ 1. the movement of air into the lungs
- \_\_\_\_\_ 2. the tube air travels through, from the throat to the lungs
- \_\_\_\_\_ 3. a dome-like, thin muscle that separates the thoracic cavity and abdomen
- \_\_\_\_\_ 4. a large air passage that connects the trachea to the lungs
- \_\_\_\_\_ 5. the exiting of air from the lungs
- \_\_\_\_\_ 6. an organ made of cartilage that utilizes air traveling through its vocal cords to create sound

### ■ Part Two: Completion

*Instructions:* Complete the following statements.

- 1. \_\_\_\_\_ occurs when the concentration of molecules outside a cell is greater than the concentration of molecules inside that cell.
- 2. \_\_\_\_\_ allow gas exchange to occur in the blood found in capillaries.
- 3. The \_\_\_\_\_ is a membrane-lined cavity behind the nose and mouth that connects to the top of the esophagus.
- 4. As air is taken in (through the nose and mouth) and travels to the \_\_\_\_\_, it is filtered from debris, warmed, and humidified.
- 5. The \_\_\_\_\_ is the vocal apparatus of the larynx.
- 6. \_\_\_\_\_ is the physical exchange of air in and out of the lungs.
- 7. The vibrations of \_\_\_\_\_ allow an animal to make a noise, such as a whine or a growl.
- 8. A/an \_\_\_\_\_ is a small passage branched from a bronchus.

CDN

BSAA

427 H2

### ■ Part Three: True/False

*Instructions:* Write *T* for true or *F* for false.

- \_\_\_\_\_ 1. Air moves out of the lungs through inspiration.
- \_\_\_\_\_ 2. Air entering the lungs mixes with used air remaining in the lungs.
- \_\_\_\_\_ 3. Diffusion is responsible for the movement of oxygen into cells and CO<sub>2</sub> out of cells.
- \_\_\_\_\_ 4. Air moves into the lungs through expiration.
- \_\_\_\_\_ 5. Cellular respiration is a form of internal respiration.
- \_\_\_\_\_ 6. The trachea and the larynx only open at certain times to allow for breathing.

*option 3*

Matching Instructions: Match the word with the correct definition.

- a. adaptation   f. genetic diversity   b. breed   g. inbreeding   c. artificial selection  
h. natural selection   d. Evolution   i. outbreeding   e. gene pool   j. purebred

\_\_\_\_\_ 1. the survival process in which better-adapted individuals are more likely to make it to a reproductive age than less-fit individuals

\_\_\_\_\_ 2. the ability of any organism to adjust or change its physiology or structure to become more suited to their environment

\_\_\_\_\_ 3. a group of animals that, as a result of breeding and selection, have certain distinguishable characteristics

\_\_\_\_\_ 4. a collection of all the genes within a freely interbreeding population

\_\_\_\_\_ 5. the variety of genes within a species

\_\_\_\_\_ 6. the cumulative, genetic change in a population of organisms from generation to generation

\_\_\_\_\_ 7. the mating of genetically similar (related) individuals

\_\_\_\_\_ 8. the practice of intentionally breeding animals (or other organisms) with one or more desirable traits to produce offspring with similar desirable or improved traits

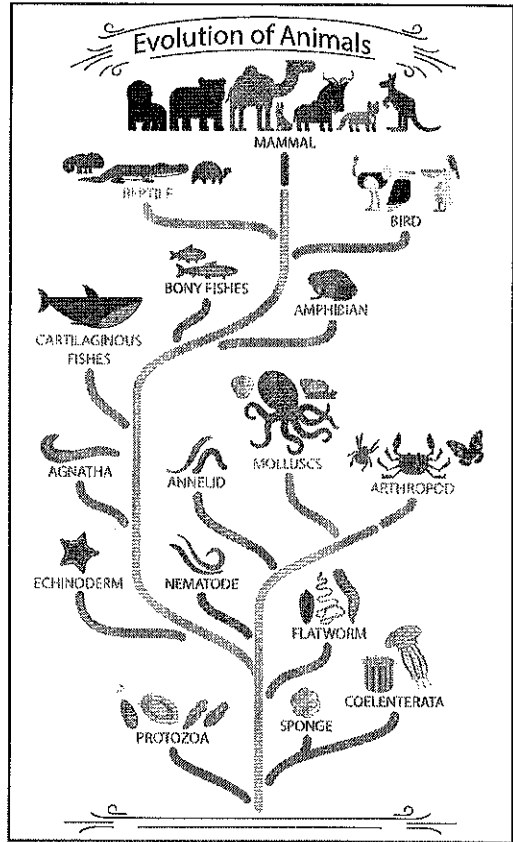
\_\_\_\_\_ 9. an animal whose parental lineage (on both sides) is from members of a recognized breed

\_\_\_\_\_ 10. the mating of unrelated individuals

**E-UNIT  
B1-3**

# Evolution and Animal Domestication

The theory of evolution has sparked debate since it was first presented by Charles Darwin in 1858. This debate, often very spirited, has taken place on political, theological, and cultural levels. This unit offers scientific insight into the mechanisms behind evolution and the evolution that led to the domestication of animals.



**Objective:**

Explain the mechanisms for biological evolution and how evolution applies to animal domestication.



**Key Terms:**

adaptation  
analogous structure  
artificial selection  
(selective breeding)  
breed  
comparative anatomy  
convergent evolution  
crossbreeding

domestication  
evolution  
gene pool  
genetic diversity  
homologous structure  
hybrid vigor (heterosis)  
inbreeding  
inbreeding depression

interspecific  
hybridization  
natural selection  
outbreeding  
outcrossing  
purebred  
taming

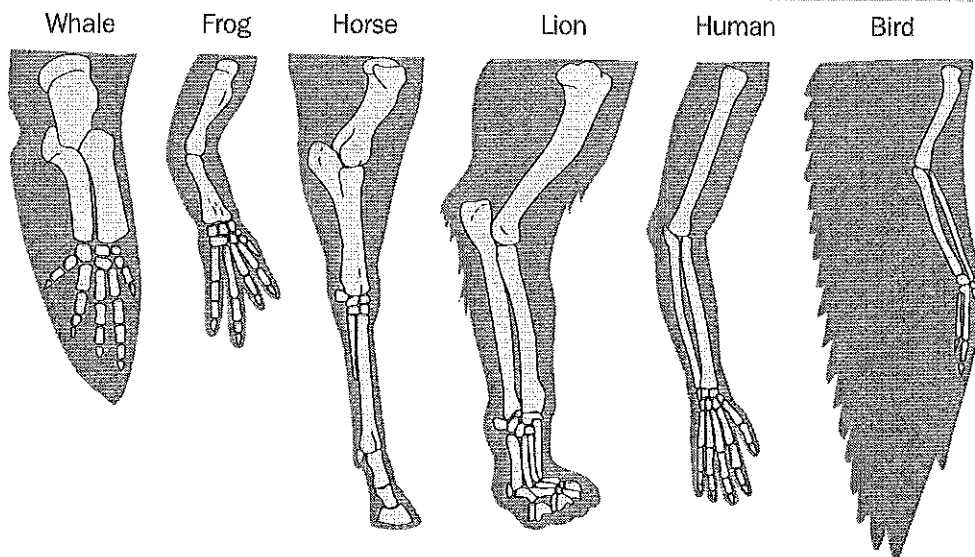
# The Genetics of Evolution and Animal Breeding

In a biological sense, **evolution** is the cumulative, genetic change in a population of organisms from generation to generation. Charles Darwin expressed evolution as “descent with modification.”

Evolution is both a theory and a fact. Unlike the meaning of the word theory in everyday conversation, in science, theory refers to an explanation of some aspect of nature that is supported by a vast body of evidence. The theory of evolution is based on overwhelming evidence from observations and confirming experiments. Scientists can state, with confidence, that no new evidence will surface to change the concepts of the theory. Evolution is a fact, because the evidence supporting it is so great that its occurrence is no longer in doubt (in the scientific community).

One of the greatest forms of evidence in support of evolution is comparative anatomy. **Comparative anatomy** is the comparison of the structural similarities of organisms to determine their evolutionary relationships. Organisms with more-similar anatomical features are more closely related than organisms with less-similar structures. Those with similarities are assumed to share a common ancestor. Scientists study anatomical similarities and differences to classify organisms and to determine evolutionary lines. Two common concepts of comparative anatomy are homologous structures and analogous structures.

A **homologous structure** is a part of an organism which is similar in different species, because the species have common ancestry (but the similar part may or may not perform the same function). For instance, the bones of vertebrate species are an example. A horse’s leg and a chicken’s wing are homologous structures.



**FIGURE 1. Homologous structures.**

An **analogous structure** is a part of an organism that serves a similar function in different species, but the species have evolved separately (they do not share a common ancestor). Analogous structures are a result of convergent evolution. **Convergent evolution** is the independent evolution of similar structural or functional traits, resulting from an adaptation to similar environments. In other words, these traits evolved in a similar environment, rather than being inherited from a common ancestor. These structures usually serve the same, or similar, purposes. Examples of analogous structures are the wings of bats, insects, and birds (for flight). Additionally, it could be the fins of fish or wings of penguins (for swimming).

## NATURAL AND ARTIFICIAL SELECTION

The evolution of animals happens naturally or artificially. Within these two processes, certain principles are universally observed.

### Natural Selection: Mechanisms

Natural selection is the mechanism by which evolution proceeds. **Natural selection** is the survival process in which better-adapted individuals are more likely to make it to a reproductive age than less-fit individuals. These stronger individuals would then create more offspring and make a larger gene-pool contribution than those less fit. A **gene pool** is a collection of all the genes within a freely interbreeding population.

The mechanism of natural selection operates on four observations of the natural world.

- ▶ Each species produces more offspring than can be supported—not all will survive to maturity.
- ▶ Offspring vary from one another genetically.
- ▶ Organisms compete with one another for limited resources.
- ▶ Individuals that have the most-favorable combination of characteristics are most likely to survive and reproduce.

### Natural Selection: Adaptations for Survival

Through natural selection, different species have evolved mechanisms that better enable them to survive and to perpetuate the species. The ability of any organism to adjust or change its physiology or structure to become more suited to their environment is called **adaptation**. All species have adaptations for survival in certain ecosystems, whether it is in a rainforest, desert, arctic region, or temperate environment. An organism must have both functional and reproductive adaptations in order to ensure that its genes are passed on to the next generation. Adaptations can be anatomical, behavioral, or physiological.

### **Anatomical Adaptations**

Anatomical adaptations involve physical structures (or morphology) such as body size, fur, and teeth. Ruminants are able to acquire nutrients from plant-based food by fermenting it in a specialized stomach. This is accomplished prior to digestion, and, principally, it occurs through microbial actions. Cattle, sheep, goats, and bison are very successful herbivores because of this anatomical adaptation.



**FIGURE 2.** Sheep have the anatomical features that allow them to acquire nourishment from grass.

### **Behavioral Adaptations**

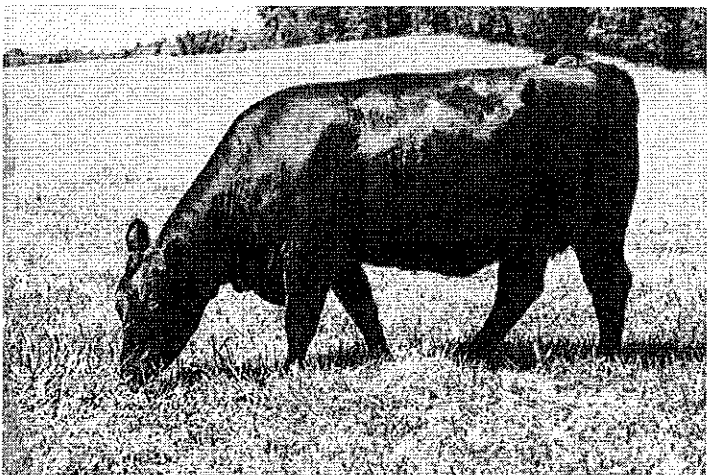
Behavioral adaptations can be inherited or learned. Chickens establish a pecking order to determine which chickens have first access to food, water, and dust-bathing areas. It also determines who gets the most comfortable nesting boxes and the best spots on the roosting bar. Sheep flock together, and cattle herd for safety. Caribou migrate hundreds of miles to reach birthing grounds. Whales will migrate thousands of miles to feed and breed.



**FIGURE 3.** The pecking order established in poultry is a behavioral adaptation.

### **Physiological Adaptations**

A physiological adaptation includes the ability to tolerate climatic conditions. For instance, tropical breeds of cattle (*Bos indicus*) evolved from domesticated Asian aurochs and adapted to hot, tropical climates. They are tolerant of intense heat, sun, and humidity. The Brahman breed (*Bos taurus*) is a tropical breed that evolved in Europe and in the Fertile Crescent



**FIGURE 4.** The Angus breed is adapted to temperate climates.

COON BSA 4-27 #3

(some are bred in the United States). The European beef-cattle breeds are adapted to temperate climates. Most breeds commonly found in the United States belong to this group (Angus, Charolais, Hereford, Simmental, Senepol, and dairy breeds).

## Artificial Selection

Understanding the mechanisms of evolution has helped in the development of agricultural animals through artificial selection. **Artificial selection (selective breeding)** is the practice of intentionally breeding animals (or other organisms) with one or more desirable traits to produce offspring with similar desirable or improved traits.

Artificial selection is the change of a domesticated species by human intervention, as opposed to the “natural environment.” The mechanisms of artificial and natural selection are essentially the same. However, with artificial selection, farmers or breeders choose the variants to be used in producing the succeeding generations. Modern breeds of pigs, sheep, and cattle are excellent examples of animals that have been altered through artificial selection.

## Artificial Versus Natural Selection

|                         | Natural Selection   | Artificial Selection   |
|-------------------------|---|--|
| <b>The Meaning:</b>     | The process in nature by which only the organisms that are best adapted to their environment tend to survive and reproduce, transmitting their genetic traits to the next generation. | Artificial selection is when humans act as the “environmental pressure” that shapes populations. |
| <b>Where It Occurs:</b> | Natural populations   | Domestic populations   |
| <b>Controlled by:</b>   | Nature  | Humans   |
| <b>Rate of Process:</b> | Slow  | Much faster  |
| <b>Produces:</b>        | Great biological diversity  | Varieties of organisms very different from native generations                                    |

## ANIMAL DOMESTICATION

**Domestication** is the process by which wild plants and animals are genetically modified over time for traits that are more advantageous or desirable for human use.

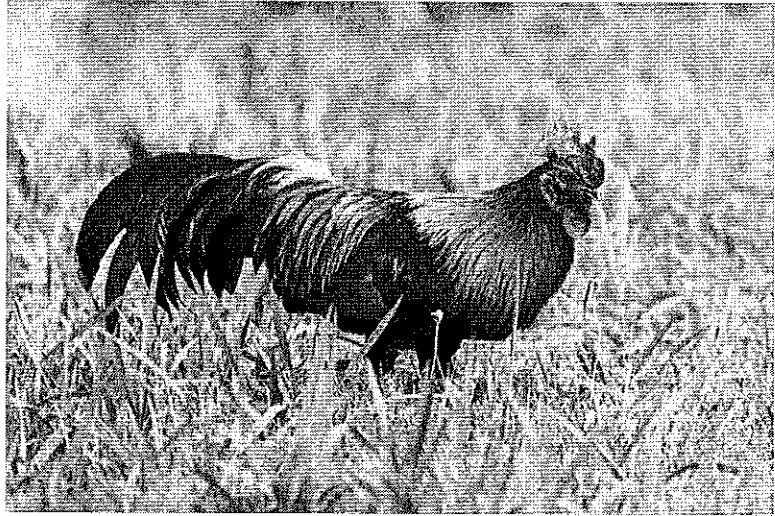
The domestication of plants and animals led to humans abandoning a nomadic lifestyle and forming urban communities thousands of years ago. Domestication allowed fewer people to cultivate more food. With more predictable food supplies, people were able to spend more time on crafts, travel, and trade.



## Early Domestication

The first incident of the domestication of an animal was that of the gray wolf, occurring around 15,000 years ago. Modern dogs (*Canis lupus familiaris*) are the result of the domestication of the gray wolf (*Canis lupus*). Over years of artificial selection, dogs became a distinct species.

Around 10,000 years ago, people in Mesopotamia began to domesticate goats and sheep for meat, milk, and hides. At about the same time, chickens were domesticated in Southeast Asia. Shortly thereafter, humans began domesticating larger animals, such as oxen and horses, for plowing and transportation. Five species of wild cattle have been domesticated within the last 10,500 years.



**FIGURE 5.** The red jungle fowl is believed to have been domesticated about 10,000 years ago.

Domesticated animals can look very different from their wild ancestors. Think of the many modern breeds of dogs and how they differ in appearance to wolves. Also, domesticated chickens look very different from wild chickens. Wild chickens generally weigh about two pounds. Through domestication and selective breeding to yield more meat, they have become much larger. Today, domestic chickens weigh as much as 17 pounds. Wild chickens lay a small number of eggs once a year, while domestic chickens may lay 200 or more eggs each year.

## Animals Used in Domestication

Certain animal species proved easier to domesticate than others. This is why only a few animal species out of the thousands that exist have been domesticated. According to professor and biologist Jared Diamond, there are six criteria that animals must meet for domestication. Many species qualify for some of the criteria, but very few species meet all six criteria.

1. A domesticated species must be able to eat a variety of foods and to find enough food in and around human settlements for survival. For instance, cows and sheep forage on grass and eat surplus grains. Dogs and cats scavenge on human leftovers or waste.
2. A domesticated species must reach maturity quickly, especially in relation to the human life. Humans can't afford to devote too much time feeding and caring for an animal before it grows large enough to be put to work or slaughtered.

COON BSAA 4-27 #3

3. A domesticated species must be willing to breed in captivity. Species such as antelope will not breed in crowded enclosures.
4. A domesticated species must be docile by nature. Cows and sheep are generally submissive. In contrast, the African buffalo and American bison are both unpredictable and very dangerous to humans. Similarly, the zebra, though closely related to the horse, is aggressive and resistant to human interaction.
5. A domesticated species must lack a tendency to panic and flee when startled. Deer and gazelles have flighty temperaments that make them impossible to domesticate. Although sheep are panicky, they have a flocking instinct that activates when they are nervous. This flocking instinct makes herding possible.
6. A domesticated species must conform to a social hierarchy dominated by strong leadership. They should recognize their human caretaker as the group leader. One exception to this criterion is the cat.

### Domestication Verses Taming

There is a distinction between domestication and taming. Domestication involves the permanent genetic modification of an animal, which leads to an inherited tolerance toward humans. **Taming** is the training of a wild-born animal through behavioral modification to reduce its natural tendency for avoiding or attacking humans. The goal of taming is tolerance to the presence of humans. There is no genetic modification (through breeding) associated with taming.



## Digging Deeper... UNCOVERING ADDITIONAL FACTS

### Where Animals Were Originally Domesticated

- The first domesticated sheep and goats appeared in Southwest Asia.
- Chickens were first domesticated in Southeast Asia.
- All cattle are descended from as few as 80 animals that were domesticated from wild oxen in Western Asia.
- The domestication of hogs occurred independently from wild-boar subspecies in Europe and Asia.
- Dogs were domesticated separately in Eastern and Western Eurasia.
- The Arabian or dromedary camel was domesticated in Arabia.
- Water buffalo were domesticated in China.
- Wild tarpan horses, believed to be the ancestors of modern horses, were domesticated in Ukraine.
- The donkey was domesticated in Egypt.
- The domestication of llamas and the alpacas occurred in South America. Some historians believe South Americans saved these species from the brink of extinction.

## GENETIC BASIS OF ANIMAL BREEDING

The domestication of animals has produced breeds. A **breed** is a group of animals that, as a result of breeding and selection, have certain distinguishable characteristics. Animals of a breed share a phenotype, or they have a homogeneous appearance and behavior. These shared characteristics distinguish the breed from other organisms of the same species. Breeds are developed through genetic isolation or a natural adaptation to the environment, selective breeding (artificial) for the environment, or a combination of the two.

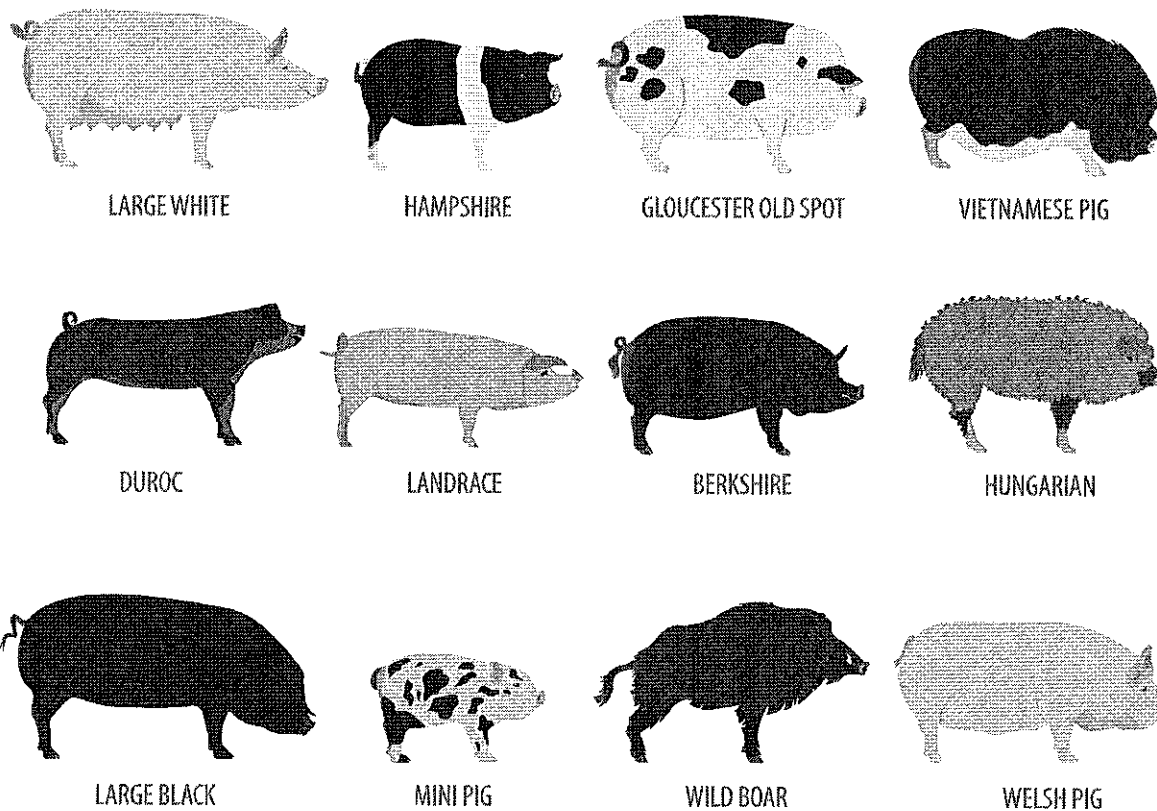


FIGURE 6. Hog breeds are distinguished by certain characteristics.

### Objectives of Animal Breeding

The main objectives of animal breeding are:

1. To improve the growth rate of the breed
2. To increase the production of milk, meat, eggs, wool, etc.
3. To produce superior quality of milk, meat, eggs, wool, etc.
4. To improve animal resistance to various diseases
5. To increase the productive life of an animal
6. To increase or improve the rate of reproduction

## Methods of Animal Breeding

Inbreeding, outbreeding, outcrossing, crossbreeding, and interspecific hybridization are all forms of animal breeding.

### *Inbreeding*

**Inbreeding** is the mating of genetically similar (related) individuals. Inbreeding increases the number of individuals that are homozygous for a trait with each successive generation. Therefore, it increases the expression of recessive traits. In practice, a superior cow and a superior bull of the same breed are identified and mated. The offspring are evaluated, and from these, a superior male and female are identified for further mating. This process is followed for four to six generations.

Purebred animals are a result of inbreeding. A **purebred** is an animal whose parental lineage (on both sides) is from members of a recognized breed. The parents are homozygous for certain traits. In other words, a purebred animal is the result of mating by animals with the same breed that have had an unmixed lineage over many generations. For example, the mating of dogs of the same breed results in offspring with traits that are very predictable.

Inbreeding can lead to inbreeding depression. **Inbreeding depression** is the lowered ability of a population to survive and reproduce—a result of mating between close relatives. Fertility and productivity can be restored in the population through the mating of superior, unrelated animals from the same breed. Inbreeding depression occurs in wild animals, plant populations, and in humans.

### *Outbreeding*

**Outbreeding** is the mating of unrelated individuals. Outbreeding often leads to offspring that are better adapted for survival than their parents (inciting hybrid vigor). **Hybrid vigor (heterosis)** is a tendency of an organism to have superior qualities over those of the parents, such as size, growth rate, yield, disease resistance, and fertility. Animal breeders achieve hybrid vigor by mating two different purebred lines that have advantageous traits. Outbreeding may occur as outcrossing, crossbreeding, or interspecific hybridization.

### **OUTCROSSING**

**Outcrossing** is the mating of animals of the same breed that have had no common ancestors in the parental lineage for up to four to six generations. Outcrossing introduces unrelated genetic material into a breeding line, and it increases genetic diversity. In some cases, only one outcross is required to overcome inbreeding depression.

### **CROSSBREEDING**

**Crossbreeding** is the process of producing offspring through the mating of two purebred individuals that come from different breeds, varieties, or species. Superior males of one breed are mated with superior females of another breed. As an example, the

Hisardale sheep is a new breed (from Punjab) created by crossing Bikaneri ewes and Marino rams.

### INTERSPECIFIC HYBRIDIZATION

**Interspecific hybridization** is the mating of animals from two different species. The progeny obtained from such a mating are usually different from both the parental species. The offspring may exhibit desirable characters from both parents. For example, a mule is produced from a cross between a female horse and a male donkey. Mules are reputed to be more patient, hardier, and live longer than horses. They are also less obstinate and more intelligent than a donkey.

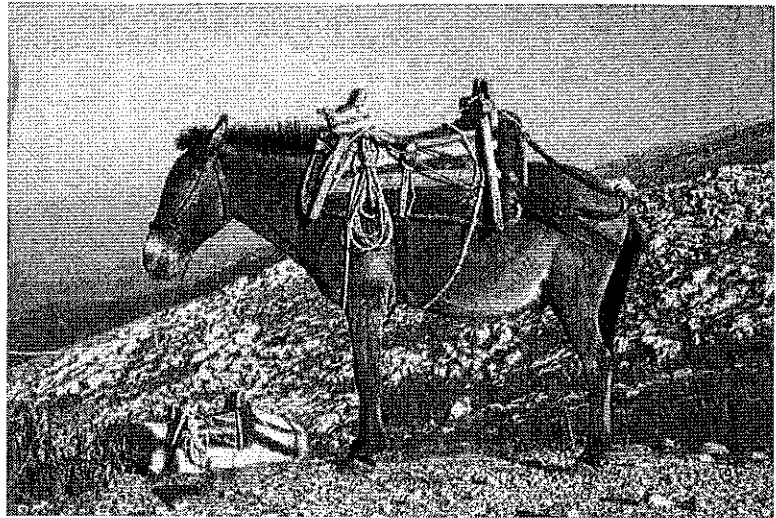


FIGURE 7. A mule is the result of interspecific hybridization.

### Genetic Diversity

**Genetic diversity** is the variety of genes within a species. Over hundreds and thousands of years, farmers have found ways to improve the quality and yield of livestock and poultry through artificial selection. However, one of the major problems with artificial selection is its effect on genetic diversity.

Genetic diversity is important in agriculture. Many local breeds have gone extinct in the past 100 years. During that time, people have favored more-productive breeds produced on an industrial scale. Even individuals of industrial breeds have been decreasing in genetic diversity. The loss of breeds to extinction also means a loss of genetic diversity, and this loss reduces a species' capacity to adapt to new diseases, climate changes, or food sources.



### Summary:

Evolution is the cumulative, genetic change in a population of organisms from generation to generation. Evolution is both a theory and a fact. One of the greatest forms of evidence in support of evolution is comparative anatomy.

Natural selection is the survival process in which better-adapted individuals are more likely to make it to a reproductive age than less-fit individuals. These stronger individuals

COON BSA 4-27 #3

would then create more offspring and make a larger gene-pool contribution than those less fit.

Artificial selection (selective breeding) is the practice of intentionally breeding animals (or other organisms) with one or more desirable traits to produce offspring with similar desirable or improved traits. With artificial selection, farmers or breeders choose the variants to be used in producing the succeeding generations.

Domestication is the process by which wild plants and animals are genetically modified over time for traits that are more advantageous or desirable for human use.

The domestication of animals has produced breeds. A breed is a group of animals that, as a result of breeding and selection, have certain distinguishable characteristics. Breeds are developed through genetic isolation or a natural adaptation to the environment, selective breeding (artificial) for the environment, or a combination of the two. Inbreeding and outbreeding are the two main methods of animal breeding.

Genetic diversity is the variety of genes within a species. A loss of genetic diversity reduces a species' capacity to adapt to new diseases, climate changes, or food sources.



### Expanding Your Knowledge:

Learn more about how evolution relates to agriculture by going on YouTube to watch the BrainStuff video, "Why Don't Humans Ride Zebras?," at <https://www.youtube.com/watch?v=RMpMxaX3Kdg>.



### Checking Your Knowledge:

#### ■ Part One: Matching

*Instructions:* Match the word with the correct definition.

- |                         |                      |
|-------------------------|----------------------|
| a. adaptation           | f. genetic diversity |
| b. breed                | g. inbreeding        |
| c. artificial selection | h. natural selection |
| d. evolution            | i. outbreeding       |
| e. gene pool            | j. purebred          |

- \_\_\_\_\_ 1. the survival process in which better-adapted individuals are more likely to make it to a reproductive age than less-fit individuals
- \_\_\_\_\_ 2. the ability of any organism to adjust or change its physiology or structure to become more suited to their environment
- \_\_\_\_\_ 3. a group of animals that, as a result of breeding and selection, have certain distinguishable characteristics
- \_\_\_\_\_ 4. a collection of all the genes within a freely interbreeding population

COON BSAA

4-27#3

- \_\_\_\_\_5. the variety of genes within a species
- \_\_\_\_\_6. the cumulative, genetic change in a population of organisms from generation to generation
- \_\_\_\_\_7. the mating of genetically similar (related) individuals
- \_\_\_\_\_8. the practice of intentionally breeding animals (or other organisms) with one or more desirable traits to produce offspring with similar desirable or improved traits
- \_\_\_\_\_9. an animal whose parental lineage (on both sides) is from members of a recognized breed
- \_\_\_\_\_10. the mating of unrelated individuals

### ■ Part Two: Completion

*Instructions:* Complete the following statements.

1. \_\_\_\_\_ is the comparison of the structural similarities of organisms to determine their evolutionary relationships.
2. A/an \_\_\_\_\_ is a part of an organism which is similar in different species, because the species have common ancestry (but the similar part may or may not perform the same function).
3. A/an \_\_\_\_\_ is a part of an organism that serves a similar function in different species, but the species have evolved separately (they do not share a common ancestor).
4. \_\_\_\_\_ is the independent evolution of similar structural or functional traits, resulting from an adaptation to similar environments.
5. \_\_\_\_\_ is a tendency of an organism to have superior qualities over those of the parents, such as size, growth rate, yield, disease resistance, and fertility.
6. \_\_\_\_\_ is the process of producing offspring through the mating of two purebred individuals that come from different breeds, varieties, or species.
7. \_\_\_\_\_ is the training of a wild-born animal through behavioral modification to reduce its natural tendency for avoiding or attacking humans.
8. \_\_\_\_\_ is the process by which wild plants and animals are genetically modified over time for traits that are more advantageous or desirable for human use.
9. \_\_\_\_\_ is the lowered ability of a population to survive and reproduce—a result of mating between close relatives.
10. \_\_\_\_\_ is the mating of animals of two different species.

COON BSA 4-27 #3

■ Part Three: True/False

*Instructions:* Write *T* for true or *F* for false.

- \_\_\_\_\_ 1. Evolution is both a theory and a fact.
- \_\_\_\_\_ 2. An observation of the natural world (related to natural selection) is that each species produces more offspring than can be supported—not all will survive to maturity.
- \_\_\_\_\_ 3. Artificial selection is also known as selective breeding.
- \_\_\_\_\_ 4. One criterion for domestication is that the animal must be a herbivore.
- \_\_\_\_\_ 5. The mechanisms of natural and artificial selection are essentially the same.
- \_\_\_\_\_ 6. Behavioral adaptations include the ability to tolerate climatic conditions.
- \_\_\_\_\_ 7. Individuals of industrial breeds have been increasing in genetic diversity.
- \_\_\_\_\_ 8. Analogous structures are a result of convergent evolution.
- \_\_\_\_\_ 9. Animals of a breed share a phenotype, and they have a homogeneous behavior.
- \_\_\_\_\_ 10. Hybrid vigor lowers a population's ability to survive and reproduce.