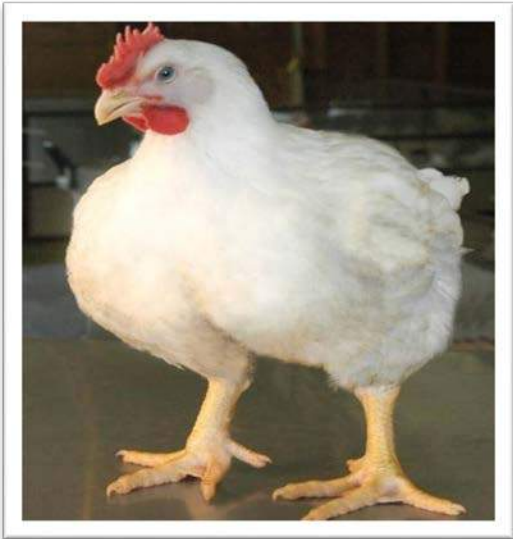


# Compiled Poultry Resource Book!



# Selection

Chicken Breed Selection (Schirtzinger, McDermott – ANR-60)

# Basic Information About Chickens:

## Select Articles from eXtension

Except for a few articles from specialists at Ohio 4-H Youth Development, these articles are from eXtension, a national organization dedicated to sharing research-based information from America's land-grant universities, including The Ohio State University. The articles have not been modified from their originals and are collected here for your convenience. You can view them and the complete collection of articles about poultry on eXtension here: [articles.extension.org/poultry](http://articles.extension.org/poultry)

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## CHICKEN BREED SELECTION

ANR-60

Agriculture and Natural Resources

Date: 08/17/2017

**Sabrina Schirtzinger, Extension Educator, Agriculture and Natural Resources, Knox County****Tim McDermott, Extension Educator, Agriculture and Natural Resources, Hocking County**

There are various reasons people raise chickens: for eggs, meat, show and exhibition or simply to enjoy caring for and watching chicks grow. For some, raising chickens is a hobby while others see it as a sustainable part of living. This fact sheet will explore characteristics of chicken breeds to help select the right breed for you.

### What are your goals for raising chickens?

Before selecting the breed of chick to purchase, you need to ask yourself several questions. The first one is: What are your needs for your flock? This is important because you are looking at a commitment of potentially seven to eight years, which is the average lifespan of a chicken. Other questions include:

- What is your end goal for raising chickens?
- Do you want a certain type of egg, or are you looking for meat production chickens?
- Is your goal egg production, egg and meat production, or just meat production?
- Are you interested in raising chickens for show purposes and production is not important?

Each breed of chicken has traits that make them better suited for exhibition, egg, meat or dual purpose production.

### Terminology

Being able to talk “chicken” is important. Here are a few terms used for poultry:

- Hen: a female adult chicken
- Rooster: a male adult chicken
- Chick: a baby chicken of either sex
- Pullet: a female chick (immature chicken)
- Cockerel: a male chick (immature chicken)
- Broody: a hen inclined or wishing to incubate eggs
- Non-Setting: a hen that does not have the inclination or wish to incubate eggs
- Dual Purpose: chicken practical for meat and egg production



## Egg Production

All hens will lay eggs; however, their egg production will vary. A rooster is not needed for egg production. Hens will lay non-fertile eggs without a rooster, a rooster is only needed if you want fertile eggs in order to hatch chicks. A hen usually lays one egg every 26 hours; although, there may be days when a hen will not lay an egg at all. As the hen ages, the egg size will increase; however, the shell quality and egg production will decrease. Hens that are producing eggs will need extra calcium in their feed to support shell development. Egg colors vary between breeds. Egg colors include: white, various shades of brown, or other colors such as blue and green. The best egg laying breeds tend to be the smaller bodied breeds such as Ancona, Leghorn and Minorca.

The breed used the most for commercial egg laying is typically White Leghorns. These birds are intended to produce eggs at a higher rate. Commercial producers only keep layers for two years before replacing the hen. White Leghorns are not usually the best choice for the novice backyard poultry enthusiast as they can be loud, nervous and occasionally aggressive towards people.

## Egg and Meat Production

Some chicken breeds are referred to as dual-purpose breeds that will lay an adequate amount of eggs and grow large enough for meat production. The downside, though, is that the chicken will not mature quickly like other breeds of meat chickens. Hybrid birds, also called sex-linked, tend to be good dual-purpose, but hybrid birds cannot reproduce.

## Meat Production

Chickens that are bred solely for meat production are generally poor egg layers because these birds are faster growing. Because of their faster growth, meat birds require a larger amount of feed daily with a higher protein content compared to egg-laying birds. The fastest growing birds are a Cornish chicken crossed with a White Rock, which is referred to as a Cornish Cross. Using good livestock care practices, producers will have fryers at approximately seven weeks weighing 4 to 6 pounds, reaching roasting stage of 6 to 10 pounds in eight to 12 weeks.

Just like commercial egg layers, commercial meat birds have been selected for desired characteristics to be able to grow quickly with high feed efficiency. Similar to White Leghorns, the breeds used in commercial production are not usually the best choice for the backyard poultry enthusiast.

## Shows and Exhibition of Poultry

Shows offer an opportunity to display any breed of chicken and are becoming popular in the Midwest. The American Poultry Association (APA) has a publication called The American Standard of Perfection that has a complete description of all the breeds and varieties of domestic chickens. This publication describes the appropriate breed characteristics needed for birds to be shown in exhibition.



Figure 1. Ameraucana chicken is a common backyard breed that lays blue/green eggs.



Figure 2. Chicken eggs vary in sizes and colors.

## Buying Your Chickens

Day old chicks can be purchased from hatcheries or feed stores. Chicks that are sold as a “straight run” will be a mixture of pullets (females) and cockerels (males). To buy only pullets, make sure the chicks are sexed. Before you purchase a rooster, make sure the regulations in your area allow for them. Many cities have implemented rules on keeping backyard poultry and do not allow roosters. A straight run purchase of chicks should be avoided in this case and only pullets should be purchased.

Biosecurity refers to procedures implemented to protect animals from disease-causing pathogens to help keep them healthy. One of the biggest aspects of raising chickens, or any type of livestock, is to make sure that biosecurity protocols are followed closely. Chickens should be purchased free of any disease to avoid introducing a disease into your existing flock. It is best to purchase similar age birds from a similar species at one time. Avoid purchasing poultry from unknown sources. Do not bring a bird into your flock if you do not know its prior health record. The Animal Plant Health Inspection Service of the U.S. Department of Agriculture has a fact sheet to reference on biosecurity. The fact sheet is available by searching for USDA poultry biosecurity.



Figure 3. Meat production chicken for exhibition.

To help biosecurity, the National Poultry Improvement Plan (NPIP) was developed in the 1930s with the mission to eradicate a number of major poultry diseases such as pullorum, salmonella, mycoplasma, and avian influenza. Breeders that are members are required to have their birds tested for pullorum-typhoid and be vaccinated against Marek’s disease. It is critical when purchasing chickens to only buy birds certified free of NPIP diseases. Starting with healthy chicks is paramount to having a healthy flock. According to the Ohio Poultry Association, the following Ohio hatcheries comply with NPIP regulations: Eagle Nest Poultry, Meyer Hatchery, Mt. Healthy Hatchery, and Ridgway Hatchery.

## What temperament of chicken is ideal for you and your family?

After you have decided the goal for your backyard flock (eggs, meat or show), another characteristic to consider is breed temperament. Each breed has general temperament tendencies, but each bird will have a unique personality. If you are planning to have a small backyard flock of only three to five birds that are enjoyed as pets as well as producers in the local food chain for the family, you may consider a more docile breed. If you plan to involve children as caretakers to learn about keeping and taking care of animals, choose a breed with characteristics that are more compatible with your family so the children will enjoy the experience.

Breeds with the reputation for docility include: Plymouth Rock, Wyandotte and Orpington. These may be good choices for the novice backyard poultry enthusiast or if young children will be helping to raise and care for the poultry. Roosters, of any breed, on the other hand are naturally aggressive and may not be suitable for the novice poultry enthusiast or flocks where children are caring for the birds.

Individual bird behavior is unpredictable. The breed characteristics should be used only as a guide knowing that selecting primarily for temperament is difficult. Using a reputable and knowledgeable breeder is a good start in choosing which breed of chickens you wish to select to start your backyard flock.



Figure 4. Buff Brahmas are a gentle breed.



Figure 5. Black Australorps are a popular brown egg breed.

## Chicken Breeds

Selecting the best breed of chicken can be difficult as there are so many choices. Understanding their differences will help to save you time and money. The following chart highlights characteristics considered by producers when determining the breeds for their flocks. It is designed to be a starting point when deciding between all the breeds. Once you pick the breed you are most interested in, further research of the breed is encouraged.

| Breed       | Varieties  | Egg Color  | Egg Size    | Characteristics  | Primary Usage |
|-------------|--|------------|-------------|--|---------------|
| Ameraucana  | Black, Blue, Blue Wheaten, Brown Red, Buff, Silver, Wheaten, White | Blue/Green | Large       | Medium sized chicken, colorful feather patterns. Excellent egg layers. | Eggs          |
| Anconas     | Single Comb and Rose Comb  | White      | Extra Large | Known for being excellent large egg layers. Non- setting.              | Eggs          |
| Australorps | Black  | Brown      | Large       | Popular breed for light brown eggs, heavy bird used for meat as well.  | Dual          |
| Brahmas     | Light, Dark, Buff  | Brown      | Large       | Heavy-bodied, broody breed.  | Eggs          |
| Buckeye     | Only one variety   | Brown      | Large       | Heavier and wider bodied breed, excellent dual-purpose.                | Dual          |
| Buttercups  | Gold, Silver   | White      | Medium      | Mainly used for egg production.  | Eggs          |

| Breed                | Varieties   | Egg Color   | Egg Size    | Characteristics  | Primary Usage |
|----------------------|---|-------------|-------------|--|---------------|
| Campines             | Silver, Golden  | White       | Medium      | Smaller-bodied breed more suitable for egg laying.   | Eggs          |
| Cochins              | Buff, Partridge, White, Black, Barred, Silver Laced, Golden Laced, Blue, Brown        | Brown       | Small       | Fluffy feather, broody breed, and considered one of the largest breeds.                          | Eggs          |
| Cornish              | Dark, White, White Laced, Blue, Brown   |             |             | Excellent meat chickens.   | Meat          |
| Delawares            | Only one variety  | Brown       | Large       | Mostly white with barred tail and hackle (neck feathers).  | Dual          |
| Dominiques           | Only one variety  | Brown       | Large       | An American white and black barred breed (also known as cuckoo pattern). Adapt well to climates. | Exhibition    |
| Dorkings-Single Comb | Silver Gray, Colored, Cuckoo, Red, White  | White       | Medium      | Versatile breed used for meat and egg production. Has red ear lobes, but produces white eggs.    | Dual          |
| Faverolles           | Salmon, White   | Light Brown | Medium      | Dual Purpose breed, mainly used for exhibition and has 5 toes.                                   | Dual          |
| Hamburg              | Black, Golden Penciled, Golden Spangles, Silver Penciled, Silver Spangled, White      | White       | Medium      | Excellent large egg layers and good foragers.  | Eggs          |
| Jersey Giants        | Black, Blue, White  | Brown       | Large       | Large, heavy breed used for egg production and meat.   | Dual          |
| Leghorn              | Light Brown, Dark brown, White, Buff, Black, Silver, Red, Black Tailed Red, Columbian | White       | Extra Large | Prolific egg layer   | Eggs          |
| Maran                | Black Copper, Wheaten   | Dark Brown  | Extra Large | Excellent egg layers with very dark brown eggs. May be used for meat.                            | Dual          |



| Breed                          | Varieties   | Egg Color       | Egg Size    | Characteristics   | Primary Usage |
|--------------------------------|---|-----------------|-------------|---|---------------|
| Minocra                        | Single comb black, Single comb white, Rose comb black, Single comb buff, Rose comb white,   | White           | Extra Large | Large framed, hardy and active breed.   | Eggs          |
| New Hampshire Red              | Red   | Brown           | Extra Large | Dual Purpose breed, used more for meat production.  | Dual          |
| Orpington                      | Black, Blue, Buff, White  | Brown           | Large       | Heavy dual purpose breed, and an excellent egg layer. Known to lay well in the winter months too. | Dual          |
| Plymouth Rock                  | Barred, White, Buff, Partridge, Silver Penciled, Blue, Columbian                            | Brown           | Large       | Dual purpose broody chickens that will make good mothers, and do not mind the cold.               | Dual          |
| Polish-Bearded and Non-Bearded | Golden Silver, White, Buff Laced, White Crested Blue, Black, Crested White                  | White           | Medium      | Prolific egg layers, similar to Leghorns.   | Eggs          |
| RedCaps                        | Only one variety  | White           | Medium      | This breed is a good egg layer, meat chicken and exhibition breed.                                | Dual          |
| Rhode Island Reds              | Single Comb and Rose Comb   | Brown           | Large       | Known for being the best egg layer as a dual purpose breed.                                       | Dual          |
| Sussex                         | Speckled, Red, Light, Brown, Silver, Buff   | Brown           | Large       | Dual purpose breed.   | Dual          |
| Welsummers                     | Only one variety  | Very Dark Brown | Large       | Good egg production chicken, cold weather hardy with a docile temperament.                        | Eggs          |
| Wyandottes                     | Silver Laced, Golden Laced, White, Black, Buff, Partridge, Silver Penciled, Columbian, Blue | Brown           | Large       | Dual purpose breed. Cold weather hardy and make a good exhibition bird.                           | Dual          |

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All photos by Sabrina Schirtzinger, OSU Extension.

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# Anatomy and Physiology

External Anatomy of Poultry Kept on Small or Backyard Flocks: Chickens

Comb

Wattles

Anatomy of a Feather

Avian Digestive System

Avian Immune System

Avian Muscular System


Avian Reproductive System – Female

Avian Reproductive System - Male

Avian Respiratory System

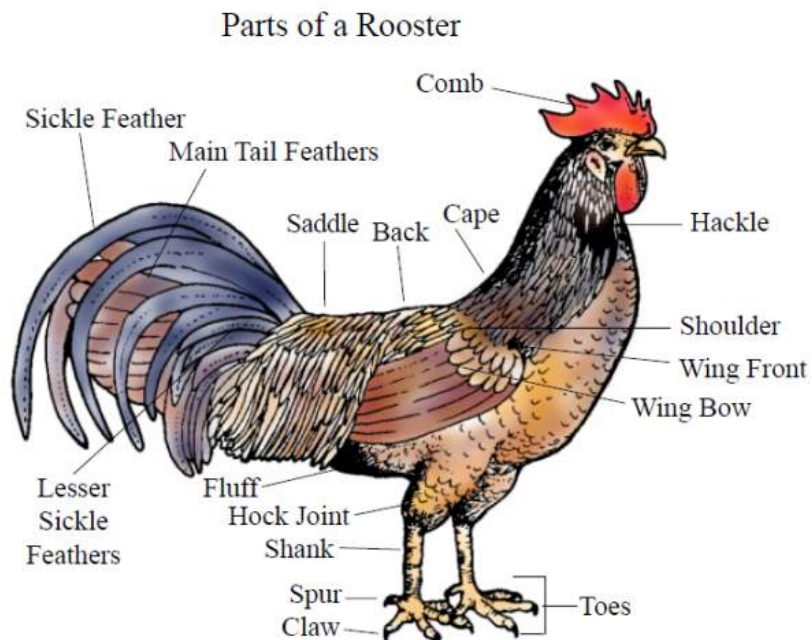
Avian Skeletal System

## External Anatomy of Poultry Kept on Small or Backyard Flocks: Chicken

 [articles.extension.org/pages/65352/external-anatomy-of-poultry-kept-on-small-or-backyard-flocks:-chicken](https://articles.extension.org/pages/65352/external-anatomy-of-poultry-kept-on-small-or-backyard-flocks:-chicken)

**Written by:** Dr. Jacquie Jacob, University of Kentucky

The basic external parts of a chicken include the comb, beak, wattles, ears, earlobes, eyes, eye rings, wings, tail, thighs, hocks, shanks, spurs, claws, and toes. As Figure 1 shows, both male and female chickens have these basic parts. The differences between males and females include the size of the comb and wattles, the size of the spurs (in older birds), and the characteristics of the hackle and cape feathers. Hackle and cape feathers of males have pointed ends, whereas those of females have rounder ends. In addition, males have sickle feathers in their tails and hackle feathers on their backs, and females do not.



## Parts of a Hen

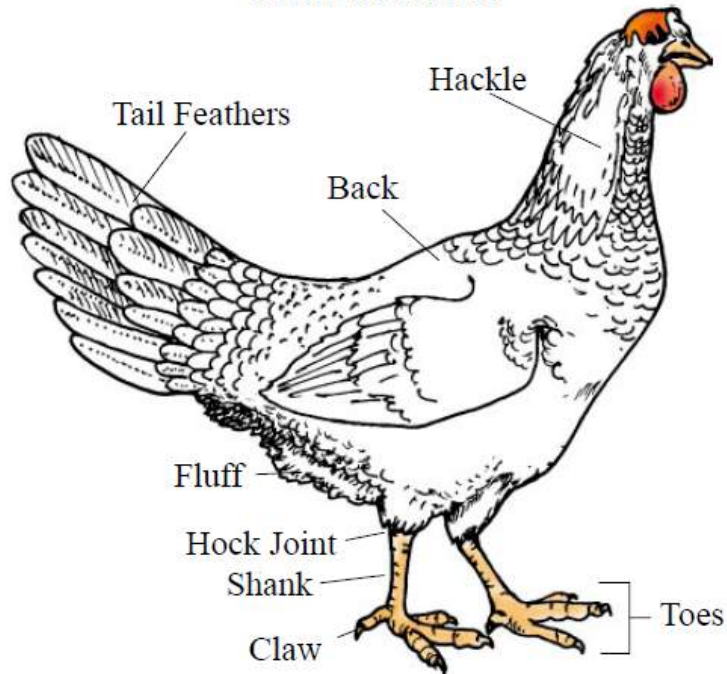
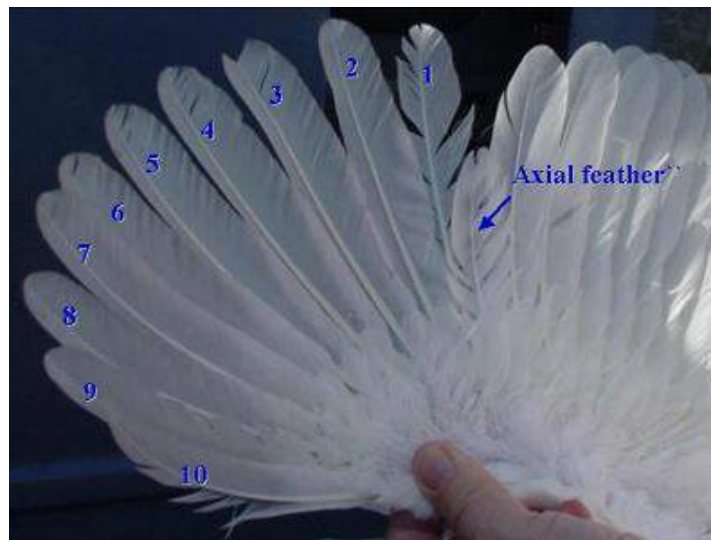


Fig. 1. Parts of an adult male chicken and an adult female chicken. Source: University of Illinois. Used with permission.

A chicken's **wing** has several flight feathers. As Figure 2 shows, the axial feather separates the primary feathers and secondary feathers. When a hen molts, she starts losing feathers from the axial feather out.

Fig. 2. Primary feathers (numbered 1 through 10) and axial feather of an adult chicken. Source: Jacquie Jacob, University of Kentucky.



The **thigh** of a chicken is the upper part of the leg attached to the body of the bird. The thigh ends at the lower leg (drumstick). The thigh is connected to the **shank** (foot) at the **hock** joint, which is the equivalent of the ankle in humans. Chickens stand and walk on their **toes**. Most chickens have three toes projecting forward and one projecting back, sometimes referred to as the **claw**.

A few breeds, however, have five toes on each foot. Some breeds also have feathers on their shanks and toes. Figure 3 compares the legs of a female chicken and a male chicken, and Figure 4 compares the bones in a chicken leg with those of a human leg.



Fig. 3. Legs of a female chicken (left) and a male chicken (right). Source: Jacquie Jacob, University of Kentucky.

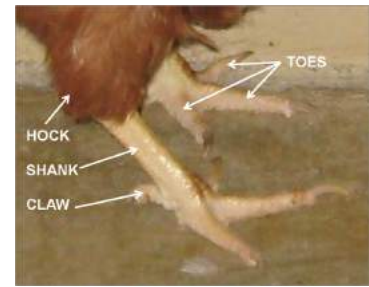


Fig. 4. Comparison of the lower portion of the skeleton of a chicken (left) and the lower portion of the skeleton of a human (right). Source: Public domain images.

A chicken's head has several parts, as shown in Figure 5. One of the most prominent features on a chicken's head is the **comb**. Figure 6 shows different types of combs. A chicken's **comb** and **wattles** are red, soft, and warm. Chickens do not have external **ears** as humans do. The ears are just openings into the ear canal, and each is protected by a covering of feathers. The **ear lobe** is a specialized skin located below the ear. The color of the ear lobe depends on the breed of chicken. The two possible colors are red and white. The eyeball is covered by the **eye ring**. When the eye is open, the eye ring appears as a ring of skin around the eye (thus the name *eye ring*).

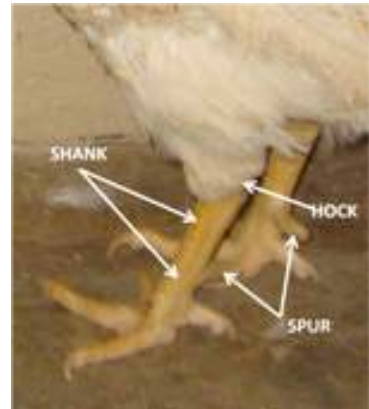
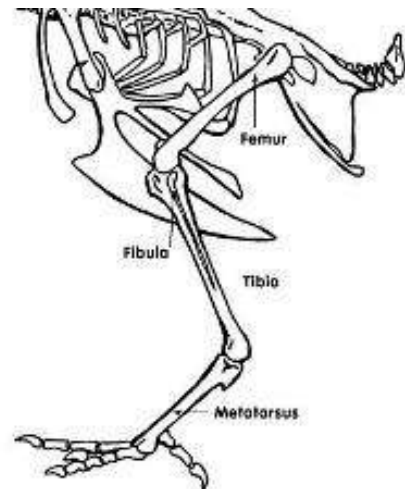


Fig. 5. Parts of a rooster's head. Source: Jacquie Jacob, University of Kentucky.



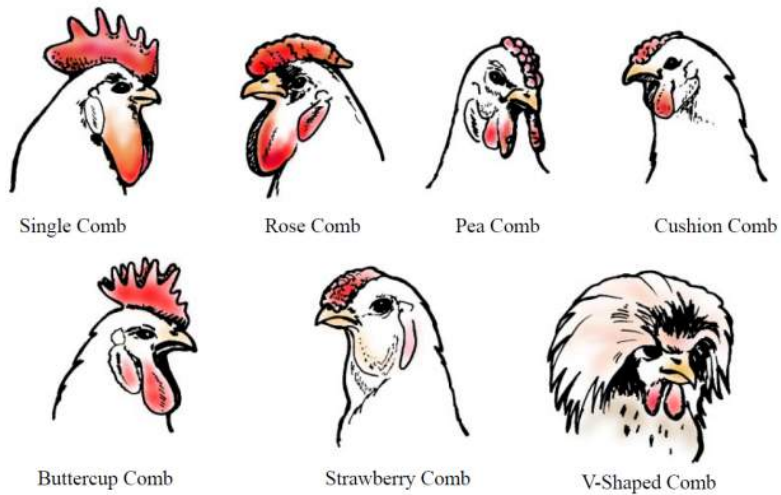
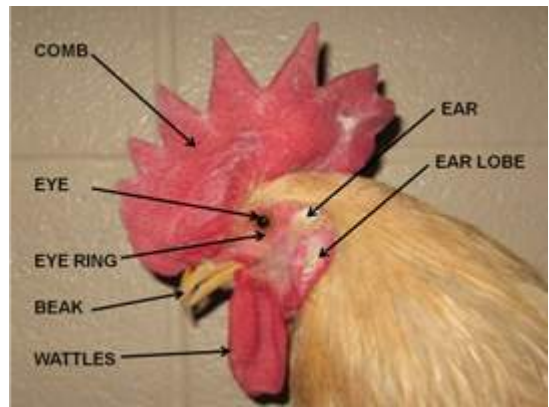


Fig. 6. Comb types. Source: University of Illinois. Used with permission.

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### For More Information

[Poultry: A Guide to Anatomy and Selected Species](#), University of Illinois

# Wattles

[articles.extension.org/pages/65351/wattles](https://articles.extension.org/pages/65351/wattles)

**Wattles** refers to the flap of skin under the chin of a chicken or turkey.

Figure 1. Labeled parts of a chicken's head. Source: Jacquie Jacob, University of Kentucky

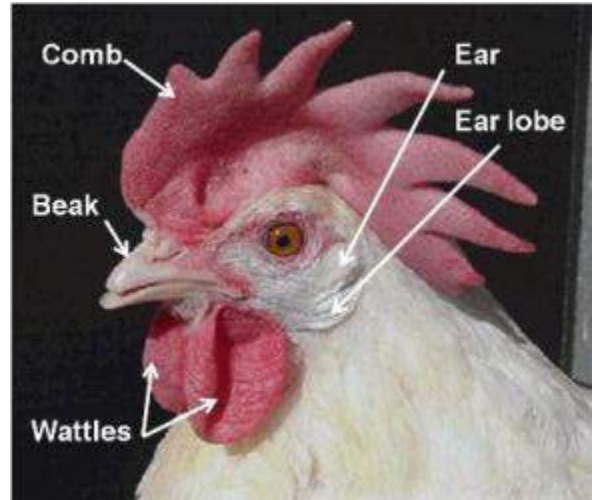
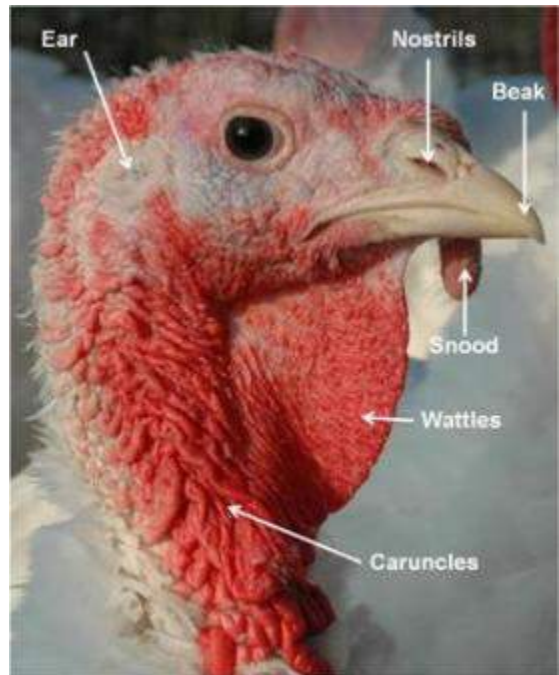



Figure 2. Labeled parts of a turkey's head. Source: Jacquie Jacob, University of Kentucky



# Anatomy of a Feather

 [articles.extension.org/pages/65367/anatomy-of-a-feather](https://articles.extension.org/pages/65367/anatomy-of-a-feather)

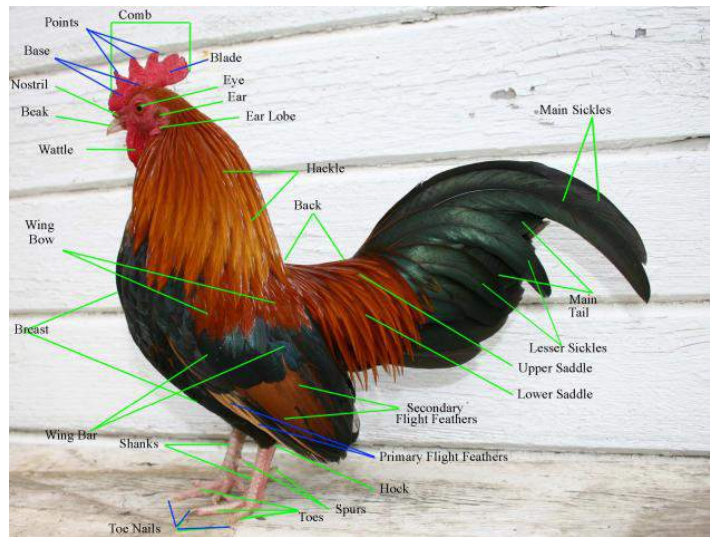
**Written by:** Dr. Jacquie Jacob, University of Kentucky

Birds come in different shapes and sizes, but one thing they have in common is feathers. Feathers are unique to birds; that is, everything that has feathers is a bird. Figure 1 shows feathers of various sizes, shapes, colors, and purposes on an adult male rooster.

Fig. 1. Parts of an adult male rooster.  
Source: John Anderson, The Ohio State University.

Feathers play three main roles in birds' lives:

- Feathers provide insulation, allowing birds to maintain their body temperatures in a wide variety of environmental conditions.
- Certain feathers are instrumental in allowing birds to fly.
- Because they come in different shapes and colors, feathers provide individual plumage that can serve to camouflage a bird or attract a mate.



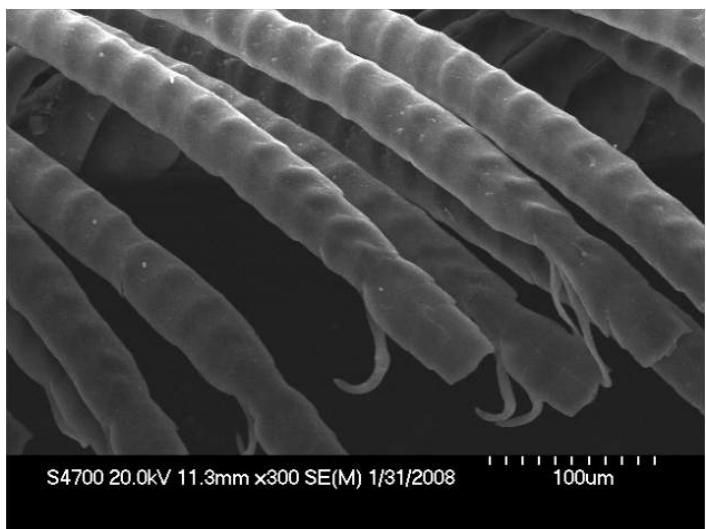
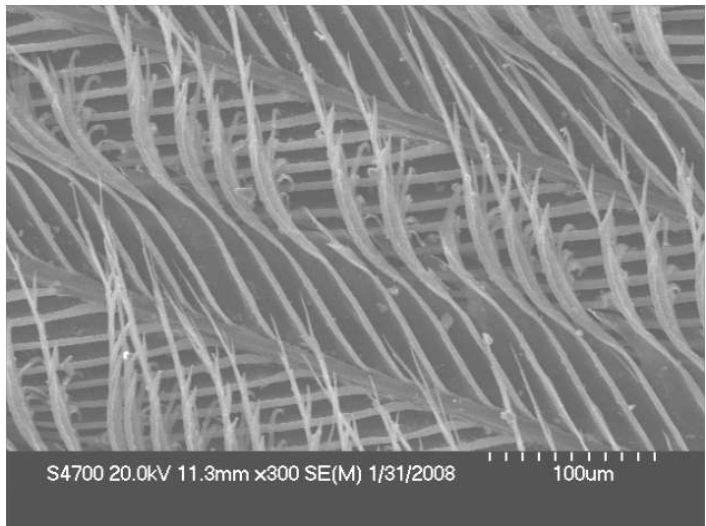
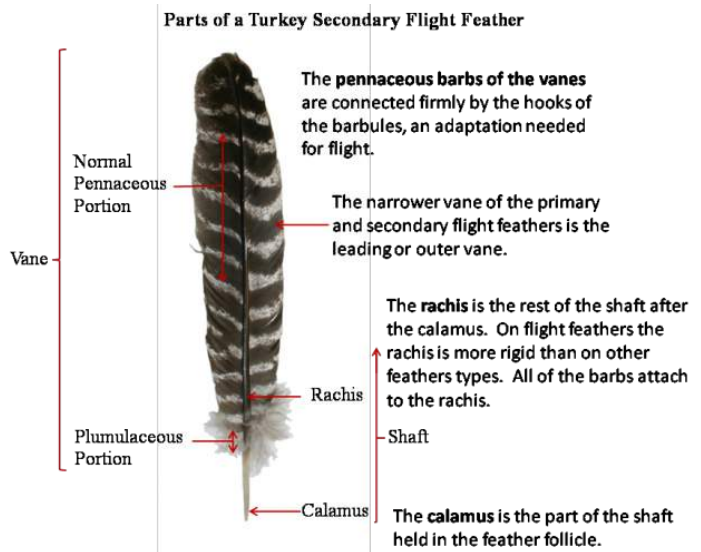
Figures 2 and 3 illustrate features of flight feathers, and Figure 4 shows a feather whose purpose is ornamentation.

Fig. 2. Parts of a feather. Source: Jesse Lyons, University of Missouri.

Fig. 3. Electron microscope image of part of a pheasant secondary flight feather. Flight feathers must be tough to withstand the rigors of flight. The barbs on a flight feather are strong and are connected to adjoining barbs of the same vane by the hooks on the barbules. Source: John Anderson, The Ohio State University.

Fig. 4. Electron microscope image of part of a peacock eye feather. This feather is ornamental and not meant to withstand the forces a flight feather must endure. Spacing exists between the barbs, and the hooks do not hold the barbs together. The ridges on the


barbs are part of the complex color-producing system present on peafowl.  
 Source: The Ohio State University.





# Avian Digestive System

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 [articles.extension.org/pages/65376/avian-digestive-system](https://articles.extension.org/pages/65376/avian-digestive-system)

**Written by:** *Dr. Jacquie Jacob, University of Kentucky*

An understanding of the avian digestive system is essential for developing an effective and economical feeding program for your poultry flock and for recognizing when something is wrong and taking necessary actions to correct the problem.

The digestive system of any animal is important in converting the food the animal eats into the nutrients its body needs for growth, maintenance, and production (such as egg production). An animal's body breaks down food through both mechanical and chemical means. In many animals, mechanical action involves chewing; however, because birds do not have teeth, their bodies use other mechanical action. Chemical action includes the release of digestive enzymes and fluids from various parts of the digestive system. After being released from food during digestion, nutrients are absorbed and distributed throughout the animal's body.

## Parts of a Chicken Digestive Tract

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The chicken has a typical avian digestive system. In chickens, the digestive tract (also referred to as the gastrointestinal tract or GI tract) begins at the mouth, includes several important organs, and ends at the cloaca. Figure 1 shows a chicken digestive tract, and Figure 2 shows the location of the digestive tract in the chicken's body.

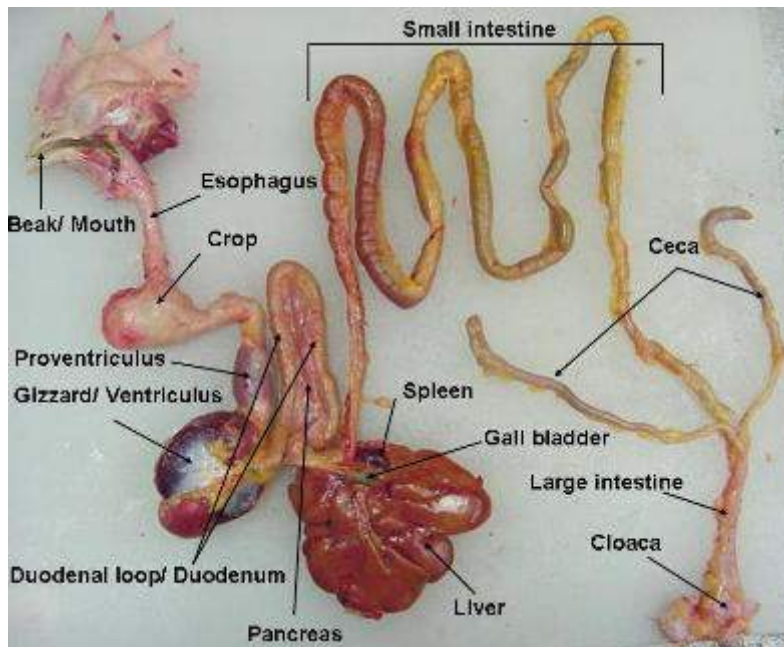


Fig. 1. Digestive tract of a female chicken. Source: Jacquie Jacob, University of Kentucky.

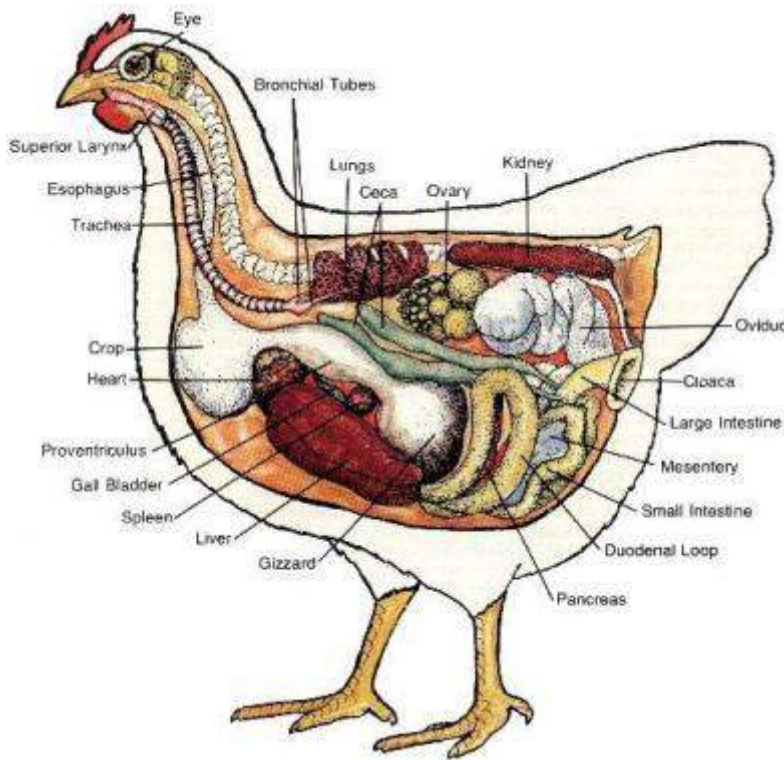


Fig. 2. Location of the digestive tract in a female chicken. Source: Public domain.

## Beak/Mouth

As with most birds, a chicken obtains feed by using its beak. Food picked up by the beak enters the mouth. Chickens do not have teeth, so they cannot chew their food. However, the mouth contains glands that secrete saliva, which wets the feed to make it easier to swallow.

Also, the saliva contains enzymes, such as amylase, that start the digestion process. The chicken uses its tongue to push the feed to the back of the mouth to be swallowed.

## Esophagus

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The esophagus is a flexible tube that connects the mouth with the rest of the digestive tract. It carries food from the mouth to the crop and from the crop to the proventriculus.

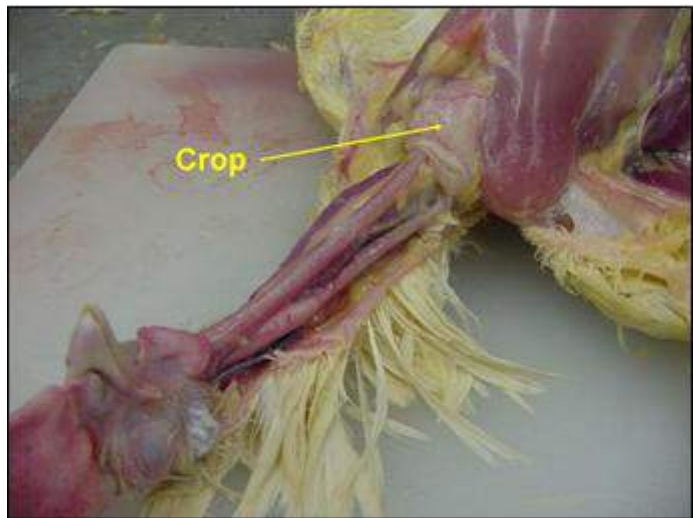
## Crop

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The crop is an out-pocketing of the esophagus and is located just outside the body cavity in the neck region (see Figure 3). Swallowed feed and water are stored in the crop until they are passed to the rest of the digestive tract. When the crop is empty or nearly empty, it sends hunger signals to the brain so that the chicken will eat more.

Fig. 3. Location of the crop in a female chicken. Source: Jacquie Jacob, University of Kentucky

Although the digestive enzymes secreted in the mouth began the digestion process, very little digestion takes place in the crop—it is simply a temporary storage pouch. The crop evolved for birds that are typically hunted by other animals but need to move to the open to find feed. These birds can consume relatively large amounts of food quickly and then move to a more secure location to digest that food.



Occasionally, the crop becomes impacted, or backed up. This problem—called crop impaction, crop binding, or pendulous crop—can occur when a chicken goes a long time without feed and then eats too much too quickly when feed is available again. Crop impaction also can occur when a chicken free-ranges on a pasture of tough, fibrous vegetation or eats long pieces of string. With crop impaction, even if a chicken continues to eat, the feed cannot pass the impacted crop. The swollen crop also can block the windpipe, causing the chicken to suffocate.

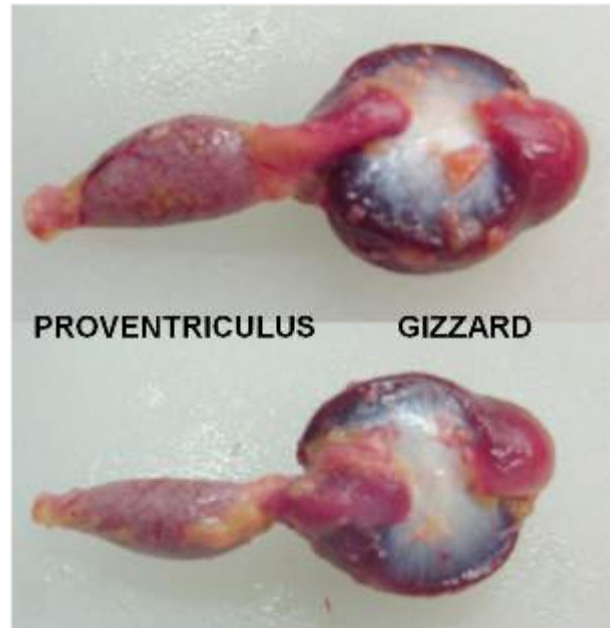
## Proventriculus

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The esophagus continues past the crop, connecting the crop to the proventriculus. The proventriculus (also known as the true stomach) is the glandular stomach where digestion primarily begins. Hydrochloric acid and digestive enzymes, such as pepsin, are added to the feed here and begin to break it down more significantly than the enzymes secreted by the

salivary glands. At this point, however, the food has not yet been ground—this organ is called the proventriculus because its location in the digestive tract is before the ventriculus, where food is ground (see Figure 4).

Fig. 4. Two views of the proventriculus and gizzard from a chicken digestive tract. Source: Jacquie Jacob, University of Kentucky



## Ventriculus (Gizzard)

The ventriculus, or gizzard, is a part of the digestive tract of birds, reptiles, earthworms, and fish. Often referred to as the mechanical stomach, the gizzard is made up of two sets of strong muscles that act as the bird's teeth and has a thick lining that protects those muscles (see Figure 5). Consumed feed and the digestive juices from the salivary glands and proventriculus pass into the gizzard for grinding, mixing, and mashing.



Fig. 5. Inside of a chicken gizzard, with the internal lining removed. Source: Jacquie Jacob, University of Kentucky

When allowed to free-range, chickens typically eat small stones. The acidic environment in the proventriculus softens the stones, and then the strong muscles of the gizzard grind them into tiny pieces. The stones remain in the gizzard until they are ground into pieces small enough to pass to the rest of the digestive tract.

Grit, a commercial product made up of small stones, can be used as a supplement to chicken feed. Chickens fed only commercially prepared feed do not need grit. Chickens that eat whole grains or chickens kept on pasture that do not consume enough pebbles with the forage typically require a supplementation of grit. Grit should not be confused with limestone or oystershell, which are given to laying hens as sources of calcium for their eggs' shells.

When a chicken eats a small, sharp object, such as a tack or staple, the object is likely to get stuck in the gizzard. Because of the strong grinding motion of the gizzard's muscles, such sharp objects can put holes in the gizzard wall. Chickens with damaged gizzards grow thin and eventually die. Preventing this situation is a good reason to keep a poultry house free of nails, glass shards, bits of wire, and so on.

## Small Intestine

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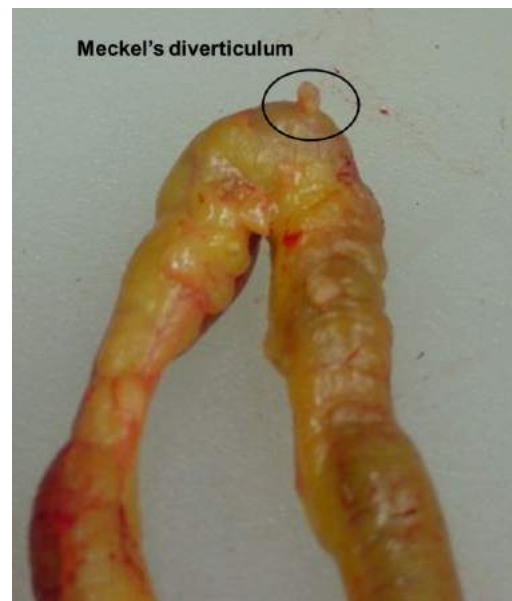
The small intestine is made up of the duodenum (also referred to as the duodenal loop) and the lower small intestine. The remainder of the digestion occurs in the duodenum, and the released nutrients are absorbed mainly in the lower small intestine.

The duodenum receives digestive enzymes and bicarbonate (to counter the hydrochloric acid from the proventriculus) from the pancreas and bile from the liver (via the gall bladder). The digestive juices produced by the pancreas are involved primarily in protein digestion. Bile is a detergent that is important in the digestion of lipids and the absorption of fat-soluble vitamins (A, D, E, and K).

The lower small intestine is composed of two parts, the jejunum and the ileum. The Meckel's diverticulum marks the end of the jejunum and the start of the ileum (see Figure 6). The Meckel's diverticulum is formed during a chicken's embryonic stage. In the egg, the yolk sac supplies the nutrients needed for the embryo to develop and grow. Right before hatch, the yolk sac is taken into the navel cavity of the embryo. The residual tiny sac is the Meckel's diverticulum.

Fig. 6. Location of the Meckel's diverticulum in the digestive tract of a chicken. Source: Jacquie Jacob, University of Kentucky.





## Ceca

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The ceca (plural form of *cecum*) are two blind pouches located where the small and large intestines join. Some of the water remaining in the digested material is reabsorbed here. Another important function of the ceca is the fermentation of any remaining coarse materials. During this fermentation, the ceca produce several fatty acids as well as the eight B vitamins (thiamine, riboflavin, niacin, pantothenic acid, pyridoxine, biotin, folic acid, and vitamin B12). Because the ceca are located so close to the end of the digestive tract, however, few of the produced nutrients are absorbed and available to the chicken.

## Large Intestine (Colon)

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Despite the name, the large intestine is actually shorter than the small intestine. The large intestine is where the last of the water reabsorption occurs.

## Cloaca

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In the cloaca, the digestive wastes mix with wastes from the urinary system (urates). Chickens usually void fecal material as digestive waste with uric acid crystals on the outer surface—that is, chickens do not urinate. The color and texture of chicken fecal material can indicate the health status of the chicken's digestive tract: the white, pasty material coating chicken fecal material is uric acid, the avian form of urine, and is normal.

The reproductive tract also exits through this area. When a hen lays an egg, the vagina folds over to allow the egg to leave through the cloaca opening without coming into contact with feces or urine.

## Intestinal Microflora

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Both the small and large intestines normally are populated with beneficial organisms (bacteria, yeast, etc.), referred to as microflora (*micro* meaning "small" and *flora* meaning "plants"). These microflora aid in digestion.

When chicks hatch, their digestive tracts are virtually sterile. If raised by a mother hen, a chick obtains the beneficial microflora by consuming some of its mother's fecal material. In artificial incubation and brooding, chicks do not have this option. In such situations, producers can provide the chicks with probiotics, which are preparations containing the beneficial microflora that normally inhabit a chicken's digestive tract. Through the probiotics, the chicks receive the beneficial bacteria they need to fight off infection by pathogenic bacteria, such as salmonella.

Intestinal disease in chickens normally occurs when the balance of normal microflora is upset—that is, the normal microflora are overrun by too many foreign organisms. The result is enteritis, or inflammation of the intestines. Enteritis produces symptoms that include diarrhea, increased thirst, dehydration, loss of appetite, weakness, and weight loss or slow growth. Severe damage to the intestinal tract typically is called necrotic enteritis (*necrotic* meaning "dead tissue"), which is a problem in many types of production systems.

# Avian Immune System

 [articles.extension.org/pages/65345/avian-immune-system](https://articles.extension.org/pages/65345/avian-immune-system)

**Written by:** *Dr. Jacquie Jacob, University of Kentucky*

Knowledge of the avian immune system is critical when designing a poultry health program.

## Immune System Mechanisms in Chickens

Like other avian immune systems, the immune system of chickens is made up of two types of mechanisms—nonspecific and specific.

**Nonspecific immune mechanisms** include the inherent ways in which a chicken resists disease. These mechanisms, often overlooked when flock managers design a poultry health program, include the following factors:

- **Genetic factors.** Through generations of selection, breeders have developed chicken strains that do not have the receptors required for certain disease organisms to infect them. For example, some strains of chickens are genetically resistant to the lymphoid leukosis virus.
- **Body temperature.** The high body temperature of chickens (105°F–107°F) prevents a number of common mammalian diseases from affecting them. For example, black leg disease and anthrax of cattle are not problems in poultry (although these diseases may occur if the body temperature of a chicken is lowered).
- **Anatomic features.** Many disease organisms are unable to penetrate a chicken's intact body coverings (skin and mucus membranes) or become trapped in the body's mucus secretions. Some nutritional deficiencies (such as biotin deficiency) and infectious diseases compromise the integrity of the body coverings, allowing penetration of disease organisms.
- **Normal microflora.** The skin and gut of a chicken normally maintain a dense, stable microbial population. These microflora prevent invading disease organisms from establishing themselves.
- **Respiratory tract cilia.** Parts of the respiratory system are lined with cilia, which remove disease organisms and debris. High levels of dust or ammonia in a poultry house can cause the ciliary system to become overwhelmed and ineffective.

An understanding of nonspecific immune mechanisms helps explain why good management practices are important in maintaining poultry health. For example, overuse of antibiotics or poor sanitation may lead to a disruption of the normal microflora; poor nutrition may lead to

selection of disease-resistant strains of chickens may prevent or lessen the effects of certain diseases.

**Specific immune mechanisms**, which make up the acquired immune system, comprise noncellular (humoral) and cellular components. The **noncellular component** includes **immunoglobulins** (or **antibodies**) and the cells that produce them. Antibodies are specific for the foreign materials (antigens) to which they attach. For example, the antibody against Newcastle disease virus attaches only to the Newcastle virus, not to the infectious bronchitis virus. The **cellular component** of the specific immune mechanisms includes all the cells that react with specificity to antigens *except* those associated with antibody production. The cells associated with this system, T-lymphocytes (T-cells), begin as the same stem cells as B-lymphocytes (B-cells). However, T-cells are programmed in the **thymus**, whereas B-cells mature in the **bursa of Fabricius**.

## Active and Passive Immunity

A chicken may become immune to a disease organism by producing antibodies itself or by obtaining antibodies from another animal.

The process of a chicken producing its own antibodies following exposure to a foreign material (such as a bacterium) is called **active immunity**. This process occurs when the bird is exposed to a vaccine or a field disease challenge. Active immunity is adversely affected by anything that damages the cellular or humoral immune systems.

The process of a chick receiving pre-made antibodies from a hen through the egg is termed **passive immunity**. The antibodies are not produced by the chick. Maternal antibodies are present in the yolk, albumen, and fluids of the egg. If a hen has a high antibody titer level to a particular disease, the chick also is immune to that disease for several weeks. However, since the immune system of the chick is not stimulated to protect against that disease, the chick will produce no additional antibodies specific for that disease and will have no memory cells to produce such antibodies in the future. A flock manager must be aware of the maternal antibody levels in chicks to schedule vaccinations. If a chicken is vaccinated when maternal antibody titer levels are elevated, the vaccine may be buffered excessively, resulting in a reduced response. Conversely, if vaccination is delayed, and maternal titer levels are low, a severe vaccine reaction may result.

## Lymphoid Organs

The **lymphoid organs** play a major role in avian immunity. As previously indicated, the bursa of Fabricius (site of B-cells) and the thymus (site of T-cells) are considered primary lymphoid organs. Functional immune cells (T-cells and B-cells) leave these organs and accumulate in secondary lymphoid organs, such as the **spleen, bone marrow, and gland of Harder**. Also, the lungs have lymphoid tissue that helps protect against inhaled disease organisms. This tissue is referred to as the bronchial-associated lymphoid tissue (BALT). Similarly, a series of lymphoid tissues in the digestive tract make up the gut-associated lymphoid tissue (GALT). The GALT includes the **cecal tonsils** and the **Peyer's patches** in the intestine.

# Avian Muscular System

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 [articles.extension.org/pages/65369/avian-muscular-system](https://articles.extension.org/pages/65369/avian-muscular-system)

**Written by:** *Dr. Jacquie Jacob, University of Kentucky*

For anyone interested in raising poultry for meat, an understanding of the avian muscular system—particularly the muscular system of poultry—is essential for recognizing problems that may occur and taking action to correct them. Also, it is important to know what happens as muscle becomes meat and to be aware of issues that can arise with poultry meat.

The muscular system comprises approximately three-quarters of the body weight of a chicken. Chickens, like all animals, have three types of muscle: smooth, cardiac, and skeletal. **Smooth muscle** is controlled by the autonomic nervous system (ANS) and is found in the blood vessels, gizzard, intestines, and organs. **Cardiac muscle** is the specialized muscle of the heart. **Skeletal muscle** (also called **striated muscle**) is the muscle that forms the shape of a chicken and is used for the chicken's voluntary movements. Tendons are tough, fibrous strands that attach these muscles to bone.

The poultry meat we eat is skeletal muscle. The breast meat of chicken often is referred to as **white meat**. White meat results from muscles that are used less frequently. Chickens usually do not fly. Consequently, they do not use their breast muscles as often as they would if they flew more frequently or for longer distances on a regular basis. The leg meat, such as thigh meat, typically is referred to as **dark meat**. Dark meat results from muscles that are used for sustained activity. Chickens use their legs for walking. The higher activity of the leg muscles increases the muscles' need for oxygen. The darker color of more active muscles comes from a chemical compound in the muscle called **myoglobin**, which is important for oxygen transport. Other species of poultry that are capable of flight (such as some ducks, geese, and guinea fowl) have dark meat throughout their bodies (that is, in the breast, thigh, and drumstick).

U.S. consumers, in general, tend to prefer white chicken meat, which typically is used in value-added products, such as chicken nuggets and chicken fingers. White meat often is considered the healthier of the two types of chicken meat because it has less fat and more protein than dark meat. The higher fat content of dark chicken meat gives it more flavor.

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## Converting Muscle to Meat



After a chicken is slaughtered, plucked, and eviscerated (evisceration is the removal of internal organs), the muscles undergo changes that affect the quality and appearance of the meat. After slaughter, the heart is no longer pumping and supplying oxygen to the muscles. Due to the lack of blood supply, lactic acid accumulates in the muscles, and the pH declines (the muscles become more acidic). The rate of the pH decline and the final value it reaches are important factors affecting meat quality and color. The pH typically needs to decline from the normal of 7 to 5.8. If the pH does not decline enough (usually because of excess activity before slaughter), the meat will be dark, firm, and dry. On the other hand, if the pH drops too quickly immediately after slaughter, the result is the occurrence of **pale, soft, exudative** (PSE) meat.

Another aspect of converting muscle to meat has to do with aging the meat. As is commonly observed after death, **rigor mortis** sets in soon after slaughter, resulting in a stiffness of the body. At this state, the muscles are temporarily tough. After a period of time, the muscles become more flexible again. For this reason, chicken is aged rather than eaten immediately after being processed.

## Issues with Poultry Meat

In the commercial turkey and chicken industries, the occurrence of PSE meat has increased during the past several years. Poultry processors are concerned about PSE meat in fresh tray packs because its pale color can affect color uniformity within the package. Although pale meat is as healthful and safe as more highly colored meat, it is less appealing to consumers. Moreover, while all poultry meat loses moisture during processing, pale-meat chicken loses more moisture than other poultry meat. It is estimated that pale meat results in an annual loss of about \$200 million for the U.S. broiler industry.

**Deep pectoral myopathy (DPM)**, or green muscle disease, was first identified in commercial turkey production and involves the necrosis, or death, of a part of the breast tenderloin (minor pectoral muscles), which results in yellowish-green tissue. Because the tenderloin is deep in the breast, the diseased tissue typically goes unnoticed in a carcass that is sold whole until the carcass is carved for serving.

It is believed that green muscle disease results from vigorous activity of the breast muscles, but only the tenderloins are affected. During vigorous activity, muscles normally swell from increased blood flow supplying oxygen and nutrients needed by the muscles. Compared to other muscles, the tenderloins have a more rigid muscle cover and are confined to a tighter space within the body. Consequently, they cannot expand to accommodate this increased blood flow. The net result of the muscle's being confined and compressed is self-strangulation, suffocation, and, eventually, death of portions of the tissue.

The incidence of green muscle disease increases with increasing market weight in broilers, and more cases are reported in higher-yielding crosses, especially males. Increased broiler activity induced by such factors as feed or water outages, lighting programs, catching and live haul, and even excessive noise, may result in an increased incidence of green muscle disease. The increased activity associated with free-range broiler production, especially if predators are in the area, has resulted in an increased incidence of green muscle disease as well.

## Avian Reproductive System—Female

 [articles.extension.org/pages/65372/avian-reproductive-systemfemale](https://articles.extension.org/pages/65372/avian-reproductive-systemfemale)

**Written by:** *Dr. Jacquie Jacob, University of Kentucky*

For anyone interested in raising chickens for eggs, whether for eating or incubation, an understanding of the female avian reproductive system is essential for recognizing problems that may occur and taking action to correct them.

The avian reproductive system is designed to accommodate the risks associated with being a bird. Other than birds of prey (such as hawks, eagles, and falcons), most birds *are* prey. Being close to the bottom of the food chain, birds require unique strategies for reproducing that also allow them to retain the ability to fly. For most birds, these unique strategies include producing many offspring and tending to the needs of the offspring for only a short period of time. The amount of time that birds devote to caring for their offspring depends on whether they are precocial or altricial birds, with the latter requiring more post-hatch parental care. Another reproductive strategy of birds is to produce offspring that develop outside the mother's body in eggs. All the nutrients needed for an embryo to fully develop are provided in the egg before it is laid. It is for this reason that eggs are so nutritious for humans.

Poultry lay eggs in clutches. A **clutch** is a group of eggs laid by a hen on consecutive days. After laying a clutch, a hen has a rest period of about a day or more and then lays another clutch. Clutch sizes are species- and breed-specific. For commercial egg layers, clutch size is typically large. Clutch size, as well as the number of clutches laid in a hen's laying cycle, varies by species, but the principle is the same across species.

An overview of the female chicken reproductive system helps explain why hens lay eggs in clutches. The reproductive system of a chicken hen is made up of two parts: the **ovary** and the **oviduct**. Ova (yolks) develop in the ovary. When an ovum (singular of ova) has matured, it is released from the ovary into the oviduct. This release of the ovum is **ovulation**. In the oviduct, glands secrete substances that form other parts of the egg, such as the albumen (egg white) and the shell. The total time a hen's body takes to transform a yolk into a fully developed egg and lay that egg is about 25 to 26 hours. Typically, about 30 to 75 minutes after a hen lays an egg, the ovary releases the next ovum. However, the female chicken reproductive system is sensitive to light exposure, especially the number of hours of light in a day. In chicken hens, ovulation usually occurs under normal daylight conditions and almost never after 3:00 p.m. So, when a hen lays an egg too late in the day, the next ovulation occurs the following day, and the hen has a day when it does not lay an egg.

## Parts of the Female Chicken Reproductive System

As stated, the female chicken reproductive system is made up of the ovary and the oviduct. (Figure 1 shows the female chicken reproductive system, and Figure 2 shows the location of the reproductive system in the body.) In almost all species of birds, including poultry, only the left ovary and oviduct are functional. Although the female embryo has two ovaries, only the left one develops. The right one typically regresses during development and is nonfunctional in the adult bird. (There have been cases in which the left ovary has been damaged and the right one has developed to replace it.)

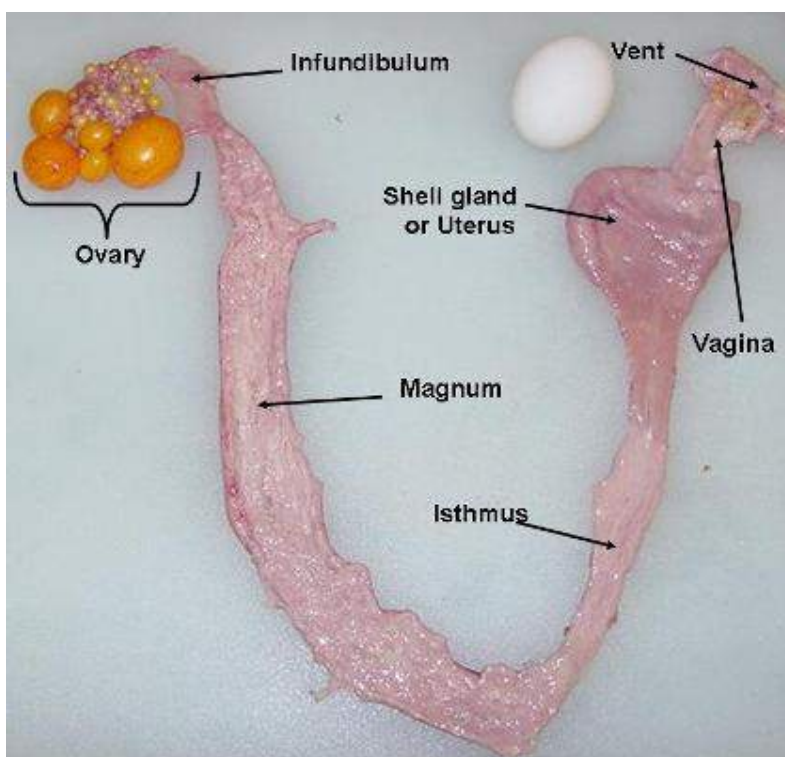


Fig. 1. Reproductive tract of a female chicken. Source: Jacquie Jacob, University of Kentucky

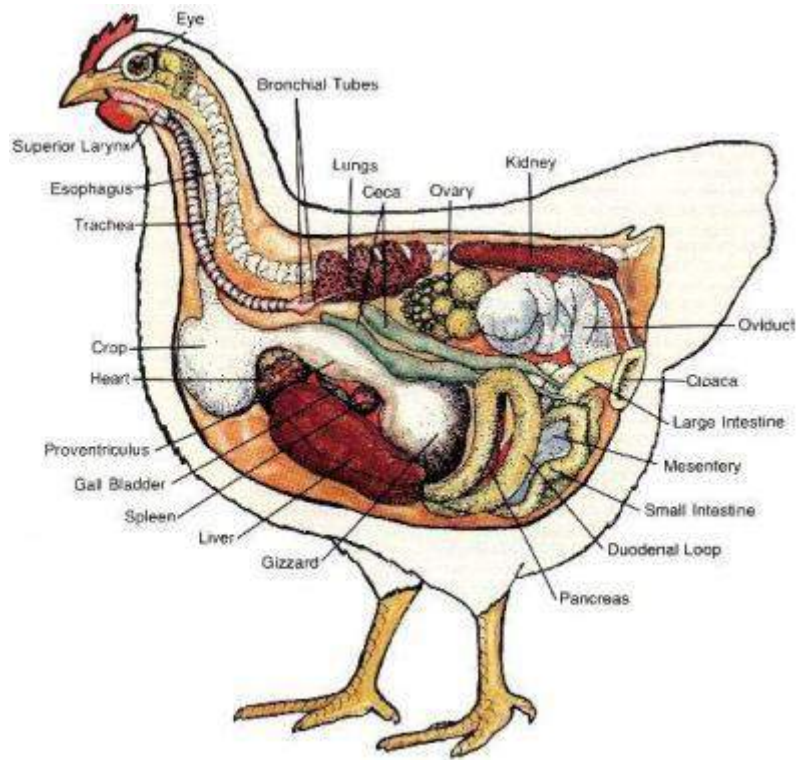


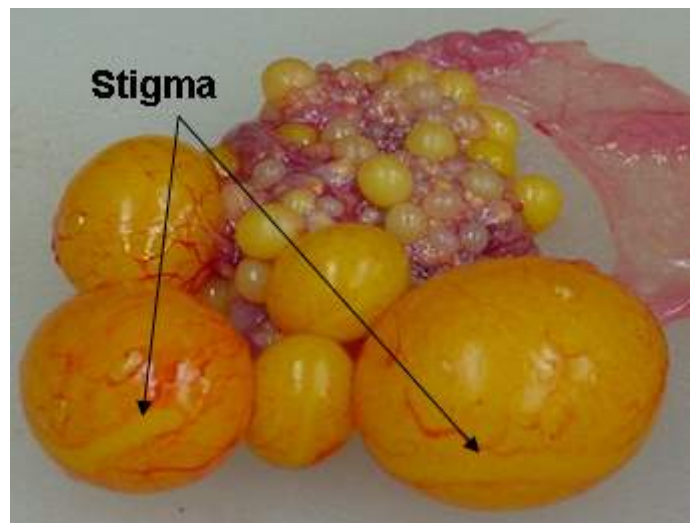
Fig. 2. Location of the reproductive tract in a female chicken. Source: Public domain

## Ovary

The ovary (shown in Figure 3) is a cluster of developing ova, and is located midway between the neck and the tail of the bird and attached at the back. The ovary is fully formed when a pullet chick hatches but is very small until the chick reaches sexual maturity. At hatch, a pullet chick has tens of thousands of ova, or potential eggs that theoretically could be laid, although most never develop to the point of ovulation. The maximum number of eggs a hen can lay is determined when it hatches because no new ova form after the chick hatches.

Fig. 3. Ovary of a chicken in egg production. Source: Jacquie Jacob, University of Kentucky

Each ovum starts as a single cell surrounded by a vitelline membrane. As the ovum develops, additional yolk forms. The color of the yolk comes from fat-soluble pigments, called xanthophylls, contained in the hen's diet. Hens fed diets with yellow maize (field corn) or allowed to range on grass typically produce eggs with dark yellow yolks. Hens fed diets with white maize,





sorghum, millet, or wheat typically produce eggs with pale yolks. The color of yolks can be improved (made darker) by the addition of marigold petals to feed to provide the desired level of xanthophylls. The ovum is enclosed in a sac that ruptures along the **stigma**, or suture line, during ovulation.

## Oviduct

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When ovulation occurs, the ovum (yolk) enters the **oviduct**. The oviduct is a twisted tube that is 25 to 27 inches long when fully developed and is divided into five major sections. These sections are the infundibulum, magnum, isthmus, shell gland, and vagina.

The first part of the oviduct, the **infundibulum** (or funnel) is 3 to 4 inches long and engulfs the ovum released from the ovary. The term *funnel* is an inaccurate name for this section because it suggests that the infundibulum is waiting for the yolk to fall into it, which is not the case. Instead, the released yolk stays in place, and the muscular infundibulum moves to surround it. The yolk remains in the infundibulum for 15 to 17 minutes. Fertilization, if it is going to occur, takes place in the infundibulum.

The next section of the oviduct is the **magnum**. At 13 inches long, it is the largest section of the oviduct, as its name implies (*magnum* being the Latin word for "large"). The yolk remains here 3 hours, during which time the thick albumen (egg white) forms.

The third section of the oviduct is the **isthmus**, which is 4 inches long. The isthmus, as its name implies, is slightly constricted (the term *isthmus* referring to a narrow strip of land joining two larger tracts of land). The isthmus is where the inner and outer shell membranes form. The developing egg remains here for 75 minutes.

The next section of the oviduct is the **shell gland** (or uterus), which is 4 to 5 inches long. In this section, the shell forms on the egg. The shell largely is made of calcium carbonate. The hen's body mobilizes 8 to 10 percent of body calcium from its bones to make the egg's shell. Bone calcium provides 47 percent of the calcium required to make a shell, and the hen's diet provides the remainder. Pigment deposition, if there is any, occurs in the shell gland. The egg remains here for 20 or more hours.

The last part of the oviduct is the **vagina**, which is about 4 to 5 inches long. The vagina does not really play a part in egg formation but is important in the laying of the egg. The vagina is made of muscle that helps push the egg out of the hen's body. The **bloom**, or **cuticle**, forms on the egg in the vagina prior to **oviposition** (the laying of the fully formed egg). The egg travels through the oviduct small end first but turns in the vagina and comes out large end first.

Near the junction of the shell gland and the vagina are deep glands known as sperm host glands that can store sperm for long periods of time, typically 10 days to 2 weeks. (One of the unique things about birds is that the sperm remain viable at body temperature.) When a hen lays an egg, sperm can be squeezed out of these glands into the oviduct and then can migrate to the infundibulum to fertilize an ovum.

## Egg Irregularities

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Various events can occur during reproduction that cause irregularities in eggs. Some of these irregularities affect the quality of the egg or consumer acceptance of the egg.

If the vitelline membrane surrounding the yolk becomes damaged, pale spots or blotches develop on the yolk. This irregularity is referred to as **mottling**. Although the appearance of the yolk has changed, there is no effect on the egg's nutritional value and typically the mottling is not noticed by consumers. A high incidence of yolk mottling, however, adversely affects consumer acceptance. The use of cottonseed meal (which contains gossypol) and sorghum (which contains tannin) in the diet can increase the incidence of mottling. A calcium-deficient diet also has this effect.

Occasionally, a hen produces **double-yolked eggs**. This phenomenon can be related to hen age, but genetic factors also are involved. Young hens sometimes release two yolks from the ovary in quick succession. Double-yolked eggs are typically larger in size than single-yolked eggs. Double-yolked eggs are not suitable for hatching as they typically have inadequate nutrients and space available for two chicks to fully develop and hatch. It has happened, but it is rare.

It is rare, but not impossible, for a young hen to produce an egg with no yolk at all. **Yolk-less eggs** (sometimes referred to as pullet eggs) are usually formed when a bit of tissue is sloughed off the ovary or oviduct. The tissue stimulates the secreting glands of the different parts of the oviduct, and a yolk-less egg results.

Even rarer is an **egg within an egg**. This occurs when an egg nearly ready to be laid reverses direction, moves up the oviduct, and encounters another egg in the process of forming. A new layer of albumen, new membranes, and a new shell form around the first egg, resulting in an egg inside an egg. Such eggs are so rare that no one knows exactly why they happen.

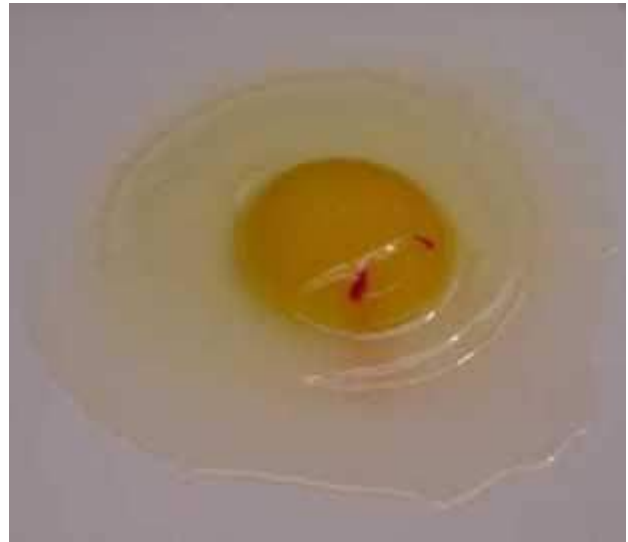
Other egg problems common when people raise their own chickens are blood spots (as shown in Figure 4) and meat spots. **Blood spots** are normally found on or around the yolk. The main cause of a blood spot is a small break in one of the tiny blood vessels around the yolk that occurs when the yolk is ovulated. High levels of hen activity during the time of ovulation can increase the incidence of blood spots. **Meat spots** are usually brown in color and are more often associated with the egg white. They form when small pieces of the wall of the oviduct are sloughed off while the developing egg is passing through. In commercial operations, eggs with blood spots and meat spots typically are identified during candling and removed (see Figure 5). It is rare, therefore, to find eggs with these irregularities in grocery stores. The incidence of blood spots is higher in brown-shelled eggs, and identifying blood spots when candling eggs with darker-colored shells is difficult.

Fig. 4. Broken out egg with a blood spot. Source: Jacquie Jacob, University of Kentucky

Fig. 5. Canded egg showing a blood spot. Source: Jacquie Jacob, University of Kentucky



Occasionally, a hen lays an egg without a shell. A **shell-less egg** feels like a water balloon. The shell membranes form around the yolk and egg white, but the egg somehow bypasses the shell-forming mechanism, and the shell is not completely deposited. The occurrence of the occasional shell-less egg is not necessarily an indication of health problems. If the incidence increases, however, a nutrition problem, primarily a deficiency of calcium, phosphorus, and/or vitamin D, may exist. If the condition persists, a veterinarian should examine the hen. Infectious bronchitis and egg drop syndrome also have been known to cause an increase in shell-less eggs.



Other problems can occur when an egg's shell is developing. The most obvious relate to shell texture. Occasionally, the shell becomes damaged while the egg is in the shell gland and is repaired before the hen lays the egg. This repair results in what is known as a **body check** (see Figure 6). Occasionally, thin spots in the shell or ridges form (see Figure 6). These shells are weaker than those of normal eggs, so eggs with thin spots are removed during inspection of table eggs and should not be used as hatching eggs.

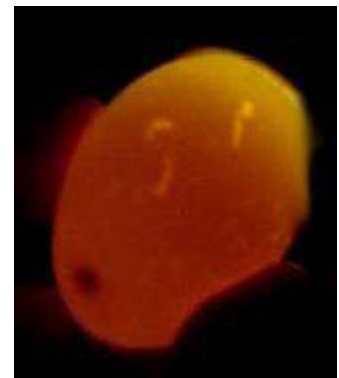


Fig. 6. Examples of poor exterior egg quality related to shell texture. Source: Jacquie Jacob, University of Kentucky

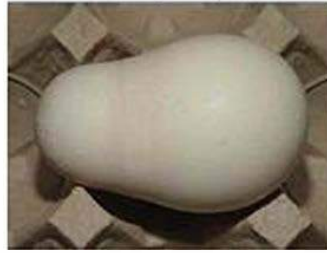
The second category of problems relate to abnormal shape (see Figure 7). Eggs with abnormal shapes do not fit well into a typical egg carton or are more likely to break during transport, so they are removed during egg inspection and are not normally sold in stores.

Hatching eggs also should have the typical egg shape. With many abnormally shaped eggs, it is not clear which is the large end, and eggs should be incubated large end up. Also, such eggs may not properly fit in the egg trays.

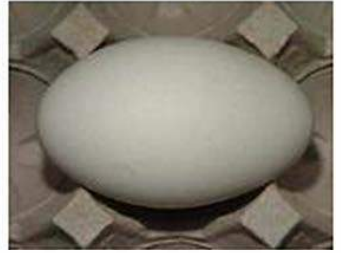


Fig. 7. Examples of abnormally shaped eggs. Source: Jacquie Jacob, University of Kentucky


A. Pearshaped egg



B. Football-shaped egg



## Avian Reproductive System—Male

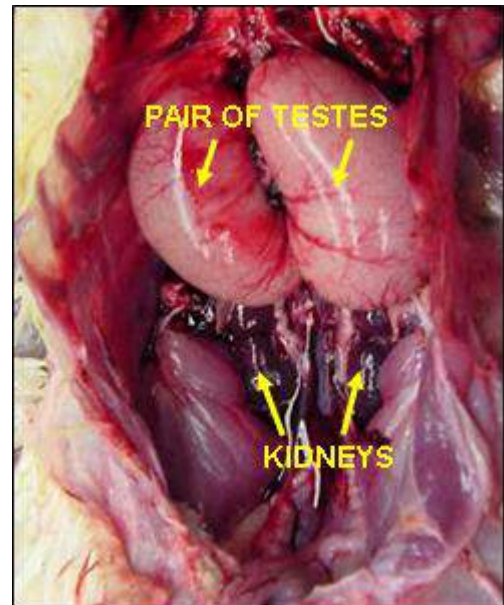
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**Written by:** *Dr. Jacquie Jacob, University of Kentucky*

An understanding of the male avian reproductive system is useful for anyone who breeds chickens or other poultry.

One remarkable aspect of the male avian reproductive system is that the sperm remain viable at body temperature. Consequently, the avian male reproductive tract is entirely inside the body, as shown in Figure 1. In this way, the reproductive system of male birds differs from that of male mammals. The reproductive tract in male mammals is outside the body because mammalian sperm does not remain viable at body temperature.

Fig. 1. Location of the male reproductive system in a chicken. Source: Jacquie Jacob, University of Kentucky.



### Parts of the Male Chicken Reproductive System

In the male chicken, as with other birds, the **testes** produce sperm, and then the sperm travel through a **vas deferens** to the **cloaca**. Figure 2 shows the main components of the reproductive tract of a male chicken.

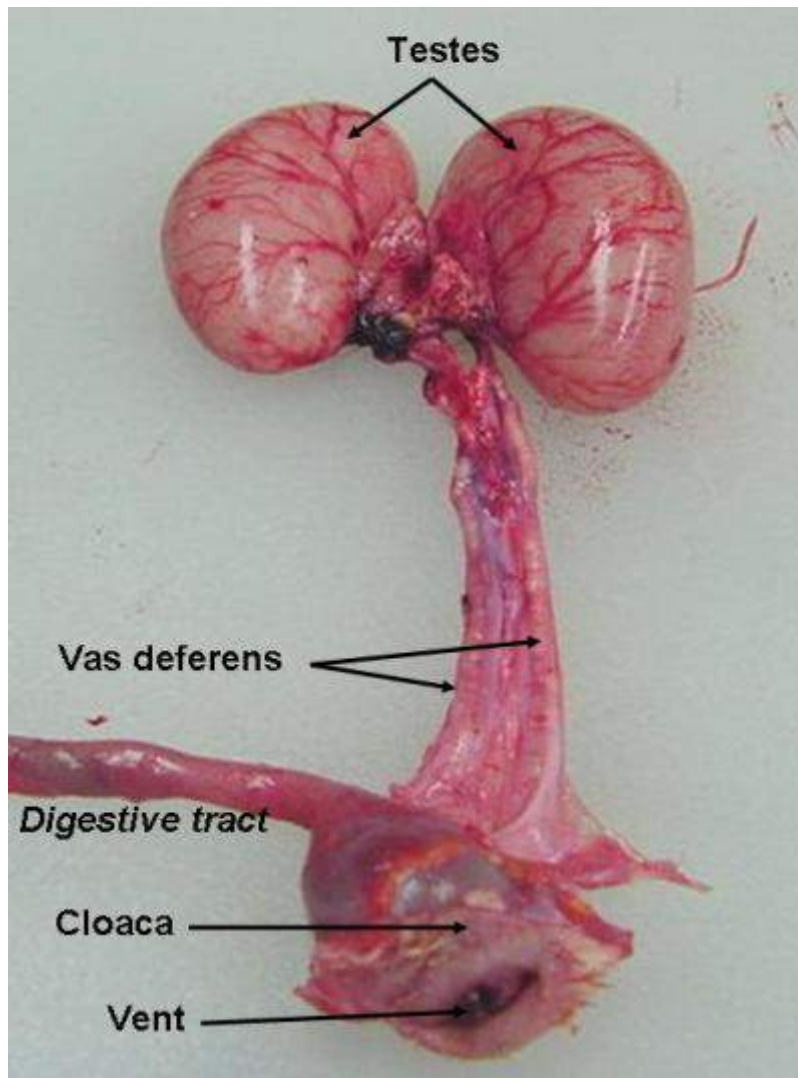


Fig. 2. Reproductive tract of a male chicken. Source: Jacquie Jacob, University of Kentucky.

The male chicken has two testes, located along the chicken's back, near the top of the kidneys. The testes are elliptical and light yellow.

Both gonads (testes) are developed in a male chicken, whereas a female chicken has only one mature gonad (ovary). Another difference between the sexes involves sperm production versus egg production. A rooster continues to produce new sperm while it is sexually mature. A female chicken, on the other hand, hatches with the total number of ova it will ever have; that is, no new ova are produced after a female chick hatches.

The vas deferens is the duct through which sperm are transported from the testes. The male chicken has two vasa deferentia (plural of *vas deferens*). The vas deferens is also the main area of sperm storage in male chickens. Applying external pressure in this area results in ejaculation, and the collection of sperm in this way for artificial insemination of hens often is referred to as milking the rooster.

Each vas deferens opens into a small bump, or papilla, on the back wall of the cloaca. The papillae (plural of *papilla*) serve as the mating organs. (The rudimentary copulatory organ located on the middle and front portion of the cloaca is inaccurately named because the chicken does not use it for copulation, or mating. It is used by breeders to classify the sex of baby chicks.)

## Fertility in Chickens

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The main goal of a chicken breeder is to produce hatching eggs. The only hatching egg is a fertilized, or fertile, egg. **Flock fertility** is the percentage of eggs produced that are fertile. Flock fertility is a critical statistic in hatching egg production: the higher the percentage, the better. An egg that is not fertile contains no embryo; therefore, no chick will hatch. Simply put, hatchability—the percentage of eggs that hatch—can never be greater than flock fertility.

Flock fertility is dependent on the reproductive status of the chickens (that is, the level of egg and semen production) combined with the chickens' interest in and capability of mating. Fertility of both male and female chickens tends to decrease as the chickens get older. For females, it is believed that the decline in fertility is due to faster release of sperm from the sperm storage tubules within the chicken's reproductive system, meaning that the hen cannot store sperm as long and, therefore, requires more frequent mating. For males, it is presumed that although roosters continue to produce sperm for many years, sperm quality declines and mating activity decreases as a rooster ages. Also, an increase in early embryo deaths occurs when incubated eggs come from chickens in the second half of their reproduction cycle. These early deaths often appear as clears and may be mistaken for infertile eggs during candling or breaking out of unhatched eggs.

## Castration of Roosters

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Roosters can be castrated. This castration, or removal of the testes, is referred to as **caponization**. Caponization must be done when a chick is small. While immature the gonads are small and easy to remove. Once the male has reached sexual maturity the gonads are large and too close to the kidneys to allow for their safe removal. When the testes are removed, the cockerel fails to develop certain male characteristics or tends to lose those characteristics if they have developed already.

Caponization produces a unique type of poultry meat (see Figure 3). The meat of a rooster tends to become coarse, stringy, and tough as the rooster ages. This decline in quality of meat does not occur in capons. Caponized males grow more slowly than intact male chickens and accumulate more body fat. Deposits of fat in both the light meat and dark meat of capons is greater than in the meat of intact males, resulting in a meat that is more tender and juicier. The older the age at which a capon is slaughtered, the more flavorful the meat is.

Fig. 3. Capons in a grocery store. Source: Jacquie Jacob, University of Kentucky





# Avian Respiratory System

 [articles.extension.org/pages/65375/avian-respiratory-system](https://articles.extension.org/pages/65375/avian-respiratory-system)

**Written by:** *Dr. Jacquie Jacob, University of Kentucky*

Respiratory diseases are the most common cause of death in a poultry flock. Knowledge of the avian respiratory system is essential for developing a health monitoring plan for a poultry flock, recognizing problems that may occur, and taking action to correct them.

The avian respiratory system is involved in the following functions:

- absorption of oxygen (O<sub>2</sub>)
- release of carbon dioxide (CO<sub>2</sub>)
- release of heat (temperature regulation)
- detoxification of certain chemicals
- rapid adjustments of acid/base balance
- vocalization

An understanding of the functions of the respiratory system begins with an understanding of the parts of the respiratory system.

## Parts of the Chicken Respiratory System

As with any avian respiratory system, the chicken respiratory system (shown in Figure 1) begins at the head region. Parts of the respiratory system in this region include the nasal openings and nasal cavities and the pharyngeal region of the mouth. The **cranial larynx** (sometimes referred to as the **superior larynx** or **glottis**), located in this pharyngeal region, is the opening to the **trachea** (windpipe). The pharyngeal region also has the openings of the esophagus. The cranial larynx is normally open to allow air passage, but it closes when feed is passing down the throat so that the feed goes down the esophagus and does not enter the trachea.

Fig. 1. Chicken respiratory system. Source: Public domain.

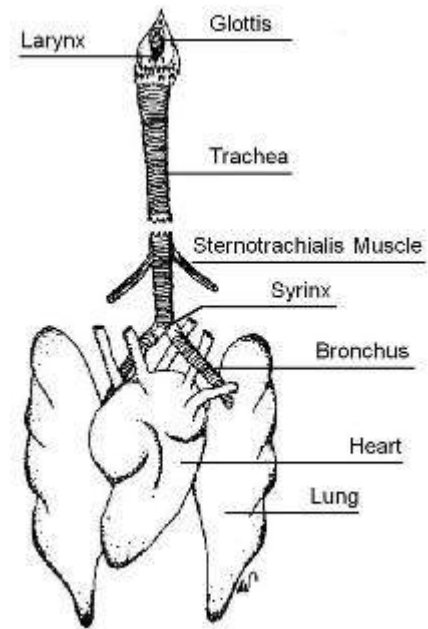
After air passes through the cranial larynx, it continues through the trachea. The trachea is made up of cartilaginous rings that keep it from collapsing due to the negative pressure present when a chicken breathes in air.

The **syrinx** (or **caudal larynx**), located near the end of the trachea, is the chicken's voice box. A chicken does not have vocal cords to produce sound. Instead, a chicken's "voice" is produced by air pressure on a valve and modified by muscle tension. It is not possible to

remove the syrinx to prevent chickens from crowing.

After the syrinx, the trachea divides into two much narrower tubes called **bronchi**. In some respiratory diseases, tracheal plugs form and physically block the respiratory tract at the junction of the bronchi, thus suffocating the chicken.

Each bronchus (singular of *bronchi*) enters a **lung**. Chicken lungs are relatively small, are firmly attached to the ribs, and do not expand. Birds have an incomplete diaphragm and chest muscles and a sternum (keel) that do not lend themselves to expansion in the way that a mammal's chest muscles and sternum do. Consequently, a bird's lungs operate differently from those of a mammal. Mammalian lungs contain many bronchi that lead to small sacs called alveoli. Because an alveolus (singular of *alveoli*) has only one opening, air flows into and out of the alveolus but not through it to the outside of the lung. In comparison, air passes through a bird's lungs in one direction. (In fact, the mammalian respiratory system is described as tidal because air goes in and out like the tide, whereas the avian respiratory system is described as nontidal.)



A bird's lungs contain **parabronchi**, which are continuous tubes that allow air to pass through the lung in one direction, and **air sacs**. The parabronchi are laced with blood capillaries, and it is here that gas exchange occurs. The air sacs, which fill a large proportion of the chest and abdominal cavity of a bird, are balloon-like structures at the ends of the airway system. The key to the avian respiratory system is that air moves in and out through distention and compression of the air sacs, not the lungs. The air sacs act as bellows to suck air in and blow it out and to hold part of the total air volume. At any given moment, air may be flowing into and out of the lung and being "parked" in the air sacs.

Air sacs are somewhat unique to avian species, found elsewhere only in certain reptiles. In the chicken, there are nine such sacs: an unpaired one in the cervical area, two interclavicular air sacs, two abdominal air sacs, two anterior thoracic air sacs, and two posterior thoracic air sacs.

Another important feature of the avian respiratory system is also part of the avian skeletal system. Some of a bird's bones are hollow. The air sacs in a bird's lungs connect to the air spaces in these bones, and the bones then act as part of the avian respiratory system. They are called **pneumatic bones** and include the skull, humerus, clavicle, keel, pelvic girdle, and lumbar and sacral vertebrae. A broken pneumatic bone can cause a bird to have difficulty breathing.

## Dangers to the Chicken Respiratory System

As part of the avian immune system, the chicken respiratory tract normally is equipped with defense mechanisms to prevent or limit infection by airborne disease agents, to remove inhaled particles, and to keep the airways clean. Specifically, chicken respiratory health is protected by the function of three defensive mechanisms: **cilia**, **mucus** secretions, and the presence of **scavenging cells** that consume bacteria. Cilia are tiny hairlike structures in the trachea that are responsible for propelling entrapped particles for disposal. Mucus is produced in the trachea. Mucus secretions and movement of cilia are well developed in chickens. The consistency of the mucus produced is important for the efficiency of the ciliary activity. Cilia cannot function when the mucus is too thick. Scavenging cells in the lungs actively scavenge inhaled particles and bacteria that gain entrance to the lower respiratory tract. These cells consume bacteria and kill them, thus preventing their further spread. The integration of cilia, mucus, and scavenging cells keeps chicken airways free of disease-producing organisms. The impairment of even one of these components permits an accumulation of disease agents in the respiratory tract and may result in disease.

The defense mechanisms of the chicken respiratory system are important because with each breath, a chicken's respiratory tract is exposed to the inside environment of a poultry house. Poor environments normally do not cause disease directly, but they do reduce chickens' defenses, making them more susceptible to infection from existing viruses and pathogens. The air of poultry houses can contain aerosol particles—dust originating from the floor litter, feed, dried manure, and skin and feathers of the chickens. These aerosol particles can have a range of adverse effects on poultry. They act as an irritant to the respiratory system, and coughing is a physiological response designed to remove them. However, excessive coughing lowers a chicken's resistance to disease. Aerosol particles often collect inside chickens and can increase carcass condemnation at the processing plant. Excessive dust in the air also is believed to result in the formation of caseous tracheal plugs, which adversely affect chickens' health.

In addition to the aerosol particles in a poultry house, gases are generated from decomposing poultry waste, emissions from the chickens, and improperly maintained or installed equipment, such as gas burners. Harmful gases most often found in poultry houses are ammonia (NH<sub>3</sub>) and carbon dioxide (CO<sub>2</sub>). Research has shown that as little as 10 ppm of ammonia causes excessive mucus production and damages the cilia. Research also has revealed that ammonia levels of 10 to 40 ppm reduce the clearance of *E. coli* from a chicken's air sacs, lungs, and trachea.

Another danger to the chicken respiratory system has nothing to do with what the bird takes into its system. Because birds do not have a diaphragm, they depend on some movement of the sternum and rib cage to breathe. Holding a bird too tightly restricts movement of the rib cage and can suffocate the bird. This often happens when young children hold baby chicks.

## Avian Skeletal System

 [articles.extension.org/pages/65374/avian-skeletal-system](https://articles.extension.org/pages/65374/avian-skeletal-system)

**Written by:** *Dr. Jacquie Jacob, University of Kentucky*

All vertebrate animals have skeletons. A skeleton allows an animal to stand and protects its internal organs and tissues. The avian skeletal system looks similar to that of mammals but must accommodate a bird's need to be light enough to fly while having necessary body support. Consequently, the skeleton of a bird includes some unique features.



- Some vertebral sections (sections of the backbone) are fused to provide the rigidity required for flight.
- The **sternum** (breastbone or keel) has a surface area large enough to allow for the attachment of the main flight muscles.
- The size of the skull is proportionally small when compared to the skulls of other species because a large head would make flying difficult.
- The tail is a short section of fused bones called a **pygostyle**.
- The ribs include the **uncinate process**, which involves overlying flaps that project from the ribs and connect adjacent ribs, giving strength to the rib cage so that it does not collapse during flight.
- The neck is long in most species. A long, flexible neck acts as a shock absorber, protecting the delicate tissues of the brain from too much jarring when a bird lands. Because a bird's body is rigid, the long neck allows the bird to reach food located on the ground more easily. A long neck also allows a bird's center of gravity to adjust when the bird changes from the upright position of walking or perching to the more horizontal position of flying.



The bones of birds are lighter in weight than those of mammals. Some of the bones are hollow and actually act as part of the avian respiratory system. These bones, called **pneumatic bones**, include the skull, humerus, clavicle, keel, pelvic girdle, and lumbar and sacral vertebrae.

Other important bones in the avian skeleton are the **medullary bones**. These bones include the tibia, femur, pubic bone, ribs, ulna, toe bones, and scapula. Medullary bones are an important source of calcium when hens are laying eggs. Eggshells primarily are made of calcium, and a hen's body mobilizes 47 percent of its body calcium to make an eggshell. When in production, a commercial laying hen cannot obtain enough dietary calcium to allow for daily egg production. Without medullary bones to draw calcium from, the hen would produce eggs with very thin and weak shells.

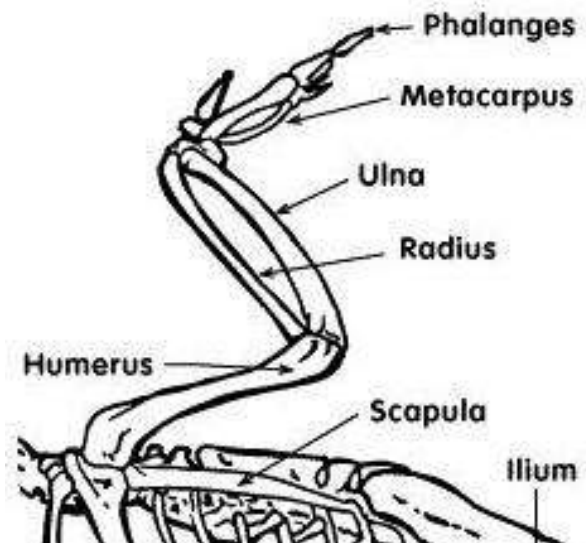
Although important differences exist between the skeletons of birds and other animals, several similarities are present as well. In general, birds have the same skeletal structure as many other animals, including humans (as shown in Figures 1 and 2).

Fig. 1. Comparison of chicken (left) and human (right) arm bones. Source: Public domain.

Fig. 2. Comparison of chicken (left) and human (right) leg bones. Source: Public domain.

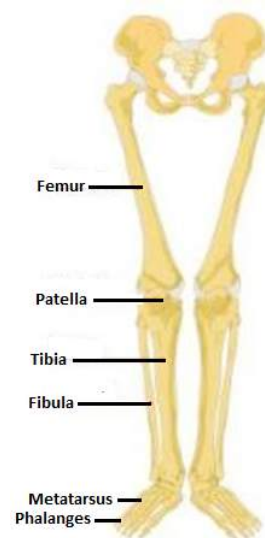
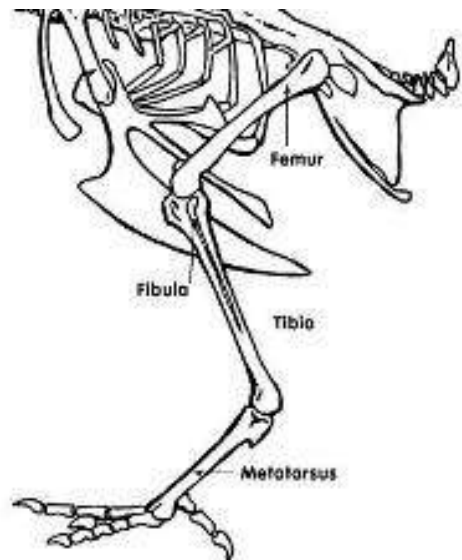
The common joints of the arms of chickens and humans are easily identifiable.

- The joint between the scapula and the humerus is the shoulder.
- The joint between the humerus and the radius/ulna is the elbow.
- The joint between the radius/ulna and the metacarpus is the wrist.



Both the human leg and chicken leg have a femur, a fibula, and a tibia. In a chicken, the femur holds the thigh meat, and the fibula/tibia combination holds the meat of the drumstick. The metatarsus of a chicken is known as the shank, and the chicken walks on its toes. A comparison of the leg joints of chickens and humans is not quite as obvious as a comparison of the arm joints.

- The joint at the top of the femur is the hip.
- The joint between the femur and the fibula/tibia is the knee.
- The joint between the fibula/tibia and the metatarsus is the ankle.




# Poultry Production

Raising Chickens for Egg Production

Raising Meat Chickens in Small or Backyard Flocks

## Raising Chickens for Egg Production

 [articles.extension.org/pages/71004/raising-chickens-for-egg-production](https://articles.extension.org/pages/71004/raising-chickens-for-egg-production)



**Written by:** *Dr. Jacquie Jacob, University of Kentucky*

If you plan to start or have started raising chickens for egg production, you need to understand flock production capabilities. You need to know how to gauge the number of eggs your flock can produce and be aware of the variables that affect egg production. You should be able to identify which hens are laying and determine why your hens are not laying. By having a firm grasp of these factors, you will help ensure the success of your flock.

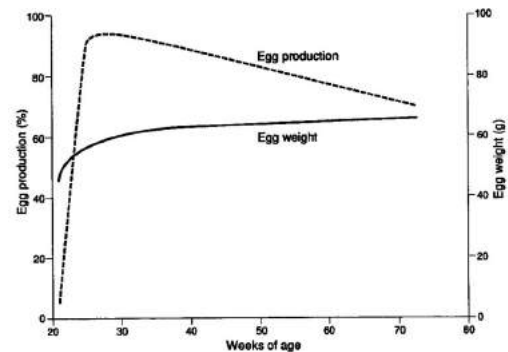
### Production Expectations and Variables Affecting Production

A hen can lay only one egg in a day and will have some days when it does not lay an egg at all. The reasons for this laying schedule relate to the hen reproductive system. A hen's body begins forming an egg shortly after the previous egg is laid, and it takes 26 hours for an egg to form fully. So a hen will lay later and later each day. Because a hen's reproductive system is sensitive to light exposure, eventually the hen will lay too late in a day for its body to begin forming a new egg. The hen will then skip a day or more before laying again. See the related article discussing the [reproductive tract of a chicken](#) for more information on the specifics of egg production.

Also, hens in a flock do not all begin to lay on exactly the same day, nor do they continue laying for the same length of time. Figure 1 shows a typical egg production curve for a flock. The flock comes into production quickly, peaks, and then slowly reduces the level of production.

Fig. 1. Typical egg production and egg weight values for egg-laying flocks.

The length of time that a flock will produce eggs varies as well. Many home flocks produce eggs on and off for three to four years. Each year, the level of egg production is lower than the previous year. Also, egg size increases and shell quality decreases each year.



Both the number of eggs you can get from a flock and the number of years a flock will produce eggs depend on several variables, including the following factors:

- breed
- management of pullets prior to lay
- light management
- nutrition
- space allowances

## Breed

Some commercial breeds of chickens have been developed specifically for egg production. The commercial White Leghorn is used in large egg production complexes, but these birds typically do not produce well in home flocks. They are simply too flighty. Moreover, they lay white-shelled eggs. People purchasing eggs from small flocks often prefer to buy brown-shelled eggs, even though no nutritional differences exist between brown-shelled eggs and white-shelled eggs.

Breeding companies also have developed commercial layers for brown-shelled egg production, with some bred specifically for pasture poultry production. In addition, many hatcheries sell what are called sex-link crosses. These specific crosses allow the hatchery to sex the chicks at hatch based on feather color. As a result, the number of sexing errors is reduced, so you are less likely to get an unwanted rooster.

Some people like having a flock composed of different breeds. Such a flock can produce eggs having a selection of shell colors. Many dual-purpose breeds, such as Plymouth Rocks and Rhode Island Reds, lay eggs with light brown shells. Maran hens lay eggs with dark, chocolate-colored shells, which have become popular lately. The Araucana is a South American breed that has feather tufts around the face and no tail and lays eggs having light blue shells. By crossing Araucanas with other breeds, breeders have produced "Easter



Egger” hens that lay eggs with light blue, green, or pink shells. The chickens produced from these crosses have beards and muffs rather than the tufts seen on Araucanas, and they have tails. If bred to the purebred standards, such a cross will result in an Ameraucana, which lays eggs having blue-green shells.

Obviously, you can choose from several breeds. When making your decision about which breed or breeds to raise, keep in mind that commercial-type hens may give you a higher level of production initially, but other breeds tend to lay for more years. For additional assistance in deciding which breed to choose, see the related article on [which chicken breed is best for a small or backyard flock](#).

## Pullet Management

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It is important to manage pullets correctly, especially in the areas of nutrition and light management, because correct management will affect the level and quality of egg production once the birds start to lay. If the pullets come into production too early, they may have problems with [prolapse](#), which can cause health problems across the flock. Also, the hens may lay smaller eggs throughout the production cycle.

When raising pullets from day-old chicks, brood the chicks as you would any other type of chick. See the related article on [brooding poultry hatchlings](#) for information about basic care of chicks. For future laying flocks, keep in mind that light management is important from brooding through all laying periods.

If you purchase pullets ready-to-lay, you should ask how the pullets were raised with regard to nutrition and light management so that you can adjust your subsequent management of the flock accordingly. For example, you may have to delay light stimulation if the hens are too small.

## Light Management for Year-Round Production

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Chickens are called long-season breeders, meaning that they come into production as days become longer. That is, they start producing eggs when there are more hours of light per day. Typically, day-old chicks are kept on 23 to 24 hours of light per day for the first few days to make sure that they are able to find food and water, especially water. After that time period, you should reduce the number of hours of light per day. If you are raising the birds indoors, you can give them just 8 hours of light per day. If you are exposing them to outdoor conditions, you are limited by the number of hours of light per day in your area, of course. When the pullets are ready to start laying, slowly increase the light exposure until they are exposed to about 14 hours of light per day. This exposure should stimulate the flock to come into lay. To keep the flock in lay year-round, you will need to maintain a schedule of at least 14 hours of light per day. You can increase the amount of light slowly to 16 hours per day late in the egg production cycle to help keep the flock in production. For most flock owners, this strategy involves providing supplemental lighting. Using a light with a stop/start timer, you can cause the light to come on early in the morning before sunrise and in the evening before sunset to ensure that the length of light exposure for the flock totals

14 to 16 hours. Also, you can get a light sensor so that the light bulb does not come on when natural daylight is available. By using such a device, you minimize your electricity use. The supplemental light you provide does not have to be overly bright. A typical 60-watt incandescent light bulb works fine for a small laying flock. For a discussion of other light choices, watch the recording of the webinar [Lighting for Small and Backyard Flocks](#) by Dr. Michael Darre from the University of Connecticut.

## Nutrition

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Chickens of any type and age require a complete, balanced diet. Feed mills assemble the available ingredients in combinations that provide all the nutrients needed by a flock in one package. Some producers mix complete feeds with cheaper scratch grains, but doing so dilutes the levels of nutrients the chickens are receiving, and nutrient deficiencies can occur. Nutrient deficiencies can adversely affect the growth of pullets and the level of production of hens.

It is also important to feed the specific feed tailored for the type and age of the chickens you have. For example, do not feed a “meat-maker” type diet to growing pullets or laying hens as it will not meet their nutritional needs. Likewise, do not feed a layer diet to growing chickens. The diet of a laying hen is high in calcium, which is needed for the production of eggshells. This level of calcium, however, is harmful to nonlaying chickens.

Some hens have a higher need for calcium than others. It is always good to have an additional source of calcium available. Oystershell, usually available in feedstores, is an excellent calcium supplement for a laying flock.

For more information, read the related article on [feeding chickens for egg production](#).

## Space Allowances

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To produce effectively, laying hens must have adequate space. The amount of floor space required by a flock depends on the size of the chickens (which is related to the breed of chicken chosen) and the type of housing used. A minimum of 1.5 square feet per hen is recommended, with 2 square feet per hen being the most commonly used space allowance. Larger allowances are required for some of the larger breeds.

To make use of the entire housing facility, you can incorporate perches. The hens will sleep on the perches at night, keeping them off the floor. The use of perches also helps concentrate much of the manure in a single location for easier cleaning of the poultry house. Moreover, chickens have a desire to perch, so providing for this behavior contributes to animal welfare. For more information, read the related article on [perches](#).

If you provide outdoor space for your chickens, the amount of outdoor space needed depends on the quality of the space. If your goal is to maintain a pasture, you will require more area than you would need if simply providing outdoor access for a small backyard

flock. An allowance of 2 square feet per hen typically is recommended for simple outdoor access. If you do provide your flock with outdoor access, be aware of predator possibilities from both the ground and the air, and provide the hens with the protection they require.

## Identification of Laying Hens

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To determine which of your hens are laying, it is important to know more about the type of hens you have. For many breeds, hens that are laying eggs have large, bright red combs and wattles. For other breeds, the combs and wattles are normal color during the laying period but fade after the laying period. For hens with yellow pigment in the skin, such as Rhode Island Reds and Plymouth Rocks, the level of pigmentation is a good indication of where the hens are in the production cycle. Hens lose the yellow pigment in a specific order. The color fades first from the vent; then the face (beak, eye ring, and earlobe); and then the feet (shanks, toes, and hock). An additional method for identifying laying hens involves evaluating the level of fat in the abdomen and the abdominal capacity as measured by the distances between the pubic bones (abdominal width) and between the pubic bones and the tip of the keel, or breast bone (abdominal depth). The lower the level of fat and the larger the abdominal capacity, the more likely the hen is to be laying.

## Reasons Hens Stop Laying

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any factors can affect egg production, with health (before and after lay) being one of the most significant. If your hens stop laying, you may be able to identify the source of the problem by asking the following questions:

- **Have the hens been laying for 10 months or more?** Your hens may just be at the end of their laying cycle. If so, they will stop production, go through a molt (loss of feathers), take a break, and start laying again. If your hens have been laying for less than 10 months, something else may be causing their lack of production.
- **Are the hens receiving enough fresh, clean water?** The hens will not eat if they cannot drink, so make sure that your watering system is functioning correctly. Keeping a watering system operational can be a challenge in the winter when the water may freeze. You can purchase waterers that have heaters attached to keep the water from freezing. Otherwise, you will have to break up any frozen water on a regular basis. Problems can occur in summer as well. Summertime high temperatures can make the water so warm that the chickens will not drink enough to meet their increased needs. For more information, refer to the related article on the [water requirements of poultry](#).
- **Are the hens eating enough of the right feed?** Feeding the wrong feed, diluting feed with scratch grains, or limiting the amount of feed available can result in your hens having a nutritional deficiency, causing them to molt and go out of production. When hens have a nutritional deficiency, it is common to see feather pecking as well as a loss of egg production.
- **Are the hens getting enough hours of light per day?** Decreases in the number of hours of light per day typically will put a flock out of production. For this reason, many

flocks that are not provided with supplemental light go out of production during the fall and winter months.

- **Do the hens have parasites?** Various internal parasites and external parasites can infest poultry flocks and stress the hens. Heavy infestations of internal parasites can result in serious damage to the digestive tract and reduce hen performance. Heavy infestations of mites can cause anemia in the hens, also adversely affecting their performance.
  - **Did any issues with eggshell quality precede the stop in egg production?** Several diseases can result in abnormal eggshells.
  - **Have there been any health issues within the flock?** A flock that has been sick will not perform as well as a flock that has not gone through a disease challenge.
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## For More Information

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Factors affecting egg production in backyard chicken flocks. J.P. Jacob, H.R. Wilson, R.D. Miles, G.D. Butcher, and F.B. Mather, University of Florida

How much will my chickens eat? Jacquie Jacob and Tony Pescatore, University of Kentucky

Keeping garden chickens in North Carolina. Anne Edwards and Donna Carver, North Carolina State University

Managing a family chicken flock. Jesse Lyons, University of Missouri-Columbia

Proper light management for your home laying flock. Chad Zadina and Sheila Scheideler, University of Nebraska

# Raising Meat Chickens in Small or Backyard Flocks

 [articles.extension.org/pages/69066/raising-meat-chickens-in-small-or-backyard-flocks](https://articles.extension.org/pages/69066/raising-meat-chickens-in-small-or-backyard-flocks)

**Written by:** *Dr. Jacquie Jacob, University of Kentucky*

Raising chickens at home for meat is becoming a popular practice. (Meat chickens are often referred to as **broilers**). Chickens raised in a backyard flock tend to be larger than commercially produced chickens found in grocery stores.

There are two important questions you should ask yourself before starting a small flock of meat chickens:

- **What do you want to accomplish with a home flock?** It is unlikely that you will be able to produce a chicken for less than the cost of purchasing one at the grocery store. A home broiler flock is a good 4H/FFA or family project. It's possible to produce a variety of chicken sizes (Cornish game, fryer, roaster, and so on) by slaughtering at different times—for example, slaughtering one-third of the flock at intervals of five, seven, and nine weeks of age.
- **Are you up to the challenge of taking care of a flock of chickens for multiple weeks?** Chickens require daily care, every day, including weekends and holidays. Consider the time and effort required for the care of a flock before deciding whether or not to start a poultry flock of any kind.

## Additional Considerations

- **Do the local zoning regulations permit you to raise poultry?** Laws and ordinances in some communities might prohibit or restrict the raising of poultry in your neighborhood. Some neighborhoods have restrictions on the processing of animals. If local laws or ordinances allow you to raise birds but not process or slaughter them, you must determine where you will take the birds for processing.
- **Do you have the necessary equipment?**
  - *Housing:* Chickens need a clean, dry, draft-free habitat that provides at least 1.5 sq. ft. of space per chicken.
  - *Heat source:* Chickens require a reliable heat source, such as a heat lamp.
  - *Waterers:* Chickens require an adequate water supply. Typically a one-quart waterer is sufficient at first, and a gallon-sized or larger waterer is appropriate as chickens grow. Fresh, clean water is essential for proper chick health and growth.
  - *Feeders:* Simple chick feeders can be used when birds are young, but a larger feeder will be necessary as chicks grow. Keep in mind that chicks double their

size in only a couple of days and will continue to grow rapidly through their first six weeks. They will need an ever expanding daily water and feed supply.

- *Bedding material:* Broilers need some form of bedding or litter to help keep them warm and to absorb moisture. Wood shavings, sawdust, or rice hulls are good litter choices. The floor of the broiler pen should be covered with a layer of litter at least 3 to 4 in. deep. The caked, or matted, litter should be removed every day. Also, the rest of the litter should be turned or stirred up once a day to make it absorb more moisture and last longer between changes. Change the litter weekly, depending on the dampness of the bedding. Never place chicks on slick surfaces such as cardboard, plastic, or newspaper. The smooth surface may result in leg problems.
- **Is the housing at sufficient distance from neighbors to prevent them being disturbed with any noise, odor, or flies that might be generated?** Use care in siting and constructing housing for your chickens, and develop a plan for manure management that will prevent odor problems.
- **Are you able to butcher your chickens yourself or is there a facility nearby where you can pay to have them butchered?**
- **Do you have enough freezer space to accommodate the number of chickens you plan to produce?**

## Getting Chicks

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It is strongly recommended that your purchase day-old chicks from a **NPIP-certified** hatchery. The breeders from such hatcheries have had their blood tested for some important poultry diseases. It is possible to get your chicks through the mail, so the hatchery you chose does not have to be within driving distance. For chicks shipped through the mail, however, a minimum order of 25 chicks is typically required.

Meat-type chicks are usually purchased on a straight-run (males and females mixed) basis. Some producers prefer to raise only pullet chicks (females). Others buy unsexed chicks, which are typically cheaper. Pullets carry more flesh over the back and breast than cockerels (males) and generally have a more rounded appearance to the breast, thighs, and legs. Cockerels, however, grow faster and reach market weight earlier than pullets.

The most economical chicken breed to raise for meat is the commercial broiler, which is a hybrid cross of different breeding flocks. Broiler chickens have been selected for fast growth and are normally the breed raised in state broiler contests. Broilers or fryers are slaughtered at seven to nine weeks of age, when they weigh 3 to 5 lb. and dress as a 2.5 to 4 lb. carcass. The same bird that when slaughtered at five weeks of age provides a Cornish game hen can be grown out to twelve weeks or longer to make a delicious roaster. If you are looking for something that grows a little slower, consider a New Hampshire, Rhode Island Red, or White Plymouth Rock.

## Preparing for Chicks

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Clean and disinfect the poultry house, feeders, and waterers at least two weeks before the chicks arrive. Wash down the house with soap and water. Then spray a commercial disinfectant labeled for use in poultry houses. Be prepared for the chicks two days in advance. Put at least 4 in. of litter on the floor of the cleaned, disinfected house.

Turn on the heat source to warm up the brooding area before chicks arrive. Infrared lamps are a convenient, easy-to-use heat source. Use porcelain sockets approved for these lamps and hang them with a chain or wire. Make certain that lamps are secured so they cannot fall to the litter and create a fire hazard. The lamps should hang so that the bottoms are 18 to 24 in. from the litter. Lamps can be raised or lowered depending on temperature conditions. Heating lamps should **not** be hung with the electric cord. The use of more than one heat lamp is often recommended, especially during cold weather, so chicks will not be without heat if a bulb burns out. There are two-bulb units that come with a thermostat, which may make it easier to control the temperature in the space. It is important to remember that you are heating the chicks and not the air, so air temperature measurements may not be the best guide when using infrared lamps. When chicks arrive, monitor the temperature at their level and observe their behavior to determine whether the temperature is appropriate (more information below).

Feed and water should be ready in the chick pen before the chicks arrive. The bottom halves of egg cartons make good feeders for the first two to three days; after that, switch to metal or plastic feeders.

*Figure 1. Brooding chicks. Source: Jacquie Jacob, University of Kentucky*



## Caring for Chicks

The first thing that chicks need when they arrive, especially if they were shipped through the mail, is water. Dip the beak of each chick into the water to teach them where the water is. This will prevent the chicks from getting dehydrated.

Young chicks are not able to adequately regulate their body temperature, so they need a source of heat for the first few weeks (referred to as the **brooding period**). It is important that the chicks have enough room to move toward or away from the heat source to find their

individual comfort zones. For the first week, the chicks' environment needs to be in the range of 90°F to 95°F. Reduce the temperature gradually, five degrees each week, until the broilers are three to four weeks old or until the pen temperature is 70°F. Place waterers a good distance from the lamps to prevent splashing water from cracking the hot bulbs. When using a heat lamp, you can change the brooding temperature by adjusting the height of the heat lamp above the floor. The temperature should be monitored with a thermometer at chick level and by observation of the chicks' response to the heat source. Cold chicks will huddle together under the heat source; hot chicks will move to the outer limits of the brooder guard; comfortable chicks will stay in a semicircle around the heat zone.

Construct a cardboard **brooder guard** (brooder circle) to keep chicks near heat, water, and feed during the first week. When the chicks are seven days old, the brooder guard can be removed to provide the chicks freedom to move around all of the pen. Distribute the feeders and waterers around the pen.

Light should be provided 24 hours a day for broilers. Twenty-four hour light (natural or artificial) increases feeding time and weight gain and improves feathering in broilers. One 40-watt bulb, hung about 6 ft. above the chicks, is needed for each 200 sq. ft. of pen space. It is a common practice to expose the chicks to short periods (10 to 15 minutes) of darkness once or twice early in the project. This will prevent panic or piling if the electricity goes off during the project.

Broilers must have adequate space to grow to their maximum potential, and the amount of required feeder and waterer space increases as the broilers get bigger. There should be enough feeder space for all the chicks to eat at one time. For chickens, feeding is a social activity, and they tend to eat as a group whenever possible. For the first two weeks, about 2 in. of feeder space is required for each chick (remember to count both sides of a long, straight feeder). After two weeks the chicks will need double this amount (4 in. per chick). To prevent feed spillage, fill the feeders only halfway. To prevent litter and chicken manure from getting into the feeders, raise the feeders off the floor as the chicks grow. A good rule of thumb is that the height of the feeders should be at the height of the chicks' backs. When switching to a new type of feeder or waterer, leave the old ones in the pen for a few days to allow the chicks to adjust to the new feeder or waterer.

Chicks also need access to fresh, clean water **at all times**. Since chickens do not eat as much if they cannot drink, it is important to have adequate waterer space. The waterers need to be cleaned and filled daily with fresh water. As with the feeders, the height of the waterers needs to be raised as the chicks grow. The lip of the waterer should be level with the height of the chicks' backs.

**Commercial feeds** are available that provide the required nutrients for growing chickens. Typically a high protein diet is fed the first two weeks, and then feeds with less protein are fed thereafter. Check with your feed dealers to see what types of feeds they have available for purchase. A 22% to 24% percent protein starter mash is usually fed to poultry meat birds for the first four weeks. Many feeding programs then switch to a 20% protein finisher feed until broiler market time. Meat birds grown on chick starter and developer feeds with lower

protein and energy content will not gain weight as rapidly as those on a broiler feeding program. When switching from one type of a diet to another, it is a good practice to mix the two feeds for a few days to provide a slow transition from one feed to the other. Broilers typically consume 2 lb. of feed for each pound of weight they put on.

Broiler chicks grow very fast, sometimes faster than their feathers. As a result, the chicks may look "half-naked" during much of the growing period. This is normal and not cause for concern.

It is possible to purchase chicken feed containing a coccidiostat as a means of controlling **coccidiosis**. If you keep your housing clean, you should not require this preventive measure. If you do need to use a coccidiostat, it must be removed from the feed several days prior to butchering (the withdrawal time should appear on the feed label).

**Feather pecking and cannibalism** can occur within a flock and are caused by overcrowding, improper ventilation (air movement), improper nutrition, and insufficient feeder or waterer space. If cannibalism cannot be controlled with proper management of these factors, the beaks of the broilers can be trimmed at any age. Beak trimming involves removing a portion of the upper mandible (beak) with a hot blade.

Poor **air movement** in small poultry houses during hot, humid weather can result in excessive broiler mortality, especially when the broilers are approaching market weight. Placing fans in the house to blow air past the chickens can greatly reduce mortality from this problem.

During the growing period, check the broilers for **external parasites** such as mites, lice, and ticks. If you encounter a problem, a commercial dust is available that can be applied directly to the chicks. Providing the chicks with an area to dust bathe will also help to control external parasites.

## Family Safety

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Protect your family from bird-transmitted disease by following these guidelines.

- Always wash your hands thoroughly with soap and water after handling poultry and/or poultry equipment.
  - Do not allow toddlers to handle poultry.
  - Avoid contact with poultry feces.
  - Wash your hands, counter tops, and utensils with hot, soapy water after handling raw poultry.
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## For More Information

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### General Information

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Raising broilers. Tom Danko, University of New Hampshire.

Home production of broiler chickens. William Owings, Iowa State University.

The small flock for poultry meat. Melvin Hamre, University of Minnesota.

Production of eggs and home-raised, home-butchered broiler and turkeys. Scott Beyer and Rhonda Janke, Kansas State University.

Break-even analysis of small-scale production of pasture organic poultry. - University of Idaho

#### **4-H and/or FFA Projects**

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The broiler project. Theresia Lavergne and Keith Fontenot, Louisiana State University.

Raising broilers and turkeys for competition. Susan Watkins, Frank Jones, F. Dustan Clark, and Jerry Wooley, University of Arkansas.

Raising broilers and roasters as 4-H and FFA projects. David Laatsch, University of Wisconsin.

# Behavior

Normal Behaviors of Chickens in Small and Backyard Poultry Flocks

# Normal Behaviors of Chickens in Small and Backyard Poultry Flocks

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 [articles.extension.org/pages/66175/normal-behaviors-of-chickens-in-small-and-backyard-poultry-flocks](https://articles.extension.org/pages/66175/normal-behaviors-of-chickens-in-small-and-backyard-poultry-flocks)

**Written by:** *Dr. Jacquie Jacob, University of Kentucky*

Chickens are one of the most studied animal species, and researchers observed chicken behavior extensively. The term *behavior* can be defined as "the way in which an animal or person acts in response to a particular situation or stimulus." In 1935, research by **T. Schjelderup-Ebbe** (1894-1976) led to the recognition of a **pecking order**—a social hierarchy within chicken flocks.

More recent research has primarily focused on the importance of different "normal" behaviors in relation to animal welfare in a commercial operation. Research indicates, for example, that laying performance of chickens is influenced by human interaction. Producers should walk through the laying house a couple of times per day, selecting times that fit into the flock's egg laying cycle, such as in the early morning before the majority of the hens have started laying and later after laying time has ended. Producers should not walk through the house at peak laying time or the hens are likely to lay more eggs on the floor. By walking through the laying house, producers expose the chickens to low levels of stress, which the chickens get habituated to. This process is referred to as socialization.

## Chick Behavior

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Much early research on chicken behavior focused on determining which behaviors are instinctive and which are learned. In a study, chicks blindfolded from the onset of hatch until one to three days of age instinctively preened themselves and scratched on the ground. In addition, when given a worm, even if alone, these chicks ran around as though there might be others in pursuit of the worm. Research has shown that chicks instinctively show fear of stinging insects but try to catch flies. Some behaviors, however, have to be taught. For example, chicks peck at their own excreta until they learn not to. Chicks must also be taught to drink—when chicks are raised without a hen, producers must dip their beaks in water so that they learn to drink. (When the beak gets wet, the chick's drinking response is initiated.) Researchers have observed that chicks will not peck at a sheet of water, even if they are thirsty and standing in it. They will, however, peck at shiny objects or bubbles in the water.

## Hen-Chick Relationship

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There is some evidence of prehatching interactions between hens and chicks. Embryos and hens begin to vocalize the day before hatching and do so more and more often as hatching approaches. If an embryo begins to give a distress call, the hen vocalizes or moves on the nest and the embryo becomes silent or begins to emit pleasure calls. Hatching bobwhite quail chicks have been shown to interact with other chicks. The time of hatching may be advanced by having contact with a slightly more advanced clutch of eggs. This acceleration, however, takes place only when chicks are in the latter stages of incubation and pipping.

The main need of newly hatched chicks is warmth. Research has shown that chicks will press against any source of warmth if they are cold; the source need not be a hen. Contact with a human hand as early as 15 minutes after hatching, for example, has been shown to reduce the number of distress calls. The clucking sound of the hen has also been shown to reduce distress calls.

In studies, chicks that had not been exposed to the sound or sight of a hen ran to a box containing a hen and other chicks. This instinct to respond to the hen, however, is lost by eight days of age. When chicks from different hens were combined and allowed to mingle, they were able to locate the appropriate hen when the hens were placed with the group. After three weeks of age, the chicks were less effective in doing so.

Chicks are able to identify their mother hen by various means, but hearing seems to be an important one. When a sitting hen was removed in the dark from her chicks and another broody hen put in her place, the chicks still found their mother hen. When the hen was disguised by various means, her chicks came to her anyway. Vision does, however, appear to play an important role in helping chicks recognize their mother hen. When chicks from three different breeds of hens were removed and placed in a pen with hens of the same breed, most of the chicks were able to find to the correct breed of the mother hen. (That is, when placed in the new pen, chicks from a black hen went to the black hen, those from a red hen went to the red hen, and those from a white hen went to the white hen.) There were some chicks, however, who made mistakes.

Hens have no favorites when it comes to a brood of chicks. It is simply first come, first served. Vocal communication is important in the hen-chick relationship. If a chick is hidden from its hen, it gives distress calls, and the hen typically goes in the direction of the sound. If, however, the chick is in a glass container—so that the hen can see but not hear the chick—the hen takes no notice of the chick.

For the first 10 to 12 days after hatching, chicks stay close to the hen. After this age, they begin to feed independently of the hen but still sleep and warm themselves under her. This stage lasts from six to eight weeks of age. The time at which a hen disassociates from her brood varies, but it typically occurs before the chicks are 12 to 16 weeks of age. The hen initiates the breakup of the brood. She pushes her chicks away and then rejoins the other adult birds. If the hen is not able to return to other adults, she will remain in charge of the brood until the males in the group are mature and begin to dominate her. If she has only one or two chicks, she may tolerate her offspring longer than usual.

## Chick-to-Chick Behavior

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Recently hatched chicks do not typically show any competitive behavior until after three days of age. By 16 days of age, fighting to determine the pecking order begins. Research has shown that with groups composed entirely of female chicks, the pecking order is established by the 10th week. In small groups, the order is typically established earlier, around eight weeks. With groups of males, the social order may remain unresolved for many weeks.

Some early research has shown that certain chicks within a brood develop leadership roles. In a scenario in which there are two sources of heat, only one of which is turned on, chicks gather around the one turned on. If that heater is turned off and the other turned on, chicks move to the other heat source. In such a scenario, some chicks repeatedly respond sooner than others. A few of these leaders have been reported to leave the group under the warm heat lamp and go to a chick lagging in the cold so that the chick will follow the leader to the heat source.

## Behavior of Mature Chickens

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### Individual Recognition

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Birds that normally form a social hierarchy, such as chickens, doves, and pigeons, usually attack a new bird of the same species or breed that is introduced into the pen or cages. In order to develop a pecking order, birds must be able to recognize individuals in a flock. This ability allows them to identify and peck only those hens lower in the pecking order. It is not clear what clues chickens are using in order to identify individual chickens within a flock.

Early research examined the effect of returning an experimentally modified bird to a flock. If the bird was pecked, researchers assumed that the others in the flock did not recognize the bird. For example, it was shown that if the lippy comb of a hen was moved to the other side of the head, she was not recognized by the others in the flock. Similarly, when individual dubbed hens were returned to a flock, they were attacked by the hens that had previously been below them in the pecking order. If, however, a larger number of dubbed hens were returned to the flock, the chickens were able to develop a new pecking order. This would suggest that the comb is not the only factor used in identifying individuals in a flock. Research showed that individual birds react to feather changes and make adjustments. Intense color changes on white individuals are more effective in producing a loss of recognition than different shades or tints. Alterations of the head and neck were shown to be more effective in producing a loss of recognition than changes to areas of the main body. Although some features are more influential than others, no single feature is the sole means of recognition.

Recent research suggests that laying hens are able to recognize around 30 individuals. The social structure developed in small groups begins to break down in flocks of 30 to 60 birds. When there are more than 60 the birds in a flock, the chickens become less aggressive and

more tolerant of each other.

## Preening

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Grooming activity in birds is referred to as **preening**. Feathers are important for insulation and waterproofing (in addition to flight for those birds that can fly). Feathers are composed of a shaft with several long thin structures called barbs. These barbs are held together by smaller barbules. Sometimes the barbs are pulled apart, which makes the feather ineffective for insulation and waterproofing. A bird runs its feathers through its beak when it preens, which realigns the barbs and makes the feathers better able to perform their functions. Birds also need to keep their feathers oiled to prevent them from becoming brittle and to help with insulation and waterproofing. Birds have a single oil gland near the base of the tail, referred to as the preen gland. Birds pinch this gland with their beaks to extract a waxy oil, which they then apply as they pass their feathers through their beaks. Chickens preen on their own, but they prefer to do it as a group activity.

For more information about feathers, refer to the article on the [Anatomy of a Feather](#).

## Fighting

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Chicks start fighting when they are only a few weeks old. They are already starting to establish their rank in the flock. This fighting often continues until they reach maturity and the pecking order is well established. Sometimes fights occur among adult birds. This can occur when a member of the flock becomes tired of its position in the social hierarchy and decides to challenge a higher-ranking bird. More commonly, however, fights occur when a new bird is introduced into the flock and has to find its place in the pecking order or when a bird is reintroduced to the flock after a long absence.

Although both male and female chickens fight, fights between males tend to be more violent and are more likely to result in injury or death. When two birds are on the verge of a fight, they will eye each other and may casually circle around each other, each pretending to peck at something on the ground while watching the other. When the fight begins, the birds will raise their neck feathers and point their wings toward the ground, spreading them apart from the body. They will then stand as tall as they can and try to face each other down. If neither bird backs down, they will start pecking, scratching, and jumping at each other. They will also beat at each other with their wings.

## Foraging

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In the wild, jungle fowl spend 61% of their time foraging. Foraging behaviors include pecking and scratching at potential food sources, as well as looking for and sampling possible food sources. Providing chickens with a complete feed eliminates the need for foraging in order to obtain nutrients, but the hens will continue performing this behavior. Although finding food is not the ultimate goal of the foraging behavior in domesticated fowl, researchers have not yet been able to determine the motivation for this behavior. There are a number of theories, but little evidence to support them.

## Nesting

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Domestic hens prefer to lay in nests containing loose material that they can settle into, molding the material with their bodies and feet, and that they can manipulate with their beaks. When given a choice, the former condition is more important than the latter. It is important for pullets to have access to nesting boxes before they start to lay. If a hen will not jump up to nest, she must be trained to do so as a pullet. If she does not learn in the laying house, she could end up laying a greater number of eggs on the floor. Birds are mimics, and the first layers become the teachers for the remaining pullets in a flock.

Hens can differ in their preference for nesting location. When a group of hens was given the choice between a nest box and a litter tray, the majority preferred the nest box. There were some hens, however, who preferred the litter tray. Those that selected the litter tray tended to spend more time exploring during the hour prior to laying an egg than did those that selected the nest box. Their final trip to the nest, when the egg was laid, was shorter for those that selected the litter tray.

The prelaying behavior of domestic chickens is similar for most hens. Before laying, a hen shows restlessness and begins to look for a nest, poking her head into the nest boxes provided. Between nest examinations, she typically resumes other behavior she had been performing—eating, preening, sleeping, and so on. Over time, the hen puts more and more of her body into the nest boxes she is examining, eventually entering one and settling down. Hens may stay in the nest after the egg is laid. They may later cackle and leave the nest. Different breeds may exhibit some aspects of prelaying behavior more than others. Leghorn hens, for example, typically show pronounced searching and nest-selection behavior. As a result, these hens spend more time visiting and investigating a number of potential nest sites before choosing one. In contrast, hybrid layers of brown-shelled eggs tend to sit longer in nests and perform nest building activities.

Prelaying behavior is triggered by hormones associated with the last **ovulation** and not by the presence of an egg in the shell gland. Normally, the prelaying behavior begins an hour or two before the egg is ready to be laid. If egg laying is delayed for some reason, the period for prelaying behavior will pass, and the hen will no longer be motivated to search for a nest. In these cases, the egg may be laid outside the nest while the hen goes about other activities. This can happen, for example, when dominant hens prevent subordinate hens from entering nests.

## Dust Bathing

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Dust bathing is the act of rolling or moving around in dirt to cleanse the skin and feathers of parasites, dead skin, and other skin irritants. It also helps prevent the buildup of the oil from preening. When chickens do not have access to dust baths, they will nonetheless go through the motions of dust bathing. In behavioral studies, hens have shown a willingness to work to gain access to material for dust bathing. (Note that access to a dust bath does not prevent feather pecking.)

## Perching

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Chickens have a desire to roost. At about three weeks of age, chicks start to jump up to higher surfaces. The structure of a chicken's claws ensures a firm grip while the chicken is perching and will prevent the chicken from falling off a tree branch, even when the bird is asleep. Chickens go to perches about half an hour before twilight, with the actual time depending on light intensity. For example, they will perch earlier than expected on a dull, cloudy day and later than expected on a bright, clear day. They seem to perch when the light is about 1.25 foot-candles. The "flying down" time in the morning is typically 30 minutes before dawn, at around 0.003 foot-candles of light. Again, the actual timing of this activity varies depending on the weather conditions. Chickens snuggle together during the night and start spreading out about two hours before the lights come on.

## Responding to High Ambient Temperatures

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Chickens can tolerate with cold weather better than hot. Chickens cannot sweat—they cool themselves by dunking their beaks in cold water or flapping their wings to air out their feathers. They may also pant when they are desperate to cool down.

## Drinking

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Chickens must have access to a supply of clean, fresh water. Water in the crop softens feed so that digestion can occur. Without water, dry feed forms clumps in the crop. The clumped feed can press on the bird's carotid artery, decreasing blood flow to the brain. This can cause paralysis and possible death. Poultry have a split in the upper hard palate of the beak that allows air into the nasal passages. This prevents a vacuum from forming in chickens' mouths. As a result, chickens rely on gravity to draw water into the crop. This is why chickens lift their heads after dipping their beaks in water.

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## For More Information

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The behavior of the domestic chicken: A review of the literature. By D.G.M. Wood-Gush. *The British Journal of Animal Behavior*. 111(3):81-110.

# Management

Biosecurity for Small Poultry Flocks

Transport and Care of Poultry

Predator Management for Small and Backyard Poultry Flocks



# Biosecurity for Small Poultry Flocks

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 [articles.extension.org/pages/67296/biosecurity-for-small-poultry-flocks](https://articles.extension.org/pages/67296/biosecurity-for-small-poultry-flocks)

**Written by:** *Dr. Jacquie Jacob, University of Kentucky*

The term **biosecurity** refers to the measures taken to prevent the introduction and/or spread of disease in a poultry flock. It is important for every poultry operation to develop, and implement, a biosecurity plan.

## Elements of an Effective Biosecurity Plan

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### Isolation

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It is important to protect your flocks from contact with other poultry flocks and, when possible, from wild birds. Take the following actions to isolate your flock(s):

- **Maintain a perimeter:** One of the best ways to keep your birds from coming into contact with other birds is to install a perimeter fence. The fence does not have to be expensive to be functional, but it does need to completely surround the birds. It should have gates that are kept closed when not in use. If there are other poultry on neighboring properties, it is highly recommended that a buffer zone be established between the two flocks to prevent mixing of the birds and transmission of any disease that may affect one flock or another. Screens should be placed on poultry-house windows and ventilation holes to keep out wild birds.
- **Avoid introducing new birds into a flock:** It is recommended that new birds not be introduced into an existing flock. New birds can carry disease into a flock even if they show no outward signs of being sick. The new birds may have recovered from a disease, and they could continue to be carriers. If new birds must be introduced into a flock, the new birds should be quarantined for at least two weeks prior to introduction to see whether they develop any signs of disease. Any birds that show signs of disease during this quarantined period should not be incorporated in the flock. If clinical signs appear in a member of your flock, then it is best to submit the sick (or dead) birds to a poultry diagnostic facility for examination and diagnosis. Depending on what the disease is, you may not want to introduce any of the new birds, with or without clinical signs, into your flock. Workers should move from the existing flock to the new birds and never the reverse unless they change clothing and shower.
- **Avoid contact with other birds:** Anyone working with your poultry flock, as well as anyone visiting your flock, should not have had contact with other birds for at least 24

hours before interacting with the flock. Contact with other birds includes hunting and visiting live bird markets, swap meets where birds are present, and pet stores.

- **Prepare a plan for self-quarantine:** If your birds get sick, stop anyone from visiting your flock. It is recommended that the birds be submitted to a diagnostic lab. During the time that you are waiting for a diagnosis, keep movement between the infected flock and other flocks to a minimum. Human and equipment movement can easily spread disease.

## Traffic Control

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Traffic control includes both the traffic on your farm as well as the traffic patterns within the farm. Take the following actions to maintain control of the traffic on your farm:

- **Establish a visitor policy:** Visitors should be kept to a minimum. Be selective about who you allow onto your farm. It is important to inquire about where they have been in the last 24 to 48 hours. If visitors might have been near other birds—poultry as well as pets (canaries, parrots, cockatiels, and so on)—they should not be allowed to interact with the flock. It is recommended that you provide any visitors with protective clothing, especially clean boots or disposable booties.
- **Separate clean and dirty functions:** Identify and distinguish tasks with the flock as dirty and clean. Clean functions include bird handling, egg pickup, and feed handling. Dirty functions include manure pickup and handling of dead birds. It is important to do the clean functions early. Workers should not go from dirty functions to clean functions without showering and changing their clothes completely. Those routinely working with the poultry flock should have specific clothes and shoes or boots that never leave the clean areas (except to be washed).
- **Isolate dead birds and manure management areas:** Areas for dealing with dead birds and litter should be separate from the area occupied by the poultry flock.

## Sanitation

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It is important to clean materials and equipment that come onto the farm. Those working with the poultry flock should also follow good sanitation practices. Note that raising a small flock under organic conditions does not preclude the use of disinfectants. There are a variety of cleaning and disinfecting materials available for use on organic poultry farms.

Be sure to disinfect vehicles and equipment and to disinfect between flocks:

- **Vehicle disinfection:** All vehicles entering a farm must be cleaned and disinfected to prevent the introduction of disease-causing organisms that can be carried on the vehicles. High-pressure sprayers can effectively remove organic material. It is important to remove the organic material before using disinfectants because such material can make the disinfectants ineffective. Vehicle wheel walls and undercarriages must be fully cleaned and disinfected before the vehicles enter the farm, and they should be cleaned before leaving as well. It is recommended that a separate area for cleaning vehicles be established at a distance from the flock. If this

is not an option, then provide vehicles with a parking area that is as far as possible from the flock.

- **Equipment disinfection:** Equipment coming onto the farm must also be cleaned and disinfected. Equipment that has been used for dirty functions must be thoroughly cleaned and disinfected before being used for clean functions.
- **Cleaning and disinfection between flocks:** A downtime of two weeks between flocks is recommended. This should give sufficient time for sweeping, cleaning, disinfection, and drying of the entire coop. Use downtime to your advantage as many disease agents do not persist very long in the environment without a host to colonize.

## Pest Control

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Several common poultry pests are capable of introducing and spreading disease on a farm. It is important to control rodents and insects. Be concerned about both flying and crawling insects as they can serve as intermediate hosts for some internal parasites and are capable of transmitting disease agents to your flock.

Rodents will feed on spilled feed, so clean feed spills immediately. Rodents can leave behind feces containing agents of disease that can infect both humans and poultry. Keeping a clean coop and feed room will ensure that you can identify potential pest problems quickly and respond with control measures in a timely manner.

**Webinar on biosecurity** - [https://learn.extension.org/events/1995#.VUjR-pN\\_CdB](https://learn.extension.org/events/1995#.VUjR-pN_CdB)

## Transport and Care of Poultry

 [articles.extension.org/pages/68945/transport-and-care-of-poultry](https://articles.extension.org/pages/68945/transport-and-care-of-poultry)

Having bought poultry from the sale yard or through a private sale, you need to ensure that you are prepared and able to provide adequate transport to your property. It is important that you are capable of caring for your new poultry and providing adequate protection from disease and predators. This fact sheet provides some basic information regarding your obligation as an owner of poultry.

Poultry being transported are subject to stress. Stress may arise from catching or handling, food and water deprivation, exposure to high velocity air movement or loud noises. When selecting poultry for travel, you must ensure that only healthy birds are selected. Sick, injured or weak birds should not be transported.



Poultry fit for transport should be carefully loaded into clean cages or crates. The minimum cage and crate dimensions are 8 inches wide, 12 inches deep, and 10 inches tall per bird.

Cages or crates should be well ventilated and of sufficient height to allow the bird to stand. Cages or crates should have rigid floors and be designed in order to prevent any part of the bird from protruding during travel. Sharp edges, hinges or latches should not project into the cage. Locking mechanisms, to prevent the birds from escaping during transportation, should be fitted.

Catching and handling birds can be very stressful for the bird, as well as for you. Injury during catching and handling can be severe. Prior to picking up the bird, the door to each cage or crate should be opened and the crate placed nearby. Each individual bird should be picked up by grasping both legs with one hand and holding both wings with the other hand to prevent them from hitting harmful objects. After picking up the bird, it should be placed into its transport cage or crate immediately.

Cages or crates should be transported in an upright position to protect the birds from the wind, dangerous temperatures, and inclement weather. Transportation with no access to water and feed must not exceed 8 hours, and birds should be monitored regularly throughout the journey.

- Carry poultry by their head, neck, wings or tail.
- Transport birds in bags.
- Transport birds with their legs tied.

- Transport birds in the trunk of a car.
- Mix mature males or different species of poultry in a single crate or cage during transport.

Before you transport your poultry to your property, it is important to make sure you have adequate facilities to house them. Unloading should occur as soon as possible upon arrival to your destination. Poultry should be handled with care while unloading and should be carried out as previously described. In general, pick the birds up by their legs while preventing their wings from striking solid objects. Thoroughly inspect your birds to ensure they have not sustained any type of injury during handling or transportation.

Unload poultry into an enclosed pen or cage which has direct access to fresh water and feed. Poultry purchased at sale yards have often been without food (and possibly water) for more than 8 hours. Whether you are purchasing pigeons, guinea fowl, chickens, ducks, turkeys, or geese, cages or pens should have an area that will provide protection from inclement weather and from predators. Adequate ventilation is also essential.

Adequate space per bird is important, regardless of the type of poultry that you have purchased. In general, about 0.25 square feet should be used per pound of weight. This will vary depending on if birds are housed in cages or pens and the type of birds that you have, e.g. fancy chickens versus meat chickens. Wood shavings or straw can be used as bedding or in nesting boxes.

Allowing poultry access to the yard or open paddocks may be desirable, but they are at considerable risk from predators, including dogs. Although most poultry will eat insects when allowed open access, geese will graze the grass. Also, you need to keep in mind that the poultry may defecate in undesirable locations and eat garden vegetables.

### **Feed and water requirements:**

Poultry require access to clean and fresh drinking water at all times. It is essential that watering containers be cleaned regularly and an adequate supply must be maintained. Inspection of poultry and their housing facilities should be done at least once each day. Watering containers and feeders designed specifically for poultry are available at your local grain or produce store.



In general, a “table scrap” diet does not meet the nutritional demands of poultry and particularly of growing birds or layers. Common deficiencies include calcium, phosphorous and vitamin D (resulting in poor bone growth and rickets), energy (poor growth, weight loss, or poor egg production) and vitamin A (poor skin and feathering).

Formulated diets are available for all poultry species and stages of a bird’s life (starter, grower and layer), and should be used as the sole source for balanced nutrition. Consult your feed store or local veterinarian to determine the most appropriate feed type and diet

for your birds.

### Assessment of the health of the poultry:

Similar to other species, backyard poultry are susceptible to disease. If you suspect that your birds have one or more of these diseases, you should consult a veterinarian. The spreading of undiagnosed diseases may cause major damage to the United States commercial poultry industry and may also place your family and community at risk.



Please remember that poultry require ongoing maintenance and supervision to remain healthy!

**Table 1. Common diseases of poultry.**

| Disease:           | Description:  |
|--------------------|---|
| External parasites | Poultry can carry a large variety of parasites on their bodies. External parasites generally cause mild clinical signs, such as feather damage, anemia and irritation. However, they may also carry severe, life threatening diseases, such as tick fever. Poultry should be examined regularly and treated for external parasites every 2 to 3 months. Products to treat this disease can be recommended by your veterinarian.   |
| Internal parasites | Along with external parasites, poultry can also carry a wide range of internal parasites. Signs of internal parasitism may include weight loss, pale combs or diarrhea. Your local veterinarian will be able to examine the feces and advise the proper treatment.  |
| Marek's disease    | Marek's disease is a viral infection that only affects poultry. The virus is transferred from bird to bird through feather dander and dust. It is able to live in the environment for a considerably long period of time and may also be spread between properties by human transfer. Birds usually become infected at a young age but may not show signs of the disease until months later. The disease may cause transitional neurological signs. In later stages, birds may also develop tumors in and on their bodies. As they grow, the tumors may cause a number of things to occur, such as weight loss, diarrhea, ill thrift and difficulty breathing. It is preferable to purchase poultry that were vaccinated at the age of one day old to prevent this disease. |
| Leucosis           | Avian leucosis is also a viral disease that only affects poultry. It is capable of causing tumors and cancer. These tumors usually appear in older birds (6 months of age or older). It causes listlessness, weight loss and unfortunately, the infected bird will eventually die.  |



|                     |   |
|---------------------|---|
| Respiratory disease | There are many causes of respiratory disease in poultry. Respiratory symptoms such as coughing, sneezing, and discharge from the eyes and nostrils can be caused by parasites, dust, high ammonia levels or a variety of bacteria or viruses, including <i>Mycoplasma gallisepticum</i> , Newcastle Disease Virus and Avian Influenza Virus. If you notice that your birds are developing such symptoms, contact your local veterinarian immediately.   |
| Coccidiosis         | Coccidiosis is one of the most common and costly diseases that affect poultry housed on litter in high densities. It causes droopiness and paleness of the comb, diarrhea and occasionally blood in the feces. The death rate of infected birds may be quite high, both in younger and older birds. To reduce the risk of spreading this disease, keep bedding dry at all times. Vaccines are also available for prevention, as are a wide selection of coccidiostats for treatment of the disease. If you notice that your birds are developing these symptoms, consult your local veterinarian immediately. |

**For more information, please contact:**

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Department of Animal Sciences, The Ohio State University. June 2013.

Information was adapted from: Transport and Care of Poultry, Dr. Mariko Lauber,  
Department of Primary Industries, The State of Victoria, Australia. July, 2007.

<http://www.dpi.vic.gov.au>

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# Predator Management for Small and Backyard Poultry Flocks

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 [articles.extension.org/pages/71204/predator-management-for-small-and-backyard-poultry-flocks](https://articles.extension.org/pages/71204/predator-management-for-small-and-backyard-poultry-flocks)



With the loss of their natural habitat, more wildlife are entering urban settings. Some of these wildlife are predators of poultry. Common predators that feed on poultry flocks include the following mammals, reptiles, and birds:

- dogs and coyotes
- bobcats
- house cats
- foxes, especially red foxes
- raccoons
- members of the weasel family, especially least and long-tailed weasels
- skunks
- opossums
- snakes, especially rat snakes
- hawks, including red-tailed, red-shouldered, and Cooper's hawks
- owls, most commonly great horned owls

## Identification of the Problem Predator

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The best long-term solution for protecting your flock is preventing predators from getting to it. Of course, this tactic is easier said than done. To develop an exclusion plan, you need to determine which type of animal is preying on your birds.

Often, the condition in which you find your flock is an indicator of which predator is involved.

- If adult birds are missing but no other signs of disturbance exist, the predator probably is a dog, a coyote, a fox, a bobcat, a hawk, or an owl. These predators typically are able to kill, pick up, and carry off an adult chicken. Hawks typically take chickens during the day, whereas owls take them during the night.
- If chicks are missing but no other signs of disturbance exist, the culprit may be a snake, a rat, a raccoon, or a house cat. Such predators sometimes leave some feathers and wings scattered away from the site because they are not able to swallow these parts.
- If birds are dead but not eaten and have parts still intact, a weasel may have attacked the flock. Members of the weasel family, including mink, kill just for the fun of killing. Often, the chickens' bodies are bloodied. Also, you might notice that internal organs have been eaten.
- If birds are dead and not eaten but are missing their heads, the predator may be a raccoon, a hawk, or an owl. Raccoons sometimes pull a bird's head through the wires of an enclosure and then can eat only the head, leaving the majority of the body behind. Also, raccoons may work together, with one scaring the chickens to the far end of a pen and the other picking off the birds' heads.
- If birds are only wounded, not dead, various predators may be to blame. If birds show signs of bites all over, a dog may have attacked the flock. Dogs do not have sharp enough teeth to consume animals cleanly. If the wounds are on the breasts or legs of young birds, an opossum may be the problem. Bites on the hocks of young birds often indicate that rats have preyed on the flock. If birds have bites and show signs that their intestines have been removed through their cloacae, the attacker may be a member of the weasel family, or cannibalism may be occurring in the flock.
- If eggs are missing, one of several predators—including skunks, snakes, rats, opossums, raccoons, blue jays, and crows—may be at fault.

In addition to examining the condition of your flock, you may be able to identify tracks of a predator that is a mammal. To view tracks more easily, put fine sand or talc powder around the area, and look for tracks the following day. The images of tracks shown in the next section of this article may help you identify a predator.

## Predator Behavior

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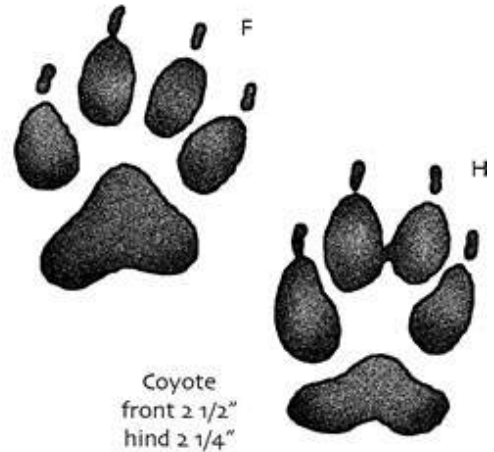
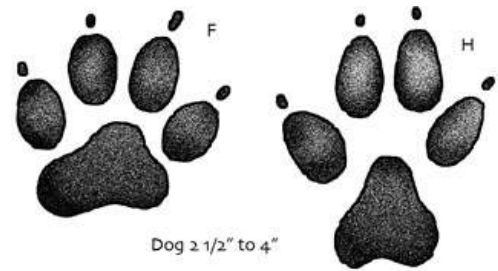
To understand how and why various animals attack poultry flocks, it can be helpful to know more about their behaviors. Knowledge of predator behavior provides background you can use as you try to identify and address predators of your flock.

## Dogs and Coyotes

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Domestic dogs allowed to run free in a neighborhood can be a problem for poultry flocks. They often kill simply for the fun of it. Dogs descended from the wolf and have retained some of the hunting instinct of this predecessor. Not all dogs will attack a poultry flock. In fact, some breeds are good guard dogs for a flock. Factors that contribute to the likelihood that a dog will attack a flock include the breed of the dog, the presence of other dogs, and the dog's past experiences. Some breeds have a greater tendency to chase prey than others. This inclination can be heightened by the presence of other dogs, often resulting in pack behavior. Also, if a dog has had success in the past at getting food by attacking a poultry flock, it is more likely to repeat the behavior.

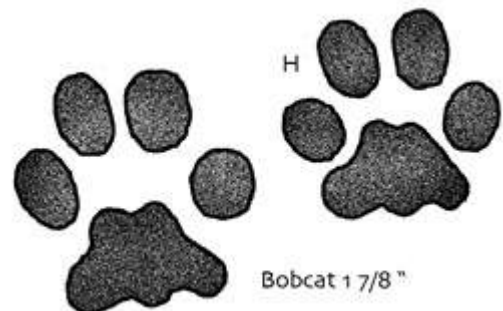
Although coyotes have been seen traveling in large groups, they usually hunt in pairs. Coyotes are primarily nocturnal (active at night) but often can be seen during daylight hours. They were once diurnal (active during the day) but, through adaptation, have developed more nocturnal habits to adjust to habitat pressure from humans.



## Bobcats

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The most common wildcat in the United States, the bobcat is only about twice the size of a typical domestic cat. Like cats, bobcats can see in low light. They prefer to hunt during the twilight hours of dawn and dusk but will attack anytime of day. They can easily carry off a chicken or two from your flock. A bobcat may eat an entire bird in a single feeding or carry the carcass away. Bobcats prefer woodlands but will venture into backyards in search of prey, especially where housing encroaches on their normal habitat.

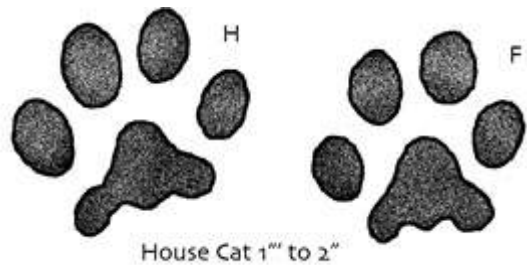




## House Cats

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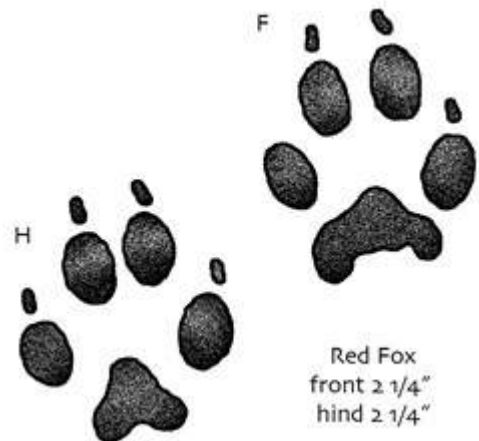
Even if well-fed, domestic cats will kill young birds. Cats are messy eaters that tend to leave parts of prey in the open areas where they have eaten. Typically, they eat the meaty portions of a bird and leave the skin, with feathers attached. With smaller birds, however, cats often consume the whole bird, except for the wings and scattered feathers. In addition, cats usually leave teeth marks on every exposed bone of prey they have eaten.



## Foxes

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Foxes, red foxes in particular, prey on poultry flocks. Foxes usually attack a bird at the throat, but some kill by multiple bites to the neck and back. Normally when a fox has been in the hen house, evidence includes only a few drops of blood and feathers. The fox carries away the dead bird, often to a den. Foxes also eat eggs. They usually open the eggs just enough to lick out the contents and leave the shells beside the nest. Most foxes live in wooded areas or on open plains, where they dig dens in the ground. They sometimes use hollow logs for dens. Gray foxes, the only foxes that readily climb trees, may den in hollow cavities of trees.



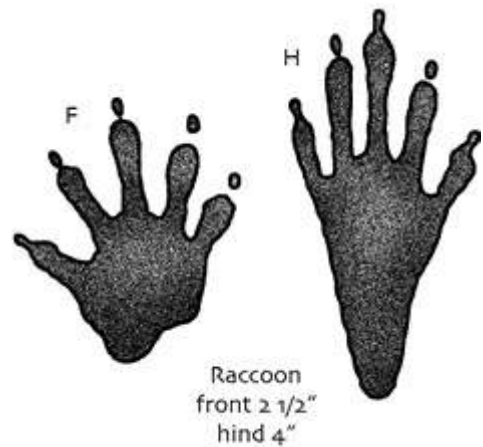




## Raccoons

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Raccoons enter poultry houses and take several birds in one night. They often tear and chew a bird's breast and crop and sometimes eat the entrails. They may remove eggs from the nest and take them away, usually within 9 meters (28 feet) of the nest, to eat them. Garbage cans and dumps can be major sources of food, attracting raccoons to urban areas. Once settled in an area, raccoons will seek other food sources, including backyard poultry flocks.



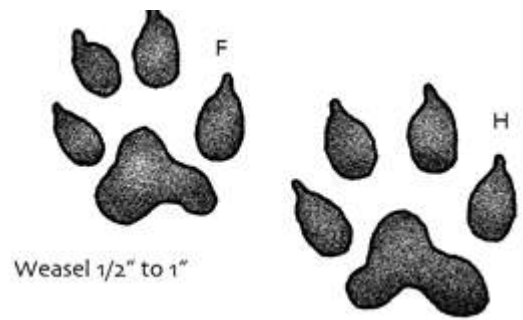
## Weasels

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The least weasel has been referred to as the smallest living predator. It is long and slender, with a long neck, a narrow head, and short limbs. Least weasels weigh only about 30 to 55 grams (1 to 2 ounces) and are usually 165 to 205 millimeters (6-1/2 to 8 inches) long, with



much of that length being tail. They are seldom seen and rarely trapped. They are active day and night and in winter and summer, and they do not hibernate. When a least weasel kills, it wraps its body and limbs around its prey and kills with a bite to the base of the skull. Least weasels can squeeze through holes as small as 1/4-inch in diameter. Consequently, they typically can get through chicken wire. Because a weasel must eat food equal to four times its body weight each day, weasels are voracious eaters.



## Skunks

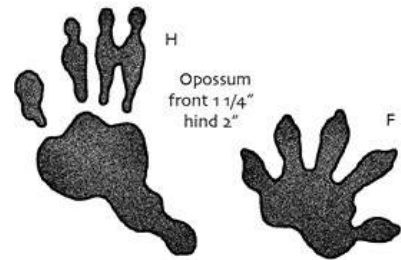
Skunks do not kill many adult birds. In general, when a skunk attacks a flock, it kills only one or two birds and mauls others considerably. Also, skunks love eggs. Usually, a skunk opens an egg at one end and punches its nose into the hole to lick out the contents. Eggs that have been eaten by a skunk may appear to have been hatched, except that the edges of their openings are crushed. A skunk may remove eggs from a nest but rarely carries them more than 1 meter (3 feet) away.





## Opossums

Opossums are omnivorous in that they eat birds, fish, insects, mushrooms, fruits, vegetables, and even eggs. When an opossum raids a poultry house, it usually kills one bird at a time, often mauling its victims. It causes eggs to be mashed and messy, often chewing the shells into small pieces and leaving those pieces in the nest. Opossums usually begin feeding on adult poultry at the cloacal opening. They consume young poultry completely, typically leaving behind only a few wet feathers.



## Snakes

Snake predation can be hard to identify because snakes eat their prey whole. For example, a snake can eat an egg whole, so the only sign of intrusion is a missing egg. The aftermath of a snake's egg-eating activity differs from that of raccoons and skunks, which typically leave shells behind after eating eggs. Rat snakes are known to eat eggs and young chicks (those less than a month old). The size of the hole needed to get to a flock depends on the size of snake. Also, a snake must be able not only to enter the enclosure but also to exit after swallowing its prey. Typically, snakes able to enter through gaps that are 1/4-inch in diameter or smaller do not cause predation damage.



## Hawks

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Of the variety of hawk species that prey on poultry flocks, the most common are red-tailed, red-shouldered, and Cooper's hawks. Hawks typically take their prey during the day. They have very keen eyesight and scan for prey from elevated perches. When a hawk spots prey, it swoops down and lands on the prey with its talons, often killing the prey on impact. A hawk may carry off a young or bantam bird and eat it elsewhere, leaving no indication of predation other than a missing bird. If a hawk eats a bird in place, it typically eats the breast, cleanly plucking the feathers. Feathers with flesh clinging to their ends may indicate that a hawk did not kill the bird but instead scavenged on a bird that died of some other cause.

### Red-Tailed Hawk

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Red-tailed hawks live in various habitats, including scrub deserts, grasslands, farm fields, pastures, parks, and woodlands. They need an open hunting area with several scattered perches. The red-tailed hawk is one of three species sometimes referred to as *chicken hawks*, although it rarely preys on standard-sized chickens.



### Red-Shouldered Hawk

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Red-shouldered hawks live in forests and swamps. They may store food near their nest to eat later. Though red-shouldered hawks usually eat rodents and other small mammals, they will eat poultry if the opportunity arises. They sometimes are referred to as *hen hawks*.



### Cooper's Hawk

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Cooper's hawks, which can fly well through heavily wooded areas, prefer to live in deciduous and mixed forests.



## Owls

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The owl that most commonly preys on poultry flocks is the great horned owl. Normally, barn owls and screech owls do not bother poultry flocks. Owls are more active at night, and that is when they typically take birds. Great horned owls live in many types of habitats, from coastlines to grasslands to mixes of woods and open fields. Great horned owls eat many kinds of animals, including chickens, ducks, and other poultry.



## Actions to Prevent Predation

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Once you have identified which predators are causing problems with your flock, you can take actions to thwart their attacks. These actions may involve changing a flock's enclosure, modifying the habitat around the area where you keep a flock, using a guard dog, or seeking assistance from wildlife services.

## Making Improvements to Fencing and Housing

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Many flock owners who allow their birds to free-range protect their flocks from ground predators by using movable fences. These fences may or may not be electrified. For an electrified fence, the amount of electricity used should be enough to stun but not kill an



animal. Aside from being less dangerous to people, this type of fence more effectively keeps predators away from a flock. A stunned predator may be discouraged from bothering the flock. A dead predator, however, will soon be replaced by another predator.

Photo: Dr. Jacquie Jacob, University of Kentucky.



In addition to attracting ground predators, free-ranging poultry are highly susceptible to aerial predation from hawks and owls. One solution to this problem may be modifying the habitat around the area where the poultry range. Eliminate any perch sites within 9 meters (100 yards) of the flock by removing isolated trees and other perching surfaces. You also may consider housing the poultry at night. Most poultry can be trained to move into a poultry house at night by feeding or watering them indoors at dusk. If a persistent hawk or owl is in an area, the easiest way to protect your flock is to use a covered run. Orange netting is best because hawks and owls see orange well. Hawks can get through any loose or weak spots in the covering, so make sure it is secure. Keep in mind that hawks and owls are federally protected species; you may not legally shoot, trap, or euthanize these birds. Noise and bird bombs are no longer legally available, and they have not been shown to be overly effective anyway.

Another option for protecting a flock is to keep the flock confined in floorless pens that are moved around on pasture routinely, often daily. In some cases, however, such enclosures may not be sufficient to protect the flock, and additional peripheral fencing may be needed.

Photo: Dr. Jacquie Jacob, University of Kentucky.



For persistent predators, it may be necessary to provide your flock with a run that is covered with welded wire. If you allow your birds to go in the run at night, make sure that predators are not able to dig under the fencing. Bury hardware cloth at least 30.5 centimeters (12 inches) into the ground to deter diggers.

Additional recommendations for management precautions include the following strategies:

- Have the flock roost inside a secured location at night, making sure to close and lock all doors.
- Ensure that the area where the birds live is clean and well-kept, with no food left in the run.
- Remove sick, dying, and dead birds immediately.

As you consider possible options for improving the area in which you keep your flock, keep in mind that lighting the area as a predator deterrent is not effective for laying flocks because of the disruption to egg laying. Also, although some flock owners have used periodic noises to deter predators, predators become accustomed to the noises in many cases, and the strategy does not remain effective.

## Using Guard Animals

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If you want to free-range your flock and local predators are a problem, consider getting guardian dogs. If well-trained, these dogs are extremely effective at deterring predators, both during the day and at night. This approach to predator control requires that the dogs stay with the flock at all times.

Great Pyrenees guard dog kept with a mixed poultry flock. Photo: Dr. Jacquie Jacob, University of Kentucky.



## Seeking Assistance from Wildlife Services

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State and federal wildlife services are available to help you identify and prevent many predators of poultry flocks. If you are interested in trapping, killing, or relocating predators, you *must* contact your local wildlife service. For many states, this is the Wildlife Services program of the US Department of Agriculture's Animal and Plant Health Inspection Service. For others, it may be a state agency.

*Predator photos courtesy of the US Fish and Wildlife Service.*

*Animal track images courtesy of the US Geological Survey (USGS).*

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## For More Information

[Predator Management with Small and Backyard Flocks](#)—eXtension webinar by Dr. Thomas Barnes, University of Kentucky



# Housing

Small-Scale Poultry Housing

House Design for Small and Backyard Poultry Flocks

Ventilation in Housing for Small and Backyard Poultry Flocks

Lighting in Housing for Small and Backyard Poultry Flocks

Insulation of Housing for Small and Backyard Poultry Flocks

Litter Material for Small and Backyard Poultry Flocks

Perches in Housing for Small and Backyard Poultry Flocks

## Small-Scale Poultry Housing

 [articles.extension.org/pages/66243/small-scale-poultry-housing](https://articles.extension.org/pages/66243/small-scale-poultry-housing)

**Written by:** *Dr. Jacquie Jacob, University of Kentucky*

In planning housing for your small poultry flock, you need to consider a variety of issues. Some are associated with the practical matters of having a coop on your property. Others are associated with the well-being and productivity of your birds.

Figure 1. Backyard Poultry Flock. Photo by Jacquie Jacob, University of Kentucky



### Practical Aspects of Housing Poultry on Your Property

There are several logistical aspects to having poultry housing on your property. When deciding on a location and design for your poultry house, answer the following questions:

- How close are you to your neighbors? Do any city ordinances specify the minimum distance that certain structures must be from a property line?
- Do you want portable housing (suitable for pasture-raised poultry) or fixed housing?
- Will the structure be designed for your convenience—that is, for ease in gathering eggs, cleaning, disinfecting, accessing electrical components, watering the flock, catching birds, and so on?
- Is the design suitable for expansion? (Is there room to grow?)
- Can the structure be used for other purposes if it is no longer needed to house poultry?

### Well-Being and Productivity of Your Flock

Many factors of poultry housing design relate to the health, safety, comfort, and productivity of your birds. To address these issues, answer the following questions:

- What species and breed will you raise? For example, will you raise meat chickens, egg chickens, ducks, or some other birds?
- What stage of production will you start with—eggs, chicks, or mature birds?
- How many birds will you raise?
- How will you ensure bird health, safety, and comfort (that is, through adequate space, adequate ventilation, appropriate lighting, appropriate sanitation measures, and so on)?

For the well-being and productivity of the birds, poultry housing should provide protection from the weather, protection from predators, adequate space, easy access to feed and water, sufficient light, and adequate ventilation.

## Protection from Weather

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Your coop should protect your flock from rain, snow, hot or cold temperatures, and other weather conditions.

Poultry housing should be dry and draft free. A simple, draft-free building with windows and/or doors that can be opened for ventilation when necessary will work.

It is important to build your coop in a high, well-drained area. Placing your coop in such a location prevents moisture from building up in the floor and outdoor runs (if present). Excess moisture can result in a buildup of ammonia in the coop. In addition, although chickens can endure quite low temperatures, they cannot tolerate being wet and cold. Consider placing a windbreak (natural or manufactured) on the side of the structure that faces prevailing winds.

In some parts of the country, winter temperatures can be stressful to birds. If you live in such an area, plan your structure to minimize this stress by using a draft-free design and installing proper insulation and heated waterers. If properly designed, poultry housing units need not be heated.

## Protection from Predators

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The best way to protect your flock from predators is to keep birds confined, remembering, however, that rodents, snakes, and other predators can dig under walls. Securely covering windows with heavy-gauge mesh wire or screening helps keep out predators as well as wild birds, which can be sources of disease. If you allow your birds to run outside the coop, install a fence to keep out land predators. It is important to bury the wire along the fence border at least 12 inches deep and to toe the fence outward about 6 inches. Taking these precautions will stop predators from digging under the fence—animals that typically dig at the base of the fence will encounter more fencing and be unable to continue. Another option is to run electric fencing around the outside of the pen. Electric fencing should be 4 inches off the ground and about 1 foot from the main fence. Energizers for electric fencing can be powered by battery or plugged directly into an outlet.

To prevent problems with hawks and owls, cover your outside runs with mesh wire or netting. Some flock owners have had success by using twine to create a grid cover 3 to 4 feet over the pen. Supplying ground cover, such as a bush or tall leafy vegetation, provides cover for the birds to hide under. If your outside runs are not predator-proof, it is best to lock up your flock before dark. Solar-powered units are available for taking this action.

To protect your flock from theft, lock the building and pens securely whenever you are not home. Also, keeping a protective dog near your coop usually works well to discourage predators and unwanted visitors. Door-closing systems are available and can be used to shut entryways automatically (controlled by a timer or by darkness).

## Adequate Space

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Birds need adequate space to move and exercise. The amount of space you need to provide depends on the type and size of the birds you raise. Spacing of .75 to 1 square foot per bird for small breeds to 3 to 3.5 square feet per bird for larger breeds is adequate.

## Easy Access to Fresh Feed and Clean Water

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Place feeders and waterers throughout the pen in locations that allow birds to access them easily. Ensure that the bottoms of the waterers and the top lips of the feeders are at the height of the birds' backs to keep the feed and water cleaner and to prevent waste. Also, make sure you provide enough feeder space for all the birds to eat at the same time. This spacing will depend on the type and size of birds you have. When possible, locate the waterers in the outside run, especially for waterfowl. This placement will help keep the moisture level down inside the coop. Birds will roost on feeders and watering units if permitted, so adapt the areas above feeders and waterers as needed so that birds cannot roost on or above them.

## Sufficient Light

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Supplying your flock with sufficient light includes providing the proper number of hours of light and intensity of light. If you wish to produce eggs from your flock year-round, you must supply the hens with supplemental light. Poultry come into production with increasing day length (number of hours of light in the day) and go out of production with decreasing day length. A 60-watt bulb every 40 feet at ceiling height is sufficient. For small poultry houses, one light above the feeding and watering area usually is sufficient. You are not exploiting the chickens' health by providing a consistent duration of light to birds through the seasons of short days.

## Ventilation

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It is important to have adequate ventilation, or air circulation into and out of the poultry house. The movement of fresh air into the coop brings in oxygen. Moisture, ammonia, and carbon dioxide are removed when the stale air moves out of the house. If the floor becomes damp or a buildup of ammonia occurs, the ventilation is not adequate. For small coops, windows or vents on one side of the house usually provide plenty of ventilation. Well-ventilated houses also must have plenty of insulation and a good vapor barrier. Failure to insulate or ventilate properly will result in moisture accumulation on the walls and ceiling in cool weather.

## For More Information

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Small Scale Poultry Housing, Phillip Clauer, Virginia Tech.

Housing Backyard Chickens, David Frame, Utah State University.

Range Poultry Housing, Robert Plamondon, edited by Anne Fanatico and Richard Earles, National Sustainable Agriculture Information Service.

Poultry Housing, Stephen Herbert, Masoud Hashemi, Carrie Chickering-Sears, and Sarah Weis, University of Massachusetts.

## House Design for Small and Backyard Poultry Flocks

 [articles.extension.org/pages/66117/house-design-for-small-and-backyard-poultry-flocks](https://articles.extension.org/pages/66117/house-design-for-small-and-backyard-poultry-flocks)

**Written by:** *Dr. Jacquie Jacob, University of Kentucky*

Accessibility, safety, exterior appearance, and appropriateness of design are important aspects of housing for your poultry flock.

Before you begin building, consider how you will access and maintain your poultry housing. Choose a design that allows for easy access to nests, perches, feeders, and waterers. Suitable access will make it easier to clean all areas of the coop.

When designing, building, and maintaining your coop, take action to prevent possible injury to you or your birds. Remove any loose or ragged wire, nails, or other sharp-edged objects from the coop. Ensure that the birds can perch on only roosts that you provide. Remove or eliminate access to other perching areas, such as windowsills, nest box tops, or electric cords, whenever possible.

If your poultry house is visible to your neighbors, you may want to ensure that it does not detract from the overall appearance of its surroundings. You can improve the looks of your poultry coop by painting and properly maintaining the exterior. Removing weeds and trash from around the coop not only enhances its appearance but also helps with rodent control. Landscaping can screen your poultry coop from neighbors as well as help muffle the sounds your flock produces.

Choose a poultry housing design that meets your particular needs. Figure 1 shows four examples of urban poultry housing.

Fig. 1. Urban poultry housing of various sizes.  
Photos: Jacquie Jacob, University of Kentucky.

Pasture poultry ark - University of Wisconsin

Also, you can find designs online. The Louisiana State University AgCenter provides a variety of poultry housing designs, including plans for the following types of housing:








# Ventilation in Housing for Small and Backyard Poultry Flocks

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 [articles.extension.org/pages/66115/ventilation-in-housing-for-small-and-backyard-poultry-flocks](https://articles.extension.org/pages/66115/ventilation-in-housing-for-small-and-backyard-poultry-flocks)

**Written by:** *Dr. Jacquie Jacob, University of Kentucky*

Ventilation is the exchange of air between the inside and outside of a poultry house. The main function of a ventilation system is to maintain adequate oxygen levels while removing carbon dioxide, moisture, dust, and odors. During summer, ventilation also is important for removing heat.

To achieve an effective ventilation system for your poultry house, consider both house placement and house design.

## House Placement

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The location of a poultry house can have an impact on the effectiveness of its ventilation system. In northern areas where it is very cold much of the year, the house should be positioned to reduce the amount of north wind exposure. In southern areas where heat is an issue, the house should be positioned to take advantage of maximum southern prevailing winds to help provide as much natural ventilation as possible.

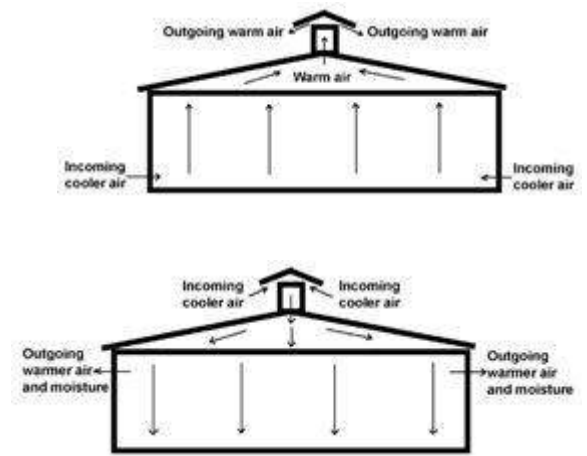
## House Design

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An effective natural ventilation system in a poultry house relies on the laws of physics to generate air movement. In particular, two important concepts are the facts that warm air rises and that warm air holds more moisture than cold air. In summer, the chimney effect causes natural ventilation to occur in a poultry house that has a ridge or eave opening in the ceiling. A constant flow of air exists if the outside temperature is cooler than the temperature at bird level inside the building (see Figure 1). During winter, the amount of fresh air brought in should be just sufficient to allow for adequate air exchange. The incoming air enters through the roof of the building and warms as it drops toward the floor (see Figure 2). Because the warmed air picks up moisture, the ventilation system must include a method for removing this air from the building to allow the air flow cycle to continue.

Fig. 1. Concept of summertime ventilation. Source: David Frame, Utah State University.

Fig. 2. Concept of wintertime ventilation. Source: David Frame, Utah State University.




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## For More Information

[Housing Backyard Chickens](#), David Frame, Utah State University

# Lighting in Housing for Small and Backyard Poultry Flocks

 [articles.extension.org/pages/66177/lighting-in-housing-for-small-and-backyard-poultry-flocks](https://articles.extension.org/pages/66177/lighting-in-housing-for-small-and-backyard-poultry-flocks)

**Written by:** *Dr. Jacquie Jacob, University of Kentucky*

Light is an important but often overlooked part of an animal's environment. Aside from allowing animals to see their environment, light affects growth, reproduction, and behavior.

## Understanding How Light Affects Birds

To devise an effective lighting plan for your poultry house, it's important to understand how birds perceive and respond to light.

Light is part of the electromagnetic spectrum, which is made up of electromagnetic radiation of varying wavelengths. Parts of the electromagnetic spectrum include radio waves, microwaves, infrared light, visible light, ultraviolet light, x-rays, and gamma rays. Visible light is electromagnetic radiation at wavelengths humans can see. We see visible light as colors, with each color determined by wavelength.

Three factors affect an animal's response to light. These factors are wavelength, intensity, and duration. As mentioned, wavelength determines the color of light. The order of the colors of visible light from the shortest wavelength to the longest wavelength is violet, blue, green, yellow, orange, and red. Intensity is the brightness of light. Duration is the number of hours of light an animal is exposed to in a day. Birds are sensitive to wavelengths outside the human visible light spectrum. While we may perceive two different light sources as the same, chickens are able to see wavelengths of light that we may not be able to see. As a result, the behavior of the chickens may be different under the two light sources.

Birds detect light in two ways—through the eyes (retinal receptors) and through photosensitive cells in the brain (extraretinal receptors). For the extraretinal receptors to detect light, the light must pass through the skin and skull of the bird. Long wavelengths (toward the red end of the spectrum) penetrate the skin and skull more efficiently than short wavelengths. Different wavelengths affect birds in different ways. Short wavelengths detected by the retinal receptors affect growth and behavior. In contrast, reproduction is linked to the extraretinal receptors and thus long wavelengths. Also, it has been reported that blue light has a calming effect on birds and that red light can reduce feather pecking and cannibalism. Blue-green light has been shown to stimulate growth, whereas orange-red light stimulates reproduction.

## Devising a Lighting Plan

When devising a lighting plan for your poultry house, you should consider lamp type, number of lamps, and placement of lamps.

The most common type of lamp used in poultry houses is the incandescent bulb (shown in Figure 1). Incandescent bulbs produce light by passing an electrical current through a thin tungsten filament, causing the filament to heat and glow. (This glowing due to high temperature is referred to as incandescence, thus the name for the bulb.) The light produced covers the entire visible light spectrum. Much of the energy produced from the electrical current is converted to heat energy, making the incandescent bulb very energy inefficient.

Fig. 1. Incandescent light bulb. Source: Doug Overhults, University of Kentucky.



Because of increasing energy costs, alternative light sources have become popular for use in poultry houses. The most common of these alternatives is the fluorescent lamp (shown in Figure 2). Fluorescent lamps produce light by passing an electrical current through a low-pressure vapor or gas contained within the bulb. The ultraviolet radiation given off is absorbed by a phosphor material that coats the inside of the lamp. The phosphor material then fluoresces, or emits electromagnetic radiation at wavelengths that can be seen as visible light. The wavelengths given off depend on the type of coating used. Fluorescent lamps cost more but have a longer life and use less electrical energy than incandescent bulbs. If you are considering using fluorescent bulbs, keep in mind the following important factors:

- Many fluorescent lamps are not dimmable, so the light in the poultry house cannot be dimmed if cannibalism becomes an issue.
- Fluorescent lamps do not work well, and sometimes do not work at all, in very cold weather.
- The type of fluorescent lamp is important. Hens need warm-white fluorescent lamps to receive the correct spectral output (more orange and red) to maintain production. Chicks benefit from cool-white lamps, which are concentrated in the blue-green wavelengths.

Fig. 2. Compact fluorescent light bulbs without a cover (left) and with a cover (right). Source: Doug Overhults, University of Kentucky.

You should choose the correct number and placement of lamps to produce even light intensity throughout your poultry house. When setting the light intensity it is important to know that fluorescent bulbs lose up to 20 percent of their original light output during their

life. If you are using fluorescent lamps, consider this factor when determining light placement. Also, dirty lamps give off decreased light intensity, so you should clean all lamps on a regular basis.



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## For More Information

[Lighting for Small-Scale Flocks](#), Robert Hawes, University of Maine


[Proper Light Management of Your Home Laying Flock](#), Chad Zadina and Sheila Scheideler, University of Nebraska

[The Science of Poultry Lighting: A Bird's Eye View](#), Once Innovations



# Insulation of Housing for Small and Backyard Poultry Flocks

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 [articles.extension.org/pages/66118/insulation-of-housing-for-small-and-backyard-poultry-flocks](https://articles.extension.org/pages/66118/insulation-of-housing-for-small-and-backyard-poultry-flocks)

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Insulation is any material that reduces the transfer of heat from one area to another. Insulating a poultry house minimizes the transfer of heat from inside to outside and from outside to inside, helping you keep heat in during winter and out during summer. As a result, using insulation both conserves heating energy and provides more comfortable conditions for your flock. Although insulation has these benefits, keep in mind that it also adds to the material costs of a building.

## Choosing an Insulation Material

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The most common types of insulation are soft materials, such as batt and blanket materials. These substances, however, are attractive to rodents and insects as nesting materials or food sources. If you use batt or blanket material, you should ensure that the insulation is tightly enclosed in a hard outer material. As an alternative, you can use a rigid insulation. Rigid insulations are made from wood by-products, cellulose, or expanded plastic materials, such as polystyrene. The outer surfaces of sheets of rigid insulation vary in hardness, but some types are strong enough to last in poultry houses.

Regardless of whether it is soft or rigid, insulation must be effective. The effectiveness of insulation is indicated by its R-value. The R-value is a measure of the resistance of a material to conduct heat as indicated by the difference between inside and outside surface temperatures. Good insulating materials have R-values of greater than 10.

The effectiveness of insulation can be disrupted by climate. Moisture can condense on the interior surfaces of the exterior walls or ceiling of a poultry house during cold weather if the temperatures of those surfaces drop below the dew point of the inside air. This effect is similar to what occurs when moisture collects on the outside of an iced drink. Some types of insulation lose their effectiveness if they get wet. Consequently, adding a vapor barrier of plastic sheeting to insulating material (on the side of the material that faces into the poultry house) helps keep moisture from reaching the interior surface of the exterior walls or ceiling.

## Installing Insulation


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You can install insulation in the walls and in the ceiling or under the roof of your poultry house. Insulation installed in the ceiling or under the roof works equally well in insulating the building. However, when possible, such as when building a new structure, it is best to place the insulation directly under the roof, thereby providing fewer nesting spots for rodents and insects.

Your birds should not be exposed to or have access to the insulation or vapor barrier. You should cover any insulation or vapor barrier material with an interior sheathing. The interior sheathing should be durable and made of material that can be easily fastened, painted, cleaned, and disinfected. Options for interior sheathing include wood, plywood, sheet metal, and plastic panels.

## Litter Material for Small and Backyard Poultry Flocks

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 [articles.extension.org/pages/65873/litter-material-for-small-and-backyard-poultry-flocks](https://articles.extension.org/pages/65873/litter-material-for-small-and-backyard-poultry-flocks)

**Written by:** *Dr. Jacquie Jacob, University of Kentucky*

Most home poultry flocks are raised on the floor with some type of litter. (As used here, the term *litter* means "bedding material." It also can mean "used bedding material," which would include not only the bedding material but also manure, spilled feed, water, and feathers.)

What makes good litter? Good litter should

- be nontoxic to the birds (including being free of mycotoxins that can be produced during certain fungal contaminations);
- be free of contaminants, such as pesticides and metals;
- be very absorbent;
- have a reasonably short drying time;
- have reduced thermal conductivity;
- be able to be repurposed after being used as bedding material (e.g., as a land application); and
- be readily available and relatively inexpensive.

For every small flock producer, the choice of litter is based on the appropriateness, availability, and cost of the material.

### Wood Shavings

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In general, the best litter is wood shavings from a soft wood, such as pine, spruce, or hemlock (with pine being the preferred option). However, this material has become expensive to use as litter in poultry housing due to the dramatic increase in demand in the last few years. Wood shavings now are being used to make fiberboard, paper, and cardboard and to supply the horticulture industry with pots, compost, and mulch.

### Alternatives to Wood Shavings

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The increasing cost and reduced availability of wood shavings has led researchers and poultry producers to explore alternative materials, including pine sawdust, pine bark, wood pallet pieces, pine stump chips, pine straw, paper by-products, rice hulls, peanut hulls, ground corncobs, chopped straw, sand, and leaves. These other materials are usually compared to wood shavings; some are as effective or nearly as effective and others are less effective as poultry litter.

## Pine Sawdust

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Chickens have been shown to do well on pine sawdust, although litter consumption has been a problem. Turkeys are even more prone to litter consumption than chickens, making sawdust a less desirable choice for litter in turkey housing. Another strike against sawdust as a bedding material for turkeys is that sawdust tends to contain aspergillus organisms, to which turkeys are particularly susceptible. Sawdust also contains terpenes (undesirable oils found in conifer trees).

## Pine Bark

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Pine bark is a by-product of the wood industry and is available in large quantities in some locations. For broiler production, wood bark has been shown to be as effective as pine shavings. Pine bark also has been used successfully for layers, pullet replacements, heavy roasters, breeder replacements, and capons. The birds reared on bark performed as well as those reared on pine shavings. However, particle size, moisture content (which affects mold content), and the amount of wood splinters in the bark can be major concerns. For example, when particles are larger than 1 inch, increased incidence of litter caking occurs.

## Wood Pallet Pieces

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Wood pallets used in the warehouse and trucking industries have been chopped into small pieces and recycled as bedding material for poultry. Wood fiber pellets, available as a commercial product resulting from recycling wood pallets, have been shown to be a good bedding material. One concern, however, is that wood pallets may have held toxic materials. Some wood pallets may be tainted with paints, fuels, pesticides, solvents, and other flammables. Also, it is important to make sure that there are no nails in the resulting material.

## Pine Stump Chips

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Although performance of poultry reared on pine stump chips has been good, breast blisters are often a problem for meat chickens raised on this material.

## Pine Straw

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Pine straw was found to be a poor choice for bedding material, as it caked over quickly.

## Paper By-products

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Shredded paper can be used as an alternative litter material; however, it has a tendency to compact and cake during the first two weeks of use, reducing its effectiveness. If used, newspapers should be limited to only old newspapers because some printing inks are toxic until thoroughly dried. Glossy paper should not be used because it will not absorb moisture.

## Rice Hulls

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Rice hulls are readily available in some parts of the country, and birds have performed well when rice hulls are used as bedding material. Rice hulls typically are free from excessive dust, and their size, thermal conductivity, and drying rate make them a good choice for bedding. Rice hulls can be used alone or in combination with pine shavings.

## **Peanut Hulls**

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Peanut hulls have been successfully used by broiler growers in some parts of the country, primarily in the Southeast, where peanuts are grown.

## **Ground Corncobs**

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Corncobs are popular in areas where large amounts of corn are produced. The corncobs must be cut, and pieces should be no larger than the size of a garden pea. If the pieces are too long, breast blisters can become a problem. Corncobs have a high capacity to absorb moisture, but wet cobs also form mold.

## **Chopped Straw**

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Chopped straw is widely used in cereal-producing countries. Straw refers to any stem material from grass or grains, including barley, Bermuda grass, flax, oat, wheat, and rye. Wheat straw is the type most commonly used as a litter material. Straw is difficult to manage and is prone to caking. If straw is used, it should be chopped to one inch or less. The length of the straw is more important than the type of straw. Straw that is too long will mat over more quickly. It may take more heat to keep straw dry.

In a study comparing chopped straw from annual rye grass, perennial rye grass, fescue, orchard grass, and pelleted rye grass, the annual rye grass and pelleted rye proved to be superior overall to the other grass straw types. One producer who had been using chopped straw indicated that straw was harder to work with in the winter than in other seasons. As a result, he used sawdust in the winter and chopped straw the rest of the year. Also, he found that organic crop producers prefer used litter that results when the original litter is straw rather than another material.

## **Sand**

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Researchers at Auburn University have investigated the use of sand as a bedding material in commercial broiler houses. Their research has shown that broilers raised on sand performed as well as or better than those raised on pine wood shavings. Foot pad quality also was improved. These findings were confirmed in a field study. After 10 consecutive flocks of broilers were raised on sand as the bedding material, the broilers continued to have good growth and feed conversion. In addition, the houses with the sand bedding had less dust, lower levels of darkling beetles, less caking, and improved house temperatures (2°F cooler in summer and warmer in winter).


## **Leaves**

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Some small flock producers have used leaves successfully as a seasonal bedding material.

# Perches in Housing for Small and Backyard Poultry Flocks

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 [articles.extension.org/pages/66089/perches-in-housing-for-small-and-backyard-poultry-flocks](https://articles.extension.org/pages/66089/perches-in-housing-for-small-and-backyard-poultry-flocks)

**Written by:** *Dr. Jacquie Jacob, University of Kentucky*

The domesticated chicken is a descendant of the jungle fowl of Southeast Asia, whose natural habitat is forested areas. Today's chickens have not lost the urge to roost, especially at night. Consequently, you may wish to include perches in your poultry housing. Laying hens make full use of perches. Meat-type chickens (broilers), due to their extra weight, typically do not use perches. Most waterfowl do not use perches; however, Muscovy ducks, like chickens, do prefer to roost.

Although it is not mandatory in the United States to include perches in poultry housing, research has shown that chickens prefer having them. Recent animal welfare legislation in the United Kingdom requires poultry growers to provide birds with perches, with a minimum of 15 centimeters per hen (about 6 inches per hen) of perch space under regular standards and 18 centimeters per hen (about 7 inches per hen) under organic standards. Moreover, there must be a minimum of 30 centimeters (about 12 inches) of horizontal space between perches and 20 centimeters (about 8 inches) between a perch and the wall. Also, the perches cannot have sharp edges.

## Benefits of Using Perches

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Providing laying hens with perches is a way to relieve their stress and to reduce certain injuries and cannibalism. During the day, hens that are lower in the pecking order use the perches to escape pecking from more dominant hens. This ability to escape reduces the incidences of injury to the head and neck caused by aggressive pecking and cannibalism caused by severe feather pecking. At night, when all the hens perch, the more dominant hens take the higher perches.

Perches can play a role in manure management as well. Perches allow birds to stay off the floor, particularly during the night. Consequently, manure tends to accumulate under the roost area, and the rest of the bedding material in the house stays cleaner.

The use of perches also can affect egg laying. A higher level of floor eggs has been reported for flocks without access to perches.

## Risks of Using Perches

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Domesticated chickens are considerably heavier than the mature jungle fowl, and the modern chicken has a relatively smaller wing surface area. These traits make the modern chicken an awkward flier. As a result, often an increase in keel injuries exists in chickens with access to perches, due to misjudged landings.

Research from 2010 and 2011 showed that the use of perches is associated with a higher incidence of skeletal damage (such as bone fractures and keel deformations) and fat pad lesions. Additional research is under way to determine the best materials and design of perches to reduce the incidences of these issues.

## Guidance for Installing Perches

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If you plan to include perches in your poultry housing, you should introduce the perches to the flock when the birds are still young. Rearing chickens without early access to perches has been shown to impair their ability to use the perches as adults.

Location and placement of perches are important. Locate perches in an area of the house where they will not interfere with the daily care of the birds, including feeding, watering, and egg gathering. Also, the roosts should be removable to allow you to clean out the manure that accumulates under them. Place the lowest perch about 3 feet off the floor to minimize the opportunity for other chickens to feather peck a chicken using this roost. Consider the vertical distance between perches too. If the vertical distance between perches is too large, it is more likely that the chickens will misjudge their landings and collide with perches, thereby injuring their keels. Also, chickens find it difficult to land safely on perches when jumping down, so ensure that there is sufficient floor space to allow the chickens to land safely when leaving the higher perches.

Perch shapes and the materials used to make perches vary. Europeans typically use round iron tubes for perches to minimize infestations of red mites (*Dermanyssus gallinae*), which don't like such perches. However, these perches are associated with a higher risk of keel deformations. Some flock owners have used plastic perches with mushroom shapes, but red mites hide during the day in the areas where these perches are connected to each other. Wooden perches also are very sensitive to red mites. In Europe, the presence of red mites is a more significant problem for poultry producers than keel deformations, so European producers prefer the iron tube perches. If red mites are not a concern, wooden perches are the best option because more layers use perches if the perches are square rather than round.

## Bulletin #2217, Winter Care of Your Laying Hens

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### Winter Care of Your Laying Hens

*By Richard J. Brzozowski, Poultry Specialist, University of Maine Cooperative Extension*

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Keeping laying hens productive through the winter months means keeping them well fed, well watered, healthy, and comfortable. Below is a checklist of management tips that is designed to assist the farmer/grower in keeping their farm flock comfortable. Any stress on the birds could force a molt and the decline or end of egg laying.

- **Light** — Provide 14 to 16 hours of light per day for your laying hens. There is no advantage to supplying more light than this. A 60 watt incandescent light or 13 watt Compact Fluorescent or comparable LED bulb hung at 7 feet high with a white downward reflector will provide adequate light for a 200-square-foot pen. Place lights on a timer for convenience and consistency. Keep light bulbs clean for light quality and quantity.



- **Spacing** — Provide two to three square feet of floor space per bird. Birds need ample space for their comfort, reduced stress, and ease of movement.
- **Roosting Space** — Provide comfortable roosts so that all birds can roost at the same time. Provide at least 6-8 inches of linear roost space per hen. Roosts should be 1.5-3 inches in diameter. Round stock is preferred. Clean tree branches with bark work fine as roosts.
- **Ventilation** — There needs to be an exchange of air for laying hens to be healthy. This can be accomplished with intake or exhaust fan(s) or natural ventilation. If the smell of ammonia is evident, adequate ventilation is lacking. An exhaust fan with a thermostat is a reasonable investment and works well without causing drafts. Proper placement of the fan is essential for effectiveness. Ammonia tape can be used to monitor and detect high levels of ammonia. Ammonia levels in the poultry house/pen should be kept below 20 parts per million (ppm).
- **Check for Drafts** — Although you want a good exchange of air in the poultry house/pen, you need to make sure all areas of the henhouse are draft-free. Check for drafts at high points, low points, and at every corner. A technique for checking is to wet your bare hand with water and feel for drafts or use a piece of tissue paper and watch for movement. A candle could also be used to check for drafts, but this method is a bit more hazardous.
- **Sanitation** — Keep all areas of the pen clean. Remove soiled feed and dirty water immediately. Keep feeders, roosts, nests and waterers clean. Keep bedding (litter) dry and clean. Wet or frozen bedding should be removed and replaced with clean dry shavings. Deep bedding is an insulating factor in keeping the feet of birds from getting too cold. Pine shavings are the preferred material for bedding. Use 4-6 inches as a bedding base. Clean out pens in spring and fall. Then add fresh bedding after complete cleaning and disinfection.
- **Warmth** — Laying hens begin to slow egg production when temperatures drop below 55 degrees F. Provide adequate warmth for the birds. This can be accomplished through insulating the floors, walls and ceiling with fiberglass matting or styrofoam panels. Protect insulation from bird pecking by covering it with wood or metal sheathing. Consider supplemental heat if birds cannot adequately heat the area with body heat alone. Infrared heaters (powered by propane or electricity) may be the most efficient method of heating the area. Infrared heaters are said to be effective by heating the bodies and not the air. These heaters can be controlled with a thermostat. Consider using a Thermo cube – a device plugged into an outlet into which the heater is plugged. If using a heat lamp, use the red infrared type. Use chains (not rope) to hang lamps at the desired height. Keep a thermometer or sensor inside the pen at bird level to monitor the temperature. Try to maintain a temperature at least 40 degrees F during cold spells. Be aware of any potential fire hazards when using heaters and heat lamps.
- **Feed** — Monitor feed use through the winter. Compare these records with feed use in

other seasons. Supply a 14 to 17% crude protein layer ration so the birds are never without feed. Birds typically need extra feed in cold and freezing temperatures. Avoid making changes in the feed ration. A hand full of “scratch feed” (a mix of cracked corn, oats and wheat) per 10 birds can be broadcast on the litter in the late afternoon. The scratch feed will keep the birds busy and will help turn over the litter.

- **Water** — Provide ample clean water daily to the flock. Keep water from freezing with specially designed electric heaters, warm bricks placed inside the watering container or frequent changing. Watch for leaks on waterers that freeze. Birds will suffer if they are without water for more than 10 hours. If a nipple watering system is used, consider changing to copper nipples as the plastic nipples might break with freezing temperatures. Birds need to drink water in order to keep warm. Water is imperative for feed digestion and proper metabolism.
- **Culling** — Remove sick, weak, or unproductive birds from the flock. Be observant of the poultry every day — watching them move, eat, drink, and interact.
- **Nesting** — Provide adequate nest boxes (1 nest box per 5 hens) and keep bedding inside the nest box clean and dry. Pine shavings make the best nesting material. Change nest material on a regular basis and whenever an egg breaks in the nest.
- **Rodent Control** — Keep rodents out by using traps or poisons placed strategically in bait stations. Keep the traps and poisons away from the birds and pets.
- **Egg Collection** — Collect eggs at least twice each day or more frequently so as to prevent eggs from freezing.
- **Frostbite** — Birds can get frostbite on extremities (combs, wattles, and toes). Birds should be kept from walking on snow and ice. To help prevent frostbite in small flocks, apply petroleum jelly to wattles and combs.
- **Observe Birds** — Take time to observe your birds each day. Watch the birds’ behavior around the feeders, waterers, roosts, and nest boxes. Handle a random sample of birds to check combs, feet, toes, eyes, legs color, vent size, and general appearance. When handling, look for signs of external parasites. For general monitoring, consider obtaining and using a wireless video camera to observe your birds remotely for your convenience.
- **Weigh Birds** — Randomly select a few birds to weigh. Record the weights and check weekly to make sure birds are not losing weight. Compare general bird weights to egg production. If birds are gaining weight it means they are gaining fat tissue and probably not producing. A bird that is laying heavily may lose a little weight through the winter.
- **Dust Bath** – Hens naturally clean themselves by dust bathing. A shallow wood or metal box with 3-4 inches of clean sand, wood ash or a mix of sand and wood ash would be a good addition to the hen house or coop for the winter months. Dust bathing helps deter external parasites and can provide comfort to hens. If space allows, a kiddie pool might make a good dust bath container for hens.

- **Winter Biosecurity** — Designate and use specific chore clothing and footwear when feeding, caring and handling poultry. Liquid disinfectant footbaths can be kept from freezing by using a bit of RV & marine antifreeze in the disinfectant solution. Keep visitors out of your poultry house/pen.
- **Predator Pressures** – The winter season can bring about an increased predator pressure on poultry. This likely occurs because the number of the predator’s natural prey may be in decline due to cold temperatures, snow cover and natural cycles. Adam Vashon, a certified wildlife biologist in Maine, addresses winter loss to predators as follows: “In general, all wild animals that are not hibernating require additional calories to maintain body condition and core temperature. Therefore, predators must either survive on fat reserves or eat more. Some prey species could be abundant during winter months, but that depends on recruitment and survival of that species in that year. A predator would always be willing to take easy prey. This strategy allows them to conserve their energy and maintain their reserves. If preventative measures aren’t taken, it could be your hen house that provides a predator with their next easy meal. The spring/early summer is likely the season when predator pressures are greatest on a hen house, because that is when predators are feeding themselves as well as their growing offspring.”

Make sure your henhouse or coop is secure so as to prevent entry by 4-footed or winged predators. Various methods and techniques can be employed to prevent predator loss. Check with the USDA APHIS Wildlife Services Office in your state for recommended methods.

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# Nutrition

Basic Poultry Nutrition


Water Requirements for Poultry

Common Feed Ingredients in Poultry Diets



## Basic Poultry Nutrition

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 [articles.extension.org/pages/68178/basic-poultry-nutrition](https://articles.extension.org/pages/68178/basic-poultry-nutrition)

**Written by:** *Dr. Jacquie Jacob, University of Kentucky*

Animals eat to acquire the energy and building materials that they need to live and grow. Animals use energy to perform normal body functions such as breathing, walking, eating, digesting, and maintaining body temperature. **Nutrients** provide poultry the energy and material needed for the development of bone, flesh, feathers, and eggs.

Feed has six major components:

- Water
- Carbohydrates
- Fats
- Proteins
- Minerals
- Vitamins

Each of these components is important in providing poultry the nutrients they need, and a deficit of even one can have serious health consequences for poultry.

### Water

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Water is often overlooked, but it is one of the most important nutrients. An animal can live without food longer than it can live without water. In a laying flock, a shortage of water for just a few hours can result in reduced egg production, so clean water should be available at all times. If you do not use automatic waterers, fill the drinkers twice a day. If the drinkers are filled only in the morning, birds can run out of water by midday. A laying hen drinks about 25% of her daily water intake during the last two hours of daylight.

Water plays an important role in the body of an animal. Water softens feed and carries it through the digestive tract. As a component of blood (90% of blood content), water carries nutrients from the digestive tract to cells and carries away waste products. Water also helps cool the bird through evaporation. (Birds do not have sweat glands, so their heat loss occurs in the air sacs and lungs through rapid respiration.)

A baby chick is composed of about 80% water. Even though this percentage decreases as a bird gets older, the need for water remains. There is no precise quantity requirement for water because there are several factors that affect the amount of water a bird needs:

age, body condition, diet, temperature, water quality, and humidity. As a rule of thumb, poultry consume twice as much water as feed.

## Carbohydrates

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Carbohydrates (compounds with carbon, hydrogen and oxygen) are an energy source for animals and make up the largest portion of a poultry diet. Carbohydrates are typically eaten in the form of starch, sugar, cellulose, and other nonstarch compounds. Poultry typically do not digest cellulose and the nonstarch compounds, referred to as crude fiber, well. However, poultry are able to use most starches and sugars well. Important sources of carbohydrates in poultry diets include corn, wheat, barley, and other grains.

## Fats

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Fats have two and one-quarter times the calories of carbohydrates by weight. Fat provides nine calories of energy per gram, while carbohydrates provide only four. At room temperature, saturated fats are solids and unsaturated fats are liquid. Examples of saturated fats that can be used in poultry diets include tallow, lard, poultry fat, and choice white grease. Examples of usable unsaturated fats include corn oil, soy oil and canola oil. Common sources of supplemental fat in commercially produced poultry feeds include animal fat, poultry fat, and yellow grease. The high cost of vegetable oils makes including these fats in poultry diets uneconomical.

Fats are composed of smaller compounds called fatty acids. Fatty acids are responsible for cell-membrane integrity and hormone synthesis. Although there are many different fatty acids, poultry have a specific requirement for one—**linoleic acid**—so it must be included in the diet. Linoleic acid is considered an essential fatty acid because poultry cannot generate it from other nutrients (for example, by converting one fatty acid to another).

Fat must be present in the diet for poultry to absorb the fat-soluble vitamins A, D, E, and K. In addition to its role in nutrition, fat is added to feed to reduce grain dust. Fat addition also improves the palatability of feed (that is, makes feed more appetizing).

Fats, including those incorporated in feed, have a tendency to go bad, or become rancid. This is a year-round problem, but the risk of feed going rancid is even greater in the summer. To prevent feed from going rancid, antioxidants are added to poultry diets containing added fat. A common antioxidant listed on feed labels is ethoxyquin.

## Proteins

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Proteins are complex compounds made up of smaller units called **amino acids**. After a bird consumes protein, the digestive process breaks down the protein into amino acids. The amino acids are then absorbed by the blood and transported to cells that convert

the individual amino acids into the specific proteins required by the animal. Proteins are used in the construction of body tissues such as muscles, nerves, cartilage, skin, feathers, beak, and so on. Egg white is also high in protein.

Amino acids are typically divided into two categories: essential and nonessential.

**Essential amino acids** are those that cannot be made in adequate amounts to meet the needs of the animal. The **nonessential amino acids** are those that the body can generate in sufficient quantities as long as appropriate starting material is available. There are 22 amino acids commonly found in feed ingredients. Of these, 11 are essential and must be supplied in the feed. Poultry diets typically contain a variety of feedstuffs because no single ingredient is able to supply all the necessary amino acids in the right levels.

Most feed tags indicate only the percentage of crude protein in a given feed. This information does not tell you about the quality of the protein used. Protein quality is based on the presence of the essential amino acids. For poultry, methionine and lysine are the two most critical amino acids. Deficiencies of either of these will lead to a significant drop in productivity and the health of the flock. Commercial poultry diets typically contain methionine and lysine supplements. Because of these supplements, feed can contain less total protein; without supplements, feed would have to contain excessive amounts of the other amino acids in order to meet the methionine and lysine requirements.

The main sources of protein in poultry diets are plant proteins such as soybean meal, canola meal, corn gluten meal, and so on. Animal proteins used include fishmeal and meat and bone meal. Fishmeal can be used only in limited quantities (less than 5% of the total composition of the diet) or it will give poultry meat and eggs a fishy flavor.

## Minerals

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Minerals play a role in bone formation, but minerals are also needed for several other important functions, including formation of blood cells, blood clotting, enzyme activation, and energy metabolism and for proper muscle function.

Minerals are typically classified as macro- or microminerals. Poultry require higher levels of **macrominerals** and lower levels of **microminerals** in their diets. The microminerals include copper, iodine, iron, manganese, selenium, and zinc. Although poultry have lower requirements for microminerals, these minerals play essential roles in the body's metabolism. Iodine, for example, is required to produce thyroid hormones that regulate energy metabolism. Similarly, zinc is involved in many enzyme-based reactions in the body, and iron aids oxygen transportation within the body.

The macrominerals include calcium, phosphorus, chlorine, magnesium, potassium, and sodium. Many people are familiar with calcium's role in proper bone formation and eggshell quality, but calcium's important role in blood-clot formation and muscle contraction is less well known. Phosphorus is important in bone development, and it is

part of cell membranes and is required for many metabolic functions. Chlorine is important in the formation of hydrochloric acid in the stomach and thus plays a role in digestion. Sodium and potassium are electrolytes important for metabolic, muscle, and nerve functions. Magnesium also assists with metabolic and muscle functions.

Grains are low in minerals, so mineral supplements are added to commercial poultry feeds. Limestone or oyster shell are common sources of calcium. Dicalcium phosphate is a common source of phosphorus and calcium. The microminerals are usually supplied in a mineral premix.

## Vitamins

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Vitamins are a group of organic compounds that poultry require in small quantities. Despite the low requirement levels, vitamins are essential for normal body functions, growth, and reproduction. A deficiency of one or more vitamins can lead to a number of diseases or syndromes.

Vitamins are divided into two categories: fat-soluble and water-soluble. The fat-soluble vitamins are A, D, E, and K. Vitamin A is required for normal growth and development of epithelial tissue (skin and the linings of the digestive, reproductive, and respiratory tracts) and reproduction. Vitamin D3 is required for normal growth, bone development, and eggshell formation. Vitamin K is essential for blood-clot formation.

The water-soluble vitamins include vitamin C and the B vitamins. The B vitamins include vitamin B12, biotin, folacin, niacin, pantothenic acid, pyridoxine, riboflavin, and thiamin. The B vitamins are involved in many metabolic functions, including energy metabolism. Poultry can make vitamin C, so there is no dietary requirement established for this vitamin. Vitamin C supplementation, however, has been shown to be useful when birds are stressed.

Some vitamins are produced by microorganisms in the digestive tract. Vitamin D can be produced when sunlight hits the bird's skin. Other vitamins must be supplied because they are not formed by the birds. Many essential vitamins are partially supplied by feed ingredients such as alfalfa meal and distillers' dried solubles. A vitamin premix is typically used to compensate for the fluctuating levels of vitamins found naturally in food and to assure adequate levels of all vitamins.

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## For More Information


[Poultry nutrition information for the small flock.](#) Kenneth Wilson and Scott Beyer, Kansas State University.

[Nutrition for backyard chicken flocks.](#) J.P. Blake, J.B. Hess, and K.S. Macklin, Auburn University.

[Principles of feeding small flocks of chickens at home.](#) David Frame, Utah State University.

## Water Requirements of Poultry

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 [articles.extension.org/pages/68305/water-requirements-of-poultry](https://articles.extension.org/pages/68305/water-requirements-of-poultry)

**Written by:** *Dr. Jacquie Jacob, University of Kentucky*

Water is a critical, but often overlooked, nutrient. Animals can survive longer without food than they can without water. Water is involved in every aspect of animal metabolism. It plays an important role in regulating body temperature, digesting food, and eliminating wastes. At normal temperatures, chickens typically consume twice as much water as feed. During periods of high temperature, water consumption can double or quadruple. To remain healthy, poultry flocks require water of adequate quality and quantity.

Several factors influence water quality, including the color, taste, and odor of water, as well as the presence of bacteria or other microbes, the levels of minerals, and other chemical and physical factors.

### Color, Taste, and Odor

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It is important that drinking water be clear, tasteless, odorless, and colorless. Water that is contaminated exhibits different characteristics depending on the contaminants.

- The presence of particles such as clay, silt, or organic material can make water cloudy. Such water can interfere with the proper operation of watering equipment and can indirectly lead to adverse effects on flock performance.
- Water that is reddish-brown might contain excess iron.
- A blue hue to water can be an indication of excess copper.
- A rotten egg smell is an indication of hydrogen sulfide in water. Hydrogen sulfide may also combine with iron to form black water (iron sulfide), which can also indicate the presence of sulfate-reducing bacteria.
- The taste of water can be affected by the presence of different salts. A bitter taste, for example, is associated with the presence of ferrous and manganese sulfates.

### Bacteria

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Bacteria in the water can be an indication of contamination by organic material. Water is normally tested for total bacteria level as well as coliform bacteria level. Coliform bacteria are organisms normally found in the digestive tracts of livestock, humans, and birds. The presence of coliform bacteria is typically an indication of fecal contamination. If water has a high bacterial count, the best option is to eliminate the source of the

contamination or to locate an alternative water source. It is not advisable to use disinfectants to maintain safe bacterial levels in a highly contaminated water source. Any disinfectant is likely to fail at some time and expose the birds to high levels of bacteria.

## Physical and Chemical Characteristics

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The **acidity** or **alkalinity** of water is expressed as pH level. A scale from 0 to 14 is used to measure pH. Neutral water, which is neither acidic or alkaline, has a pH of 7. Water with pH lower than 7 is acidic, and water with pH higher than 7 is alkaline. Acidic drinking water can affect digestion, corrode watering equipment, and impair the use of water-soluble vaccines and medications. Poultry prefer water with a pH of 6.0 to 6.8 but can tolerate a pH range of 4 to 8. However, water with a pH less than 6 has been shown to negatively affect chicken performance. When provided water with a pH above 8, chickens might reduce their water consumption. This in turn will affect feed consumption and bird performance.

**Hardness** refers to the amount of dissolved minerals, such as calcium and magnesium, in water. Hard water has high levels of these minerals and can cause the buildup of sludge in water lines. Hardness reduces the effectiveness of soaps and disinfectants and interferes with the administration of some medications. Although hard water can cause stains and adversely affect watering equipment, hard water has not been shown to have either a positive or negative direct effect on poultry performance.

## Mineral Content

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A large number of minerals occur naturally in water. They are usually present in amounts that do not interfere with the metabolism or digestive functions of poultry. When the levels of certain minerals are out of balance, however, poultry performance can be adversely affected.

## Nitrates and Nitrites

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Nitrogen contamination of water usually occurs in the form of nitrates and nitrites. Nitrate ( $\text{NO}_3$ ) is produced during the decomposition of organic matter. Nitrite ( $\text{NO}_2$ ) is produced during intermediate stages of the decomposition of organic compounds. The presence of nitrates and/or nitrites in water usually indicates that the water is contaminated by runoff containing fertilizer or animal wastes. Nitrates are soluble and may move with surface runoff or leach into the groundwater by percolation through the soil. Nitrate itself is not toxic, but after consumption, microorganisms found in the avian digestive tract convert nitrate to the more toxic form of nitrite. Once nitrite is absorbed into the bloodstream, it binds strongly with hemoglobin (which normally carries oxygen) and reduces the oxygen carrying capacity of the blood. Long-term nitrate and/or nitrite toxicity results in poor growth, decreased feed consumption, and poor coordination.

## Sulfate ( $\text{SO}_4$ )

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In the presence of magnesium or sodium, high sulfate levels have a laxative effect. Levels as low as 50 mg/L can have a negative effect on flock performance if either the sodium or magnesium level is also 50 mg/L. High levels of sulfate may also interfere with intestinal absorption of other minerals such as copper.

## Phosphate (PO<sub>4</sub>)

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High levels of phosphate may indicate water contamination from sewage.

## Sodium (Na)

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Excessive levels of sodium have a diuretic effect. The normal sodium level in water is about 32 mg/L. Levels above 50 mg/L, together with high levels of sulfate or chloride, have been shown to adversely affect flock performance. High levels of sodium also increase water consumption and litter moisture. This can have an adverse affect on air quality in the poultry house.

## Chloride (Cl)

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Excessive levels of chloride have been shown to adversely affect metabolism. A normal chloride level is 14 mg/L. Levels of about 14 mg/L, combined with a level of 50 mg/L of sodium, are detrimental to flock performance. Poultry can tolerate chloride levels as high as 25 mg/L as long as the sodium level is in the normal range. High levels of chloride increase water consumption and litter moisture.

## Magnesium (Mg)

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The normal level of magnesium in water is about 14 mg/L. Poultry that consume water containing high levels of magnesium have loose droppings. Magnesium may interact with sulfate, and it is in the presence of high sulfate levels that magnesium levels are a concern. Levels as high as 68 mg/L have not been shown to adversely affect production when sulfate levels are normal. A level of 50 mg/L of magnesium in combination with a sulfate level of more than 50 mg/L will adversely affect flock performance.

## Manganese (Mn)

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Excessive levels of manganese can result in an off flavor, reducing water consumption.

## Copper (Cu)

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In combination with phosphorus, copper plays a role in bone development. Ruminants are more susceptible to copper toxicity than poultry. Too much copper can give the water a bitter taste and might cause liver damage. Problems with copper can occur when dietary molybdenum is either excessive or deficient.

## Calcium (Ca)

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Calcium does not appear to have a negative effect, even at levels as high as 400 mg/L.

## Iron (Fe)

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High levels of iron, up to 25 mg/L, have not been shown to adversely affect flock performance, but they will stain waterers. High iron levels may encourage the growth of bacteria that can lead to diarrhea. When iron in the ferrous form is exposed to air, it is converted to ferric hydroxide, which gives water the typical rusty color.

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### For More Information

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Drinking water quality for poultry. Thomas Carter and Ronald Sneed, North Carolina Cooperative Extension Service.

Evaluating water quality for poultry. John Blake and Joseph Hess, Auburn University.

Sanitizing poultry drinking water. University of Florida.

# Common Feed Ingredients in Poultry Diets

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 [articles.extension.org/pages/68432/common-feed-ingredients-in-poultry-diets](https://articles.extension.org/pages/68432/common-feed-ingredients-in-poultry-diets)

**Written by:** Dr. Jacquie Jacob, University of Kentucky

The major ingredients in poultry diets provide the protein and energy required for poultry to maintain health, grow, and produce eggs. (For more information about the nutritional requirements of poultry Refer to the article "[Basic Poultry Nutrition](#).")

## Energy Sources

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Common energy sources in poultry feeds include cereals and fats and oils.

### Cereals

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**Cereals** are grasses that produce edible starchy grains, many of which can be used in poultry diets as an energy source. Although the starch in corn is highly digestible, most of the other grains contain **antinutritional factors** that interfere with digestion and/or the absorption of nutrients. These antinutritional factors include the **nonstarch polysaccharides**, often referred to as NSPs. NSPs cannot be broken down by the digestive enzymes poultry normally secrete in the small intestine (referred to as endogenous enzymes). As a result, the NSPs gel, increasing the viscosity of the intestinal contents. The increased intestinal viscosity reduces the availability of the nutrients in the feed. In addition, the presence of NSPs typically results in sticky droppings, which increase the moisture content of the litter. Litter that has a high moisture content can adversely affected air quality within the poultry house.

- **Barley** is commonly used in poultry diets in some regions of Canada and Europe. This cereal is grown on areas of both irrigated and dry land in the United States. It is an early-maturing crop that offers agronomic advantages when used in crop rotation. Barley is considered a medium-energy grain. It has a low starch content, a high fiber content, and some antinutritional factors.
- **Corn**, also called maize, is native to the Americas and was first cultivated by the American Indians. The corn plant is efficient at converting large amounts of sunlight into stable forms of chemical energy stored as starch, cellulose, and oil. Corn is the grain most routinely used in commercial poultry diets in the United States because it has a good energy content and is easy to digest. The amino acid profile of the protein in corn complements the amino acid profile of the other ingredients, such as soybean meal, typically used in feed. Alternative grains are typically evaluated in relation to corn.

- **Sorghum**, also called milo and guinea corn, is a highly drought-resistant crop that is grown in many areas of the world, including the United States. Sorghum is only 3% to 5% lower in feeding value than corn. It is often less expensive than yellow corn. The level of tannins in sorghum limit its use in poultry diets. However, tannin-free varieties are now available, and as a result, sorghum can be substituted for corn in poultry diets with only minor changes in the amounts of other ingredients.
- **Wheat** is often used in poultry diets in western Canada and parts of Europe. The husk of wheat detaches from the grain during threshing (unlike conventional barley and oats where the husk remains attached) reducing its fiber content.

## Fats and Oils

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Fats and oils provide a concentrated source of energy. Sources of fat include the following:

- **Tallow:** Derived primarily from the rendering of beef offal
- **Lard or choice white grease:** Derived primarily from the rendering of pork offal
- **Poultry fat:** Derived from poultry offal
- **Feed-grade animal fat:** Derived primarily from a mixture of rendered beef, pork, and/or poultry raw material
- **Yellow grease:** Derived primarily from reprocessed restaurant grease and cooking oil
- **Blended animal-vegetable fat:** Includes blends of different types and amounts of animal fats and vegetable oils from restaurant grease

In addition to providing concentrated energy, fats provide the following benefits:

- Improved physical characteristics of feed
- Decreased dustiness (feed loss is reduced by effective dust control)
- Improved palatability of feed
- Increased lubrication value of feed
- Reduced particle separation, which helps maintain a uniform mixture of each ration
- Possible contribution of linoleic acid, an essential fatty acid

## Protein Sources

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The many possible protein sources for poultry feeds include the following:

- Canola
- Fish meal
- Field peas
- Meat and bone meal
- Soybeans
- Cereal by-products

## Canola

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**Canola** is a variety of rapeseed that is low in glucosinolates in the oil and eruric acid in the meal. The name *canola* was coined to distinguish the plant from rapeseed, though in Europe canola is often referred to as double-zero rapeseed. Canola meal is a by-product of oil extraction from canola seeds.

## Fish Meal

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There are two basic types of **fish meal**. The first type is derived from fish, such as salmon and tuna, caught specifically for human consumption. The second type is derived from fish, such as herring, menhaden, and pollack, caught specifically for the production of fish meal. In the United States the fish most often used for fish meal is menhaden.

## Field Peas

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**Peas** are grown in temperate regions but are used as a food source worldwide. Traditionally peas rejected from the food industry were used in poultry diets. Now there are varieties of field peas grown specifically for animal feeds. Different varieties of field peas are available.

## Meat and Bone Meal

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**Meat and bone meal** are derived from slaughter by-products recycled for use in animal feeds. They are pressure cooked (rendered) to produce a nutritional and economical feed ingredient.

## Soybeans

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**Soybean meal** is the dominant protein supplement used in poultry diets and is considered the standard to which alternative sources of feed protein sources are compared. Soybean meal has a high protein content, especially compared to other plant protein sources.

## Cereal By-Products

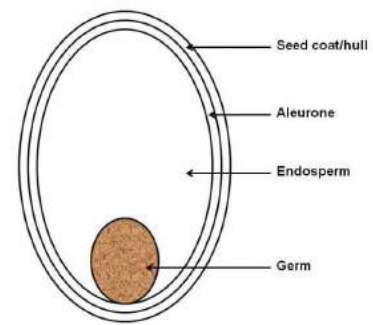
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Many of the cereal grains used as animal feed are also used for human consumption or the development of industrial products. The grains are cleaned and then either dry or wet milled. Dry milling removes the outer fibrous coating of the seed and is used in the production of flour. Wet milling is used in the production of sugar, starch, syrup and/or oil. Many of the by-products of both dry and wet milling are suitable for inclusion in poultry feeds.

Understanding the by-products generated by dry and wet milling requires a basic understanding of the parts of the cereal grain. All grains have four basic parts: seed coat, aleurone, endosperm, and germ.

*Diagram by Jacquie Jacob, University of Kentucky*

The **seed coat** can exist in the form of a hull. For those cereals without a hull, the seed coat is in the form of the pericarp. The function of the seed coat is to protect the grain from moisture, insects, and fungal infection. The seed coat must be broken to allow for the digestion of the nutrients contained within the seed. The seed coat does not supply nutritional value, but depending on the particular type of cereal, the seed coat can dilute the amount of starch in the diet. In oat grains, for example, the hull represents 25% of the seed (on a dry matter basis). In sorghum, however, the seed coat represents only 3% to 6% of the grain weight and has little effect on the nutritional value of the grain.



The **aleurone** is a layer surrounding the endosperm. The **endosperm** is the location of most of the starch, which provides energy to the animals consuming it and is also the source of flour. The aleurone contains fiber and protein. The **germ** is the embryo of the seed and the location of protein and oil.

## Common Cereal By-Products

- **Grain hulls** are the outer covering of the grain seed. The most common hulls are from oats and rice milling. Grain hulls are low in energy and crude protein but high in crude fiber. Hulls are typically classified as roughage and not widely used in feeds for poultry that require growth or high production.
- **Bran** is the coarse outer covering of a seed. It also contains a little of the flour. The most common brans are corn, rice, and wheat. Nutritionally, bran contains fiber and protein.
- The **germ** is the embryo of the seed. Germ meal is high in lipids and protein. The most common feed germ meals are derived from corn and wheat.
- **Gluten feed** and **gluten meal** are by-products of wet milling. Gluten is the substance remaining after removal of the germ and the starchy endosperm. Gluten feed and meal are considered protein sources. The most common cereals used in gluten feed and meal are corn and sorghum.
- **Middlings** (also referred to as midds) are by-products from the production of flour. They include the bran, shorts, germ, flour, and tailings. Rye and wheat are the most common middlings available. The maximum allowed levels of crude fiber in rye and wheat middlings are 8.5% and 9.5%, respectively.
- **Grain screenings** are a mixture of different materials that contain a minimum grain content of 70% and a maximum ash content of 6.5%. Grain screenings can include various combinations of dust, chaff, weed seeds, broken grains, unsound grains,



and any other materials separated during the cleaning and processing of the grain.

**Mixed screenings** must contain no more than 27% crude fiber and 15% ash.

- **Groats** are the grain seeds without the hull. The most common are oat and rice groats. Groats have a relatively low crude fiber content and contain a higher percentage of protein than the original grain.
  - **Mill run** (also known as mill by-product) consists of bran, shorts, germ, flour, and tailings. It is a by-product of most of the cereal grains. There are specific minimum crude fat and maximum crude fiber limits that mill runs can contain, and these requirements vary depending on the cereal grain involved.
  - **Corn hominy feed** includes corn bran, germ, and flour. It contains a higher percentage of both crude protein and fiber than the original corn grain. Compared to other by-products, however, corn hominy feed is lower in crude fiber content. Hominy feed must contain at least 4% crude fat.
  - **Barley malt sprouts** are by-products from the malting industry. They are classified as a protein source and must contain a minimum of 24% crude protein. Malt sprouts consist of roots, sprouts, and malt hulls.
  - **Rice polishings**, as the name suggests, are the residue created when polishing to produce white rice (versus brown rice). Rice polishings are low in crude fiber are high in crude fat and are a good source of the vitamin thiamin.
  - **Wheat red dog** is a by-product of milling wheat and includes tailings with some bran, germ, and flour. The maximum allowed fiber content is 4%.
  - **Wheat shorts** are also a by-product of wheat milling and consist of bran, germ, flour, and tailings. The maximum crude fiber content for shorts is 7%.
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# Health

Terminology Related to Poultry Disease

Common Signs of Illness in Poultry

Common Poultry Diseases

External Parasites of Poultry

Internal Parasites of Poultry

## Terminology Related to Poultry Disease

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### Salient Terminology

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- **Acute:** An acute disease typically involves a sudden onset of severe clinical signs and death (in contrast with a chronic illness, which involves long-term or recurrent symptoms).
- **Chronic:** A chronic disease generally progresses slowly and/or involves long-term or recurrent symptoms (in contrast with an acute illness, which involves a sudden onset of symptoms).
- **Contagious:** A contagious disease spreads rapidly from one individual to another (in contrast with a noncontagious disease, which does not spread easily).
- **Infectious:** Infectious diseases are caused by organisms, such as bacteria, viruses, fungi, and parasites, that infect, or invade, another organism and cause disease.
- **Morbidity:** The term *morbidity* refers to the number of birds within a given flock that are affected by a certain condition or disease (disease prevalence within a population) and that need to be culled—for health reasons such as leg problems or other clinical signs of disease—as a result.
- **Mortality:** The term *mortality* refers to the number of birds that die from an illness within a given flock.
- **Noncontagious:** A noncontagious disease typically does not spread easily from individual to individual (in contrast with a contagious disease, which spreads easily).
- **Noninfectious:** Noninfectious diseases are caused by nonliving agents such as poisons, mycotoxins, and nutritional deficits.
- **Poultry:** The term *poultry* refers to chickens, turkeys, ducks, geese, quail, pheasants, pigeon, guinea fowl, pea fowl, ostrich, emu, and rhea.

## Common Signs of Illness in Poultry

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 [articles.extension.org/pages/68198/common-signs-of-illness-in-poultry](https://articles.extension.org/pages/68198/common-signs-of-illness-in-poultry)

### Signs of Respiratory Infection

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A disease-causing organism can affect more than one system, leading to a variety of different clinical signs. There is considerable overlap in the common signs of respiratory diseases, making diagnosis difficult without a necropsy.

**Common signs of respiratory infection** include the following:

- Coughing
- Sneezing
- Rales (abnormal breathing sounds)
- Gasping
- Shaking head
- Discharge from the eyes
- Conjunctivitis (inflammation of the conjunctiva of the eye)
- Discharge from the nose
- Swelling of the face and/or wattles
- Bluish-purple discoloration of the face
- Retarded growth
- Inactivity
- Dirty wings (birds tend to wipe their nostrils on their wings)

**Less common signs** of respiratory infection include the following:

- Twisting of the head and neck (torticollis)
- Paralysis
- Diarrhea, which might be green and watery
- Swollen joints
- Lameness
- Red or white spots on the legs and comb
- Warts or scabs

### Signs of Nonrespiratory Infection

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**Common signs of nonrespiratory infection** include the following:

- Labored breathing
- Reduced water consumption
- Dehydration

- Reduced feed consumption
- Weight loss or stunted growth
- Emaciation
- Bluish-purple discoloration of the face
- Pale comb
- Small comb
- Abscessed wattles
- Discharge from the mouth
- Blindness
- Enlarged abdomen
- Navel infection
- Swollen joints
- Swollen foot pads
- Lameness
- Tremors
- Paralysis
- Twisting of the head and neck (torticollis)
- Weakness
- Diarrhea, which might be greenish
- White feces
- Bloody feces
- Pasted vent
- Watery droppings
- Thin-shelled eggs
- Shell-less eggs
- Reduced egg production
- Increased mortality
- Helicopter wings (that is, broken or twisted feathers)
- Ruffled feathers
- Foul odor
- Inactivity

*NOTE It is not unusual for poultry to die suddenly without showing any signs of disease.*

# Common Poultry Diseases

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 [articles.extension.org/pages/68293/common-poultry-diseases](https://articles.extension.org/pages/68293/common-poultry-diseases)

This article describes some of the common diseases that afflict poultry, as well as symptoms and indications of different types of disease. The article begins with some general information to help clarify terms commonly used in discussions of disease.

## General Information

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### Terminology Used

### Common Signs of Illness in Poultry

## Characteristics of Healthy Birds

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In order to identify signs of diseases early, it is important to be familiar with the **characteristics of a healthy bird**. A healthy bird displays the following traits:

- Erect stance with head and tail elevated
- Bright red comb and wattles
- Filled-out face parts
- Bright and alert eyes
- Clean nostrils
- Smooth, neat, clean feathers
- Filled-out legs
- Joints that are smooth and cool to the touch
- Weight that is typical for the type and age of the bird
- Powerful movements when struggling
- Scales on the legs and feet that are clean and waxy in appearance
- Color of the skin that is characteristic for the breed and strain of bird, as well as the age and state of production

In addition, a healthy bird eats and drinks frequently and displays no signs of respiratory distress.

## Diseases of the respiratory system

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### Viral Infections

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## Bacterial Infections

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## Fungal Infections

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- Aspergillosis

## Mycoplasmal Infections

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- Mycoplasmas are bacteria that lack a cell wall.

## Diseases of the Nervous System

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## Viral Infections

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## Bacterial Infections

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- Botulism
- Fowl cholera

## Fungal Infections

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- Aspergillosis

## Diseases Affecting the Intestinal System

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## Viral Infections

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- Hemorrhagic enteritis

## Bacterial Infections

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## Parasites

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## Causes of Lameness

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## Viral Infections

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- Viral arthritis
- Marek's disease

## Bacterial Infections

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- Staphylococcus(**bumblefoot**)
- Fowl cholera

## Nutritional Conditions

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- Rickets
- Cage layer fatigue

## Mycoplasmal Infections

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Mycoplasmas are bacteria that lack a cell wall.

### *Mycoplasma gallisepticum*

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Clinical signs of infection by *Mycoplasma gallisepticum* include the following:

- Coughing
- Sneezing
- Shaking of the head
- Rales
- Gasping
- Discharge from the eyes
- Discharge from the nose
- Swelling of the face and/or wattles
- Retarded growth
- General diarrhea
- Prostration

### *Mycoplasma synoviae*

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Clinical signs of infection by *Mycoplasma synoviae* include the following:

- Sneezing
- Shaking of the head
- Rales
- Discharge from the eyes
- Discharge from the nose
- Swelling of the face and/or wattles
- Retarded growth
- Lameness
- Green, watery diarrhea
- Swollen joints

### *Mycoplasma meleagridis*

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Clinical signs of infection by *Mycoplasma meleagridis* include the following:

- Coughing
- Sneezing
- Rales
- Retarded growth

- Twisting of the head and neck (torticollis)

## Diseases Affecting the Skin

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### Viral Infection

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- Fowl pox

### Bacterial Infection

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- Erysipelas

### Parasites

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- Mites and lice

## Disease Affecting the Immune System

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- Infectious bursal disease

## Conditions Affecting the Reproduction System

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There are multiple conditions that affect the avian reproductive system.

- Egg-bound birds are unable to expel eggs in the usual manner.
- Prolapse in poultry occurs when the oviduct of a female bird does not retract properly after the bird lays an egg.
- Egg peritonitis occurs when eggs are not assembled properly in a bird, and egg material fills the abdominal cavity of the bird.

## Metabolic Diseases and Conditions

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Poultry can suffer from a number of diseases and conditions related to metabolism.

- Sudden death syndrome (SDS), also known as flip-over disease, is characterized by the sudden death of birds that show no clinical signs of illness. SDS is believed to be a metabolic disease related to high carbohydrate intake.
  - Ascites, also known as "**water belly**," is a disease in which fluid accumulates in a bird's abdominal cavity.
  - Green muscle disease, also called **deep pectoral myopathy**, is a degenerative muscle disease that affects the breast tenderloin (minor pectoral muscle) deep within the breast.
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# External Parasites of Poultry

 [articles.extension.org/pages/66149/external-parasites-of-poultry](https://articles.extension.org/pages/66149/external-parasites-of-poultry)

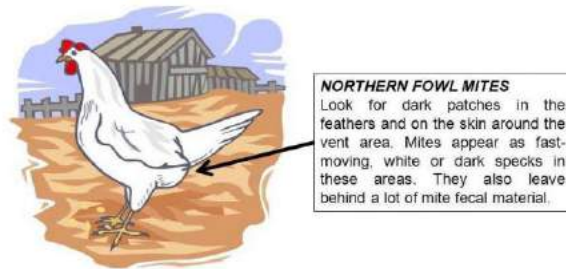
**Written by:** Dr. Jacquie Jacob, University of Kentucky

**Parasites** are organisms that live in or on another organism, referred to as the **host**, and gain an advantage at the expense of the host. There are several external parasites that attack poultry by either sucking blood or feeding on the skin or feathers. In small flocks it is difficult to prevent contact with wild birds (especially English sparrows) and rodents that may carry parasites that can infest poultry. It is important to occasionally check your flock for external parasites. Early detection can prevent a flock outbreak.

**NOTE: Brand names appearing in this article are examples only. No endorsement is intended, nor is criticism implied of similar products not mentioned.**

## Northern Fowl Mites

*Figure 1. Where to look for northern fowl mites. Created by Jacquie Jacob, University of Kentucky.*



**Northern fowl mites** (*Ornithonyssus sylviarum*) are the most common external parasite on poultry, especially on poultry in cool weather. Northern fowl mites are blood feeders. Clinical signs of an infestation will vary depending on the severity of the infestation. Heavy infestations can cause anemia due to loss of blood. Anemia is usually accompanied by a decrease in egg production or growth rate, decreased carcass quality, and decreased feed intake. Northern fowl mites will bite humans, causing itching and irritation of the skin.

Northern fowl mites are small (1/25th of an inch), have eight legs, and are typically black or brown. To check for northern fowl mites, closely observe the vent area of poultry. Northern fowl mites appear as tiny specks moving quickly on the skin. Sometimes the most obvious indication of an infestation is the presence of eggs and mite fecal material (black specks) in the vent area.

Effective treatment may involve treating all the birds with an insecticide approved for poultry. Be sure to read and follow all label instructions, including details regarding protective equipment the producer must wear and possible withholding time for

consumption of meat and eggs from treated birds. Northern fowl mites can reproduce quickly; an egg can develop into a mature egg-laying female in less than a week. None of the recommended materials for treating northern fowl mites kill the eggs. It is necessary, therefore, to re-treat an infected flock every four to seven days. Mites prefer to live on birds, but can survive off the birds for a couple of weeks. It is important to treat the inside of the poultry house, making sure the nesting area, roosts, and any cracks and crevices are treated.

Typical insecticides used to control northern fowl mites include Prozap Insectrin Dust, PoultryGuard, and Ivermectin. The label for any insecticide chosen to treat poultry should state that the insecticide is approved for use in poultry. Organic insecticides—such as PyTGanic Pro, a pyrethrum-based insecticide derived from chrysanthemums—are also available. Including food-grade diatomaceous earth (DE) in dust baths is a nontoxic insecticide option. DE is abrasive and will remove the oily or waxy cuticle layer on the outside of a mite. When this thin, waterproof layer is lost, the mite loses water and dies.

## Scaly-Leg Mites

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*Figure 2. Where to look for scaly-leg mites. Created by Jacquie Jacob, University of Kentucky.*

### **Scaly-leg mites** (*Knemidokoptes mutans*)

are smaller than the northern fowl mite (1/100th of an inch) and live under the scales on birds' legs and feet. These mites are pale gray and have flat, circular bodies. Scaly-leg mites burrow under chickens' leg scales and feed on the tissue under the scales. The legs of an infected bird get thick and crusty. In severe cases the blood supply to the toes may be cut off, and the bird may lose toes.



Infected birds can be treated with Ivermectin. In addition, coating the entire leg with petroleum jelly or dipping the legs in linseed oil will help to suffocate the mites and moisturize the scales. Although scaly-leg mites prefer to live on birds, these mites can survive in the poultry house. It is therefore important to treat the inside of the poultry house, making sure the nesting area, roosts, and any cracks and crevices are treated.

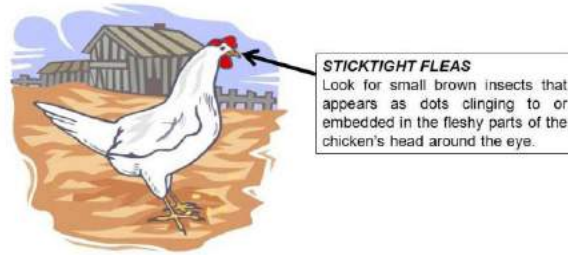
The legs of a chicken that has had a mild case of scaly-leg mites will eventually return to normal. However, in more severe cases, the swollen and deformed look to the feet may remain. Exhibition birds that have legs deformed by mites should not be shown.

## Sticktight Fleas

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Figure 3. Where to look for sticktight fleas. Created by Jacquie Jacob, University of Kentucky

**Sticktight fleas** (*Echidnophaga gallinacea*) attach themselves to the skin and wattles on the head of birds. Unlike northern fowl mites or scaly-leg mites, these fleas can thrive on other animals, including dogs, cats, horses, and humans.



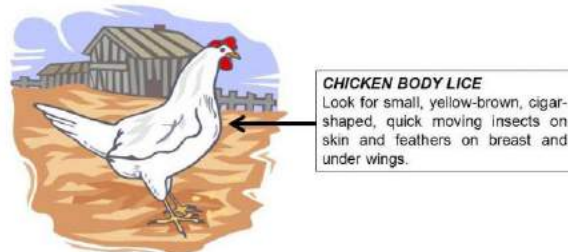
Female sticktight fleas forcefully eject eggs into the surrounding environment. Larvae develop in the soil around poultry houses. It typically takes four weeks for an egg to develop into an adult. Adults are free-living until it is time to breed, at which time female fleas attach to the skin around the face and wattles and lay their eggs to continue the cycle.

Sevin dust can be applied to exposed fleas and litter. Attached fleas will die within a short period of time, but they may remain attached for several days or weeks. An alternative method for treating a sticktight flea infestation is to coat exposed adult fleas with petroleum jelly, which suffocates the fleas. Again, even though the fleas are dead, they may remain attached for several weeks. Since such a treatment kills only the adult females, it is necessary to repeat the treatment weekly to catch any additional fleas that may have developed. In addition, it is important to treat the poultry pen by using an approved insecticide on the litter or by replacing the old litter with clean bedding.

## Poultry Lice

Figure 4. Where to look for chicken body lice. Created by Jacquie Jacob, University of Kentucky.

There are two kinds of lice: biting and blood sucking. Blood-sucking lice attack only mammals, but biting lice infect both birds and mammals. Poultry lice are species-specific and cannot survive on humans.



The **chicken body louse** (*Menacanthus stramineus*) and the **shaft louse** (*Menopon gallinae*) are the two species of lice most commonly found on poultry. Lice lay their eggs on the birds' feathers, typically near the base of the feather shaft. The eggs are cemented together and so have the appearance of a collection of white particles. After hatching, lice may live on a bird for several months; however, they can survive off the bird for only one week. The entire life cycle of the lice occurs on the host bird, primarily in the feathers.



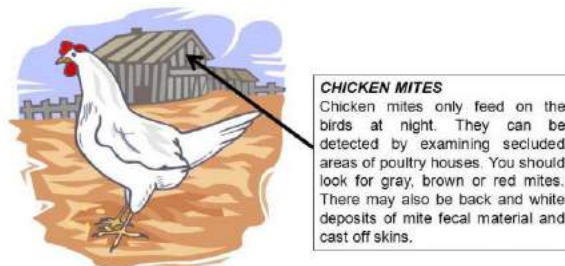
Lice that infect poultry do not suck blood; instead, they feed on dry skin scales, feathers, and scabs. They will, however, feed on any blood that appears on the skin surface. Infested birds may appear agitated because of the skin irritation. They will have damaged feathers and will appear to be in general poor health. Infested flocks may also show reduced feed intake, slowed body growth, decreased fertility, and declining egg production. Young birds are usually more seriously affected than are adult birds.

Insecticides that treat northern fowl mites will also control lice. Generally, lice do not leave the host bird unless they are moving to another bird, so careful treating of the birds' environment isn't as crucial as it is with the other external parasites. Nevertheless, it is important to treat the environment. The time from egg to adult for lice is about three weeks, so repeated treatments are required.

## Chicken Mites

*Figure 5. Where to look for chicken mites. Created by Jacquie Jacob, University of Kentucky*

**Chicken mites** (*Dermanyssus gallinae*), also known **roost mites** or **red mites**, are found on domestic fowl around the world. These mites can also thrive on people. Symptoms of an infestation are similar to those of northern fowl mites. Unlike northern fowl mites, however, chicken mites do not live on the birds. During the day, chicken mites live in dark areas in the poultry house such as cracks and crevices in roosts, walls, ceilings, and floors. Chicken mites are nocturnal, coming out at night to feed on the birds. They are blood suckers that turn red after ingesting blood. Since chicken mites feed on the birds only at night, it may be difficult to detect a mild infestation. These gray, brown, and red mites can be detected by examining secluded areas of the poultry house. In addition to the appearance of the mites themselves, their presence may be indicated by black and white deposits of mite fecal material and cast-off skins.



Chicken mites can be transferred from wild birds, rodents, and other animals. Heavy infestations of chicken mites cause birds to have pale combs and wattles. The birds also become listless and show a decrease in egg production and male fertility; young birds experience a slowing in weight gain. Infested flocks are more susceptible to other parasites and diseases.

Effective treatment requires that treating the entire poultry house, paying special attention to the areas where these mites like to hide (every crack and crevice, as well as roosts, walls, and ceilings). The birds should also be treated with an insecticide that is approved for poultry. Be sure to read and follow all label instructions, including details regarding protective equipment the producer must wear and possible withholding time

for consumption of meat and eggs from infected birds. Given the short life cycle of this parasite—7 to 14 days from egg to adulthood—it is necessary to re-treat an infected flock every 4 to 7 days. Adult mites are resistant to starvation and, when off the host, can survive without feeding for up to six months. It is important, therefore, to treat and re-treat the poultry house as well as the birds. It is also important to note that a poultry house can remain infested long after the birds have been removed.

## Less-Common Parasites

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**Fowl ticks** (*Argas persicus*), also known as **blue bugs**, are considered soft ticks. By contrast, the ticks that are normally found on cats and dogs are hard ticks. The ticks that affect birds are light reddish brown to dark brown and their skin is wrinkled. Adults are about 1/4 inch in length. Ticks live in the cracks and crevices of a poultry house. Ticks in various stages of development will feed on a host.

Females lay 50 to 100 eggs after every blood meal. Eggs are laid in the cracks and crevices in the poultry house. After the eggs hatch, the larvae seek out a host where they attach themselves and feed for four to seven days. The larvae then fall off the host and molt to the nymph stage. Nymphs and adults feed only at night and for short periods of time (15 to 30 minutes). Red spots can be observed on the bird where the tick has fed. After several nymphal molts, the adult tick emerges. The time from egg to adult is approximately 30 days.

Adult ticks are extremely resistant to starvation and can live for more than a year without feeding. Flocks infested with ticks can experience decreases in egg production and weight gain. The birds become emaciated and more susceptible to disease. In severe cases, death results. Treatment for ticks includes thoroughly cleaning and sanitizing the poultry house. After the house is sanitized, it should be sprayed with an approved insecticide.

**Bedbugs** (*Cimex lectularius*) are nocturnal. Young and mature bedbugs crawl onto birds and suck their blood. Bedbugs hide, breed, and lay eggs in various locations in a poultry house, including in nests, behind nests, under loose boards, and in cracks around the walls, roosts, and roof. Bed bugs can best be controlled by treating these locations with an approved insecticide. When disturbed, bed bugs give off a distinct odor similar to that of stink bugs.

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# Internal Parasites of Poultry

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 [articles.extension.org/pages/66279/internal-parasites-of-poultry](https://articles.extension.org/pages/66279/internal-parasites-of-poultry)

**Written by:** *Dr. Jacquie Jacob, University of Kentucky*

A parasite is an organism that lives in or on another organism (referred to as the host) and gains an advantage at the expense of that organism. The two types of internal parasites that affect poultry are worms and protozoa. Usually, low levels of infestation do not cause a problem and can be left untreated. Clinical signs of a parasite infestation include unthriftiness, poor growth and feed conversion, decreased egg production, and, in severe cases, death. Also, parasites can make a flock more susceptible to diseases or worsen a current disease condition.

## Worms

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### Roundworms

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**Roundworms** (nematodes) are common in poultry, waterfowl, and wild birds. Species of roundworms that affect poultry include species of large roundworms (*Ascaris* sp., also known as ascarids), species of small roundworms (*Capillaria* sp., also known as capillary worms or threadworms), and cecal worms (*Heterakis gallinarum*). Roundworms can cause significant damage to the organ(s) they infest. Most roundworms affect the digestive tract; others affect the trachea (windpipe) or eyes.

**Large roundworms** are the most damaging of the worms common to backyard flocks. A severe infestation can cause a reduction in nutrient absorption, intestinal blockage, and death. Easily seen with the naked eye, large roundworms are about the thickness of a pencil lead and grow to 4-1/2 inches long. Occasionally, they migrate up a hen's reproductive tract and become included in a developing egg. The life cycle of a roundworm is direct; that is, worm eggs are passed in the droppings of infected birds and then directly to birds that consume contaminated feed, water, or feces. Also, worm eggs may be picked up by snails, slugs, earthworms, grasshoppers, beetles, cockroaches, earwigs, and other insects. Known as intermediate hosts, these insects carry the eggs and when eaten by a bird pass the eggs to the bird. Identifying and minimizing the number of intermediate hosts that poultry have contact with helps prevent the birds from being infected with worms. Because approved wormer medication in poultry is limited, you should check the US Food and Drug Administration (FDA) Approved Animal Drug Products list (known as the Green Book) for currently approved medication. Medication containing the active ingredient piperazine is

available for use against large roundworms in poultry but is not effective against other internal parasites of poultry. As with all medications, read the label concerning dose to administer and withdrawal period before consumption of eggs or harvesting for meat.

Several species of **small roundworms** can affect different parts of birds and cause a variety of symptoms. Species that infect the crop and esophagus cause thickening and inflammation of the mucus membranes located there. Turkeys and game birds are most commonly affected by such species, and producers can suffer severe losses due to these parasites. Other species of small roundworms are found in the lower intestinal tract and cause inflammation, hemorrhage, and erosion of the intestinal lining. Heavy infestations result in reduced growth, reduced egg production, and reduced fertility. Severe infestations can lead to death. If present in large numbers, these worms can be seen during necropsy (examination after death). Small roundworm eggs are very small and difficult to see in bird droppings without a microscope. Medications that contain levamisole are effective in treating small roundworms.

**Cecal worms** are commonly found in chickens. As the name implies, they grow in the ceca (two blind pouches at the junction of the small and large intestines). Although cecal worms typically do not affect chickens, the worms can carry *Histomonas meleagridis*, a species of protozoan parasite that causes histomoniasis (blackhead) in turkeys. Turkeys can contract histomoniasis by eating chicken manure containing infected cecal worm eggs or earthworms that have ingested infected cecal worm eggs. So, although chickens generally are immune to problems caused by cecal worms, controlling the worms is still important for turkey health. Levamisole is effective in controlling cecal worms. A veterinarian's prescription is required for use of the drug in poultry.

## Tapeworms

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Several species of **tapeworms** (cestodes) affect poultry. They range in size from very small (not visible to the naked eye) to more than 12 inches long. Tapeworms are made up of multiple flat sections. The sections are shed in groups of two or three daily. Each section of tapeworm contains hundreds of eggs, and each tapeworm is capable of shedding millions of eggs in its lifetime. Each species of tapeworm attaches to a different section of the digestive tract. A tapeworm attaches itself by using four pairs of suckers located on its head. Most tapeworms are host specific, with chicken tapeworms affecting only chickens, and so on. Tapeworms require an intermediate host to complete their life cycle. These intermediate hosts include ants, beetles, houseflies, slugs, snails, earthworms, and termites. For birds kept in cages, the most likely host is the housefly. For those raised on litter, intermediate hosts include termites and beetles. For free-range birds, snails and earthworms can serve as intermediate hosts. There are no approved medications for use against tapeworms, so controlling the intermediate hosts of tapeworms is vital in preventing initial infections and reducing the risk of reinfection. If you get a laboratory diagnosis of tapeworm infection, always ask which tapeworm species is causing the infection and which intermediate host is involved in the parasite's

life cycle. Because the intermediate hosts for tapeworms vary greatly, it is important to identify the tapeworm species to target prevention efforts toward the correct intermediate host.

## Protozoa

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**Protozoa** are single-celled organisms found in most habitats, and they include some parasitic pathogens of humans and domestic animals. Protozoan parasites that are important to backyard poultry growers are coccidia (species of the *Eimeria* genus), cryptosporidia (*Cryptosporidium baileyi*), and histomonads (*H. meleagridis*).

By far, the most common protozoan parasites of chickens and turkeys are **coccidia**. Nine species of coccidia affect chickens, and seven affect turkeys. Coccidia are species specific, meaning that coccidia that affect chickens, for example, do not affect turkeys or other livestock. Coccidia live and reproduce in the digestive tract, where they cause tissue damage. This damage reduces nutrient and fluid absorption and causes diarrhea and blood loss. **Coccidiosis** (infection with or disease caused by coccidia) can increase a bird's susceptibility to other important poultry diseases, such as necrotic enteritis. Coccidia are in nearly all poultry. Chicks develop immunity to coccidiosis over time, with most severe cases occurring when chicks are three to six weeks old. Signs of coccidiosis include bloody diarrhea, watery diarrhea, abnormal feces, weight loss, lethargy, ruffled feathers, and other signs of poor health. Most store-bought feeds contain medication that controls but does not eliminate coccidia. Eating such feed allows young birds to develop resistance to the coccidia prevalent in their environment. However, if the birds are exposed to a different species of coccidia, they will not have immunity, and disease symptoms may result. A common medication for controlling coccidiosis in birds not fed medicated feed is amprolium. As mentioned above, following the instructions for administration is important for proper drug delivery and bird recovery. Vaccines are currently available that give newly hatched birds a small amount of exposure to coccidia, allowing them to develop immunity without developing the disease. With proper vaccination and management, routine anticoccidial medications are not necessary.

**Cryptosporidiosis** is infection with or disease caused by **cryptosporidia**.

Cryptosporidia are not specific to chickens and can infect other birds and even mammals. Cryptosporidia frequently spread from flock to flock on the feet of animals and people and can be carried by wild birds. Intestinal cryptosporidiosis is common, and symptoms are usually mild. Frequently, the only symptom is pale skin in yellow-skinned breeds. Cryptosporidiosis also can be contracted by inhalation, resulting in a respiratory infection that is more severe than the intestinal form. There is no treatment for this form of cryptosporidiosis. Providing supportive therapy and guarding against secondary infection are the only courses of action. Once recovered, birds are immune to future infection.

As mentioned previously, **histomoniasis** is a disease of turkeys caused by **histomonads**, protozoan parasites carried by cecal worms. Histomoniasis is a serious, even deadly, disease and is most common in range-raised birds. Turkeys raised with access to

chicken fecal material or earthworms that have ingested cecal worm eggs pick up histomonads and develop the disease. There is no effective treatment for histomoniasis. The only effective control is to control cecal worms, thereby reducing the spread of histomonads. Also, you should not house or range turkeys with chickens or in areas where chickens recently have been.

### **For More Information**

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Internal Parasites (of poultry), Donna Carver, North Carolina State University.

Internal Parasites (of poultry), Tina Savage, University of New Hampshire, and Michael Darre, University of Connecticut.

Intestinal Parasites in Backyard Chicken Flocks, Gary Butcher and Richard Miles, University of Florida.



# Showing

Exhibition Poultry (Miller)

Bathing and Grooming Poultry (Miller)

Showmanship (Miller)

## Exhibition Poultry

Exhibition poultry are birds raised and kept for show purposes. They are birds recognized by the American Poultry Association in their *American Standard of Perfection* and by the American Bantam Association in their *Standard*. Poultry shows offer a great opportunity to meet exhibitors, breeders, judges, and see a wide variety of birds. Many poultry shows offer showmanship for youth exhibitors.

### Finding Shows

Begin show preparation by deciding what shows you want to attend within a particular time frame. Find shows that fit into you and your family's schedule by looking for poultry shows on the Internet, contacting poultry associations, or talking with breeders. The Poultry Show Central website, [www.poultryshowcentral.com](http://www.poultryshowcentral.com), is the go-to Internet site to find show poultry information. Record the location and dates on a calendar. Download or obtain a copy of the premium list (show bill) for each show as soon as it is available. Note whether the shows use the APA or ABA breed Standard, and follow that breed standard for the birds you plan to show (ABA is for bantams only). The premium list will tell you the date, location, when the birds must be cooped in and are released, the entry deadline and entry fees, classes available, health requirements, acceptable methods for identifying birds, if youth showmanship is offered, awards being offered, and show officials contact information.

### Selecting Poultry for Show

People who show poultry are called fanciers. If you are interested in showing poultry, you first must select a quality bird. Typically, you will not find show quality birds at hatcheries; therefore, talk with breeders and attend poultry shows to find quality show birds. Once you have birds, be prepared to put a lot of work into caring for these birds, and conditioning and training them. Even though you might not show poultry year round, keeping quality show birds is a year round responsibility.

Beginners, especially, should specialize in one breed and one variety within that breed. There are so many breeds and varieties of poultry that it is easy to get carried away by purchasing several different breeds and showing a lot of birds. Exhibitors who consistently win will tell you that showing birds starts in the breeding pen. They have an extensive knowledge of the breeds and varieties they are showing, have a well-planned out breeding program, and cull any birds that do not meet the show qualifications outlined in the APA and ABA Standards.

Bantam chickens and ducks outnumber large fowl at most shows. They are a good choice for beginners as they take less space to house, are cheaper to feed, easier to manage, and can be transported in the family vehicle. Bantams are also easier than large fowl for youth to handle.



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Purchasing an APA *American Standard of Perfection* is a must for people who want to show poultry. The *Standard* establishes a scale of points that assigns a value to every feature of a bird. These features and point systems vary according to each species - chickens, ducks, geese, turkeys, and guinea fowl. For example, there is no such thing as the perfect chicken, but if there were, that bird would score 100 points. Judges deduct points, called cutting for defects, from the 100-point scale, according to the severity of a defect. If the defect is serious, it becomes a disqualification, and the bird is ineligible to win an award. The APA *Standard* lists general disqualifications that apply to all breeds and varieties, as well as disqualifications specific to certain breeds and varieties. General disqualifications for all breeds and varieties include (1) specimen lacking breed characteristics (weight, shape, color); (2) definite indications of contagious or communicable diseases; and (3) evidence of faking. Faking is the deliberate attempt to remove or conceal a disqualification or serious defect, making a bird look like something it is not, to deceive a judge or prospective buyer. It is dishonest and unethical under any circumstances.

Eight weeks prior to the first show, select the birds you plan to show, plus a few extra. That way you will have replacements if one or two do not work out. Refer to the APA *American Standard of Perfection* or the ABA *Standard* to select birds based on their symmetry, weight or size, shape and type, color, feather quality and condition. Selecting the birds early allows time to improve their condition and feather quality. Select birds with the fewest defects and with no disqualifications. If showing pullets or cockerels (poultry less than one year old), select birds that are fully feathered.

### **Housing**

Treat each selected bird for lice infestation. Then put your prospective show birds in individual pens to prevent pecking from other birds and their feathers being damaged. Individual wire pens or cages with solid bottoms large enough for your birds to stand tall and spread their wings can be used for housing. Some people purchase show coops for training purposes. Being penned in show coops also orients birds to the types of coops they will be housed in during a show.

Bed each pen with pine shavings. Do not use a form of bedding that is dusty and non-absorbent. Keep the pens clean at all times so the birds do not get their feathers stained. Every time you feed or check on your birds, remove any droppings and add more shavings if needed. Some people line the bottom of the pens or coops with vinyl flooring for ease of cleaning.

Once you have placed each bird in its pen, put an identifying leg band on each bird, if it is not already identified. Inspect each bird and make notes on its condition, any broken, damaged or off-colored feathers, scratched combs, etc. Feathers typically grow back in six to eight weeks, so if you find one or two damaged, broken, or stained feathers, gently pull them out and they should grow new feathers in time for the show. Never yank out a wing or tail feather as you might damage the feather follicle. Cut the feather leaving a two-inch stub. Then cut the shaft down the middle toward the skin. Once the feather loosens, gently pull it out. If a bird has several damaged or stained feathers, return it to the flock and wait on it to molt. Do not attempt to remove several feathers.

## **Conditioning**

Condition refers to the state of a fowl in regard to health, including cleanliness and brightness of plumage, head parts, legs, and feet. Therefore, conditioning is the process of achieving that state of good health and cleanliness. Conditioning includes nutrition and grooming.

### **Nutrition**

Check the *Standard* to see what the ideal weights are for your birds. Weigh each bird and record the date and weight. If a bird is overweight, slightly reduce the amount of food intake and increase exercise. Swimming is the best form of exercise for waterfowl. If a bird is underweight, increase its food intake. If it does not gain weight, look for the cause.

Feed your birds a balanced waterfowl, chicken, or game bird feed. Offer whole oats free choice in a separate feeder from the poultry feed. Whole oats improve feather quality. Provide granite grit to help the birds digest the oats. Also feed a small amount of black-oil sunflower seeds, safflower seeds, flax, or linseed meal to promote natural oil production, enhancing the sheen of the plumage.

Experienced exhibitors typically have a diet they customize for their show birds. Talk with exhibitors to see what works for their breeds and varieties of poultry.

### **Grooming**

If showing chickens, initially bathe each of them. Refer to the Bathing and Grooming Section for bathing instructions. Then don't bathe them again until four or five days prior to the show. This allows enough time for natural oils to return to their feathers. Waterfowl need to swim every day to help grow shiny, clean feathers. Bathing is the best conditioner for waterfowl feathers. Change the water daily since stale and dirty water will stain the waterfowls' feathers, as well as cause the bird to become sick.

## **Transporting Show Birds**

Exhibition poultry are taken to shows in many types of cages or carriers. Some people use wooden or plastic carriers made especially to transport poultry. Plastic dog crates and well-ventilated plastic tubs can also be used. Even sturdy cardboard boxes with holes to ensure adequate ventilation work for short distances.

Make sure the carrier is large enough for your bird to stand up, move around, and not damage its feathers. Line the bottom of wooden carriers with vinyl to keep droppings from soaking into the wood, and for easier cleaning. Bed the carrier floor with shavings. Make sure it does not have any sharp edges on the inside for your bird to injure itself.

If transporting more than one bird in a carrier, or a compartment within a carrier, make sure they get along. You don't want them to pick at each other or fight, which could damage their combs or feathers.

It is fine to put feed in the carrier during transport, but do not leave water in the carrier. Chances are it will spill, which could cause the cage and your bird to get wet. Stop every four hours or so to water your birds if you are traveling a long distance.

Never leave your birds inside a vehicle when it is hot outside. Also, make sure your birds are protected from drafts, rain and cold during transport.

## **Sale Birds**

Most shows have an area where people can sell their poultry. Either the owner is present or leaves a name and phone number on the cages so prospective buyers can find him/her. Many sale birds are high quality animals, but some are not. These birds may have not been health-checked and may not be in show condition.

Before buying sale birds, ask a knowledgeable exhibitor or breeder to look at the birds with you to see if they meet breeding or show standards. If purchasing any birds, spray them for external parasites before taking them home. Do not put them in the same carriers as your other birds. When you get them home, quarantine them for a minimum of fourteen days, before adding them to your flock.

Author: Lucinda B. Miller, Extension Specialist, 4-H Youth Development

Sources: *Exhibition: From Selection & Conditioning to Show Floor*, Patty Pickard  
*Standard of Perfection*, American Poultry Association, 2015  
*Storey's Guide to Raising Chickens*, Gail Damerow, 2010

## Bathing and Grooming Poultry

When showing poultry, whether for exhibition or in showmanship, the condition and cleanliness of the birds are reflections of their owners. Designate an area for your show birds, and do not allow them to run with the rest of the flock. If possible, keep them in individual coops or cages during the show season to maintain condition and cleanliness.

### Bathing

Birds should be bathed at least five days before a show. This allows the bird time to dry completely, oil to be restored to the feathers, and for them to groom their own feathers. Before you begin, gather the necessary items needed to bathe your birds.

#### List of Bathing Supplies

- Toothbrush – used to scrub the shanks, feet, toes, and toenails
- Apple Cider Vinegar – used to help rinse the shampoo out of the feathers. Use about ½ cup for a tub of water
- Shampoo – used to clean the feathers; do not use a harsh shampoo as it will make the feathers brittle. You can use a flea and tick shampoo recommended for cats or dogs, which not only cleans the birds but kills lice or mites gone unnoticed.
- Blow Dryer – used to dry loose-feathered birds if needed
- Towels – used to dry birds
- Nail clippers and file – Used to clip toenails and upper beak, and file the beak
- Sponge – used to wash the birds, particularly the head
- Cotton balls and styptic powder – to stop bleeding in case the nails and beak are cut too short
- Three tubs or 5-gallon buckets of warm water– to bathe and rinse birds; Note: You can use a utility tub with warm running water located in your basement, work room, etc., to wash and rinse your chickens instead of the three tubs. (Hand held shower heads are nice)
- Heat lamp or heat source if it is cold outside so bird's do not get chilled

**Step 1:** Hold the bird in one hand with the legs between your fingers and your other hand on the bird's back. Slowly lower it into one tub of water. Birds will typically enjoy the warm water. Some will go to sleep, so watch they do not drop their head into the water and drown.

**Step 2:** Put a small amount of shampoo on the bird and wash every part of the bird. Wash in the direction the feathers grow, taking care not to break any. You may need to wash the vent area and the ends of the wings twice to ensure cleanliness. Be careful when washing feather-legged breeds not to tear any feathers on the legs or feet.





Step 3: Put the vinegar into the second tub and thoroughly rinse your bird.

Step 4: Put your bird in the third tub of warm water to make sure there is no shampoo left in the feathers. If you don't get all of the soap out of the feathers, they will clump together, look gummy and dull.

Step 5: Remove the bird from the third tub and wrap it in a towel. Make sure its head is sticking out of one end of the towel and its feet are sticking out of the other end.

Step 6: Use a soft toothbrush to clean the shanks, feet, toes, and toenails. Again, be very careful not to damage the feathers on the legs and feet of feather-legged breeds.

Step 7: With the bird still wrapped in the towel, clip the ends of the toenails and spur. Be careful not to cut into the quick (vein) or it will bleed. If this should happen, apply styptic powder using a cotton ball. Apply pressure until the bleeding stops. (Use flour, liquid bandage)

Step 8: Wash the face with a sponge or cotton ball.

Step 9: Clip the upper part of the beak and file the sides to match the bottom part of the beak. Never trim the bottom part of the beak.

Step 10: Remove your bird from the towel.

Step 11: Put hard-feathered birds in a clean carrier, coop, or small pen with clean shavings and allow to air dry. They will groom their own feathers and be dry in about 24 hours. Make sure the wet birds are not in drafts, or where it is too cool, cold, or too hot.

Step 12: It is best to let loose-feathered birds dry on their own. However, if you decide to blow dry these birds, do so on low heat. Be careful not to hold the dryer too close as the heat could hurt the bird's skin and feathers. Too much heat from hair dryers can damage feathers. Drying birds with a hair dryer can be a long process. Most birds look better if allowed to dry and preen on their own.

Once your birds are dry, keep them clean by putting them in clean individual coops or cages about the size of the show coop. Bed with dust-free shavings and keep the cages clean.

Use soapy toothbrush to gently scrub of any dirt on combs and wattles and around their face. Use the nail file to pick dirt out from under their toenails and from under the scales on their legs.

If the weather is too cool or cold, set up a place in your house for the birds to dry. If that is not an option

## Grooming

Preparing your bird for show doesn't stop after bathing and some pre-show grooming! Once you arrive at a show, you should do some final grooming that will make your bird look its best for the judge.

Come prepared to the show with a grooming box. A plastic tackle box is great to carry your last-minute grooming items. Items to carry in your show box include:

NPIP Number and/or Paperwork should be in an envelope in your grooming box

Baby oil gel (coconut oil) – used to shine shanks, feet, combs, and wattles

Toothbrush – in case you find some dirt or manure on the feet

Styptic powder – in case you need to stop bleeding from anything

Cotton balls – used to clean feathers or apply baby oil

Nail clippers – in case you forgot to trim a toenail or the beak

Antibiotic ointment – to put on combs or wattles that have been scratched

Wet wipes or washcloth – used to clean legs and feet at the last minute

Silk cloth – used to shine feathers of tight-feathered birds

Band-Aids – in case your bird pecks or scratches you causing bleeding

(Use baby oil to enhance combs)

Electrical zip ties in case a partition is not solid

Clear plastic if you need to put around coop to keep birds from fighting

The show, including showmanship, will have a start time. Get there in plenty of time to coop in your birds. Touch them up at this time. Keep checking them to make sure they are still clean prior to the aisle being closed for judging, or when your showmanship class is called. Do any final touch up as close to judging as possible. It is important you stay clean for showmanship, so when touching up your birds wear an old shirt or apron. A carpenter's bib apron with front pockets keeps your clothes clean and gives you places to put things.

Follow these steps:

Step 1: Remove your bird from the show coop and check it over for any dirt or manure that may have gotten on it. Use a damp cloth or baby wipes to clean the feet, toes, and vent area, or any other dirty spots.

Step 2: Using either a cotton ball, cloth, or your fingers, put a tiny amount of baby oil gel on the beak, comb, wattles, earlobes, shanks, feet, and toes. For feather-legged breeds, put just a little on the bare parts of their legs and feet. Also, put a dab on the spurs.

Step 3: Smooth out any rough feathers by running your fingers down the shaft and putting the web back together. You may need to do this feather by feather, paying particular attention to the wings and tail feathers.

Step 4: Use the silk cloth to rub the bird from head to tail several times, always going in the direction the feathers lay. Rub the underside, also.

Step 5: Remove any soiled bedding in the show coop. Put your bird back in and gently give it one last wipe with the silk cloth.

Remove the water from birds with beards and muffs until the judge is finished. You do not want the feathers wet. You can also use a (need to find out what it is called) waterer where the bird can only get its beak wet and the beard and muff stays dry. Pop bottle waterer

Also remove the food after their evening feeding so your bird's crop is not full. A full crop can change its appearance.

Always monitor your birds. If the judge is taking a long time to judge your class, and it is a hot day, do not let your birds go too long without water.

Author: Lucinda B. Miller

Sources:

*Bathing and Grooming Poultry for Show: An Easy-to-Follow Manual for the Beginner*, Megan and Makayla Kinard, APA-APA Youth Program

Tim Bowles, Lucasville, Ohio

## Poultry Showmanship – Chickens

**Showmanship** is a competition where you are judged on your knowledge, presentation and handling of poultry. A judge will ask questions about poultry in general, as well as questions about your project bird, and evaluate how you handle and present your bird.

For showmanship you need to learn about poultry, select the right bird, have a bird that is used to being handled, dress properly, have a positive attitude, and know the steps in showing your bird. Keeping showmanship records will provide information needed to continually improve.

Each poultry exhibition, whether open poultry shows or county or state fair shows, will have exhibition rules. You must follow the rules, and dress codes if applicable, to be permitted to show or successful in showing. Be prepared prior to your class and be on time.

### Learning about Poultry

You must study to gain the knowledge to be successful in showmanship competition. Many questions asked come from the American Poultry Association (APA) American Standard of Perfection and the American Bantam Association (ABA) Bantam Standard. Questions may also come from this Poultry Resource Handbook and other sources. Since you do not know what the judge is going to ask, it is difficult to know what to study. Start by learning the basics. Know the class, breed, variety, sex and age of the bird you are showing. Know the external anatomy of the species of poultry you are showing, including the parts of the wing and feathers. Use correct terminology. All birds are judged against the standard for their breed. Learn what the standard is for the breed you are showing and be prepared to tell the judge any faults your bird might have, as well as how you could improve your bird's appearance. The older you are, the more you will be expected to know, regardless of whether or not it is your first year in showmanship. Sample questions for all age groups are available on the APA-ABA Youth Poultry Club website.

In addition to studying, you must learn how to properly handle and present the type of bird you are showing. Attend a poultry show where there are youth showmanship classes and watch the young people show their birds. Watch how they handle their birds and interact with the judge. Talk to some of the youth after they are done showing if you have questions. If you have the opportunity, talk with a showmanship judge after he or she is completely finished judging. Study, practice, and observe showmanship classes to help you be successful in showmanship.

### Selecting the Right Bird

Selecting the right showmanship bird is an important part of showmanship. This shows the judge you know how to choose a bird that best represents the standard for that breed and variety. Select a bird in top condition to show the judge you know what a healthy and conditioned bird looks like.

Choose a breed and variety that interest you. Select a bird old enough to have its adult feathering. If at all possible do not use a bird in a molt, with broken feathers, or with definite disqualifications.



The bird needs to be the right size and temperament to easily handle. Younger and smaller children may want to show bantam birds, as they will fit in their hands better than will large fowl. Work with two or three birds in case one goes into a molt, breaks feathers, or has other problems that makes it unacceptable for showmanship.

### **Personal Appearance**

It is important to dress properly when showing poultry. A well-groomed appearance can make a good impression on the judge.

Wear neat and clean clothing. Dark pants help hide any dirt or droppings. Long pants and long-sleeved shirts, tucked in, give a pleasing appearance to a judge.

Many judges like to see youth wearing show (lab) coats. Wearing a white (or other color) show coat adorned with any pins or patches you have won in poultry events, and/or from membership in poultry associations, displays to the judge your interest in poultry and recognition of knowledge gained. Wear a collared shirt underneath the show coat. Show coats also keep your clothes clean. County fairs may have showmanship dress codes, so make sure you check with your county Extension staff or fair board prior to the show.

Do not wear short-sleeved shirts and jewelry, as judges may consider them unsafe to you as well as your bird. Also, do not wear ball caps or hats, sandals, flip flops, or other open-toed shoes.

Your hands and fingernails should be clean. Tie long hair back away from your face so it does not interfere with showing your bird. Do not chew gum. Do not bring a cell phone into a showmanship class.

Decide what is unique about you that will catch and keep a judge's attention to help him/her remember you, without distracting from your overall appearance and showing your bird.

### **Positive Attitude**

Have a pleasant and positive attitude when showing your bird. Always pay attention to where the judge is. Listen intently to any instructions the judge gives. Watch how he or she is interacting with the other exhibitors. Show respect for the judge and be polite throughout judging. When the judge approaches you to begin judging, shake the judge's hand, and say "Good morning" or "Good afternoon." You may also say "Yes sir/ma'am" or "No sir/ma'am." Tell the judge "Thank you" when you are done being judged and shake his/her hand again.

When asked a question, answer with confidence. If you do not know an answer simply tell the judge you do not know but will find out before being judged the next time. Speak loud enough for the judge to hear, and talk clearly. Look at the judge when talking. The judge has about 4-5 minutes to determine what you know. Do not waste time by talking too much and not letting the judge ask the questions needed to determine your knowledge.

Never talk to other competitors during judging. Your attention should be on the judge and your bird until the class is over and the judge turns in his/her results. Be courteous to other exhibitors if asked to pass the bird to the person beside you or when taking other directions from the judge.

Once the class has been judged and awards presented, exhibit good sportsmanship by being gracious in winning as well as in defeat. Congratulate the person who won, and those who placed above you. If you win, thank those who congratulated you. The judge may be watching and remember the type of sportsmanship you displayed the next time he or she is your judge.

### **Showmanship Records (After Judging)**

After your showmanship class, write down the questions asked, and whether you knew the answer or not. Also record the judge's name and anything you can remember about the judge, so you will know his or her likes or dislikes if you have the same judge at another show. Keep a notebook with pages like the one below and record everything you can remember. This will help you be better prepared for future showmanship classes.

Form fields:

- Show: \_\_\_\_\_
- Bird shown: \_\_\_\_\_
- Judge's name: \_\_\_\_\_
- Placing: \_\_\_\_\_
- Date: \_\_\_\_\_
- Question Asked:  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- Notes:  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

### **Helpful Hints**

A judge may ask you questions about the patches and pins you are wearing on your lab coat, so know what they represent.

Judges may do things to see if you are paying attention, or to see how long it takes for you to correct a situation. For example, a judge might put a pinch of bedding on the back of your bird, expecting you to quietly and quickly brush it off.



A judge might hand your bird to you sideways. You should ask him to please turn the bird so you can receive it in a forward position.

A judge might ask how old is your chicken, knowing you are showing a duck. The judge is waiting for you to politely say, "My duck is \_\_\_\_ years old."

Record, in your showmanship records, any kind of actions a judge might use to test your knowledge and skills.

### **Bird's Appearance**

Your bird's appearance also demonstrates your knowledge. All external parts of your bird should be clean. There should be no broken feathers, and the bird should not be molting. The comb should be intact, with no frozen points or torn blades. The ear lobes and wattles should be intact and free of scars and blemishes. Feather-legged birds should have clean, intact leg and toe feathers. The upper beak may need trimmed, as well as the birds nails. File any rough edges. Refer to the Bathing and Grooming for Show section to learn how to clean your bird for showmanship.

### **Training for Showmanship**

Coop training, posing, and handling are three essentials to teach your bird before entering a showmanship class. Train your bird so it is at ease when being held, handled, and passed to another person. It needs to know how to act when taken in and out of a coop or moved in and out of the show area, and how to pose to look like its breed pictured in the Standards.

### **Coop Training**

Once you select your showmanship birds, move them to a coop the size used for your species/breed 4-5 weeks before the show. Handle your showmanship birds daily. Build a trust and bond with these birds. Teach them to eat out of your hand. Show them a treat, such as small pieces of bread or soft dog treats, and entice them to walk to the coop door. Do not give them the treat until they walk to the door. They will catch on very quickly! However, if you have a bird that is not interested in treats, remove its regular food, but make sure it still has water. Feed it by hand twice a day until it walks to you when you open the coop door. Once it is coming to you for its food, return the food dish and hand feed once a day using a treat. The goal is to get your bird to come to the coop door when you or the judge opens the door. It will relate opening the door to getting a treat. You cannot actually give your bird a treat during a showmanship class.

### **Training to Pose**

A judge may ask you to pose your bird either in the show coop or outside of the coop on a small pad. It is very important for a bird to learn to pose while in the coop so the judge has a perfect side view. First look at your bird's picture in the Standard of Perfection or Bantam Standard and memorize the profile of that picture. You will want your bird to stand the same way as the pictured bird, with the same head posture, tail angle, and wing position.

Practice posing your bird both inside a coop and on a small rug on a table. Begin by holding your bird with its legs between your fingers and breast resting in your palm. When the bird is quiet, lower it until

its feet touch the rug. While holding the breast, use your free hand to move the head, tail, and wings into the position you have memorized. Some birds respond to being lightly stroked under the beak. Slowly remove your hand that is still holding the bird. You want the bird to stand for about 10 seconds once you remove both hands. If your bird moves, start over. Never put your hand on the bird's back as this will cause it to set or squat. Practice with your bird several times a day for about 10 minutes at a time. If you don't see improvement each time, and your bird is not cooperating, start over with another bird.

Birds, such as Modern Game bantams, are posed using a hand or a judge's stick, which is a telescoping pointer. Memorize how this bird should look when posed, and then use a treat to move it into the proper position. The judging stick is used to pose the bird in the same way as you would with your hand. To get a Modern Game used to the judging stick, gradually introduce the stick by leaving it rest against the inside of the show coop until it no longer bothers the bird. Some birds may be initially frightened or agitated. Attach a treat to the end to help the bird accept the stick. Remove the treat permanently once the bird is used to the judging stick. Be prepared to pose your Modern Game using either the hand method or a judging stick.

### **Handling and Presenting your Bird to the Judge**

When you are called to your showmanship class, you may be assigned a coop or instructed to select a coop for your bird.

#### **Step 1. Use the holding position, also called the home position.**

Hold your bird in the following manner when carrying it to the coop: Place one hand under the bird's breast with your fingers between its legs, using your palm and thumb to balance the bird's weight. The bird's head will face your elbow, its legs will hang down between your fingers, and its breast or keel will rest in your palm. Place your other hand on the bird's back or at your side. Hold the bird at your side near your waistline. Never hold birds upside down by their legs or hold them by their wings.

#### **Step 2. Approach the coop.**

Moving in a slow, calm manner, approach the coop carrying your bird in the proper position.

#### **Step 3. Place the bird in the coop.**

Standing directly in front of the coop, hold your bird in the Home Position, and open the door using your free hand. Put your free hand back on the bird's back, and put the bird in head first. Keep one hand over the bird's wings to keep them close to its body. (Always put the bird in head first, the direction in which the feathers lay, so the feathers aren't damaged, and if the bird opens its wings, they are not damaged.)

#### **Step 4. Position the bird.**

Smooth your bird's feathers. Turn your bird sideways and pose it the way it should look according to the APA Standard of Perfection or the Bantam Standard.

#### **Step 5. Close the coop.**

Close the coop door. Place your hands to your side and turn to face the judge.

**Step 6. Greet the judge.**

When the judge approaches, shake his/her hand and say "Good morning/afternoon, Sir or Ma'am." S/he may ask some general questions before asking you to remove your bird from the coop.

**Step 7. Remove bird from coop.**

When asked to remove your bird, stand directly in front of the coop door and open it. This is where training and teaching your bird proper manners is important. Your bird should not try to escape when you open the door. Ideally, it should walk toward you when you open the coop door. To remove your bird, put your hand behind the bird to move it to the front of the coop if it doesn't walk toward you. Place one hand on the bird's back to secure its wings, and slide your other hand underneath it to secure its legs. Remove it from the cage once you have total control, and hold it in the home position.

**Step 8. Continue to hold the bird.**

Hold the bird in the same manner you removed it from its coop. The bird's weight will be on your palm and thumb, and your hand on the bird's back will help it feel secure.

**Step 9. Take back the bird.**

If the judge asks for your bird, pass it with its head toward the judge. A judge might return the bird to you side first or tail first. If this is the case, the judge is seeing if you know how the bird should properly be passed. Do not take the bird from the judge. You may ask the judge to please turn the bird around with its head toward you, or simply stand there and not accept the bird. The judge will then pass the bird to you the correct way.

To take the bird from the judge, slip one hand under the bird's breast (keel), and place your other hand on its back, with its head facing your elbow. Look at the judge to let him/her know you have control of the bird. Then place your bird in the proper holding position.

**Step 10. Return the bird to the coop.**

After the interview, the judge will either ask or expect you to return your bird to the coop. Open the door and put your bird in head first. Smooth the feathers, pose your bird properly and then close the coop door. Turn to the judge, and when you are certain he or she is finished, politely say "thank you" and shake the judge's hand. Stay in front of the coop until you are dismissed. Pay attention to your bird and the judge. Do not talk to other exhibitors.

Sources: *Showmanship*, Patty Picard

*Poultry Showmanship-A Manual for the Organizer and the Judge*, APA

Tim Bowles, Lucasville, Ohio

# Human Health/Zoonosis

Safe Handling of Eggs from Small and Backyard Flocks

Salmonella and Backyard Chickens

## Safe Handling of Eggs from Small and Backyard Flocks

 [articles.extension.org/pages/71048/safe-handling-of-eggs-from-small-and-backyard-flocks](https://articles.extension.org/pages/71048/safe-handling-of-eggs-from-small-and-backyard-flocks)

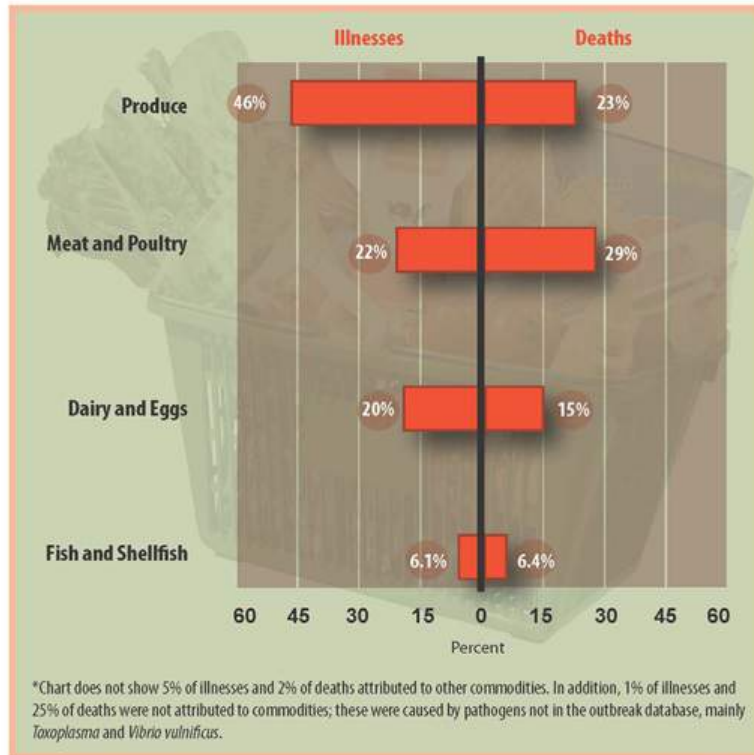


**Written by:** Dr. Jacquie Jacob, University of Kentucky

Eggs are a versatile and economical source of important nutrients, making them a great addition to any menu. Like any food of animal origin, eggs and egg products must be handled carefully. The cartons of all eggs sold in the United States must contain the following safe handling instructions: **To prevent illness from bacteria: Keep eggs refrigerated, cook eggs until yolks are firm, and cook foods containing eggs thoroughly.**

Although eggs and poultry have inherent food safety issues, many different foods have been sources of illness, as shown in Figure 1. It is important to remember that all food should be handled safely to prevent food-borne illness.

Figure 1. Contribution of different food categories to estimated domestically-acquired illnesses and deaths, 1998-2008\*



Source: Painter JA, Hoekstra RM, Ayers T, Tauxe RV, Braden CR, Angulo FJ, Griffin PM. Attribution of foodborne illnesses, hospitalizations, and deaths to food commodities by using outbreak data, United States, 1998–2008. *Emerg Infect Dis* [Internet]. 2013 Mar [date cited]. <http://dx.doi.org/10.3201/eid1903.111866>

Safe handling of eggs begins before the eggs are laid with maintaining a healthy flock and collecting clean eggs and then continues throughout the whole production and distribution systems to retail.

## Management Considerations

The most important step in the safe handling of eggs is the production of clean eggs. Several steps can be taken on the farm to minimize the potential contamination of eggs:

- **Make sure that there are enough suitable nests.** Typically one nest for every five hens is sufficient, but the nest ratio can go to one nest for every eight (1:8) hens without an increase in floor eggs. The problems arise because all the hens will try to use the same nest. It does not help if you have five nests but all 25 hens try to lay in the same one to two nest boxes. This leads to possible breakage as well as increased potential for fecal contamination.
- **Try to get the hens to use all of the nests.** Hens prefer nests that are out of the way and a little darker than the rest of the house. Unless you are using roll-away nests (the egg rolls out after the hen leaves the nest), make sure that you have enough clean bedding to reduce the incidence of breakage by cushioning the eggs and to help keep the eggs clean.
- **Supplement or change nest litter as needed.**



- **Provide roosts, and make sure the roosting areas are higher than the nest boxes.** Hens will typically roost at the highest perch. This will discourage the hens from roosting in and thereby soiling the nest boxes. Do not place the perches over the nests.
- **Collect the eggs as frequently as possible, but at least once a day.** Twice a day is better.
- **Maintain a healthy flock with these practices:**
  - Keep litter and nest boxes dry.
  - Use safe drinking water and keep water and drinkers clean.
  - Keep feed dry and feeders clean.
  - Control rodents, flies, and beetles.
- **Sanitize any equipment received from other farms.**

## To Wash or Not to Wash

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There is a big debate on whether to wash eggs, with both sides making good arguments. The state you live in largely determines whether to wash all eggs. Some states require that you wash eggs, while others do not. Even poultry specialists cannot agree, with some strongly recommending washing, while others say that eggs should not be washed. Internationally, the United States requires commercial eggs to be washed, while the European Union does not allow any shelled eggs to be washed, but it also does not allow dirty eggs to be sold as shelled eggs. As the number of eggs produced in extensive management systems (which increases the number of eggs laid outside the nest box) increases in the European Union, EU regulators reassessed their position on egg washing. A recent multi-year study came to the same conclusion as Brant and Starr (1962) that egg washing should be strongly considered, but Europe decide to leave their regulations unchanged.

Historically, Japan did not allow egg washing, but when the number of food-borne illnesses caused by salmonella increased, that country recently implemented egg washing, building on the experiences of the United States. Egg washing was just one of a range of measures taken to reduce the number of salmonella cases in Japan. Vaccination of flocks against *Salmonella enteritidis* has also been implemented. Fewer than one in 20,000 eggs now carry salmonella on the shell at the farm gate, and the incidence in the egg contents is even lower.

Research on egg washing done in the early 20th century was used by both the United States and Europe to develop their egg-handling requirements, with dramatically different conclusions. The egg-washing method used in these studies consisted of a wire basket that could hold 50 to 60 eggs being lowered into a rotating washing machine. The water was about 120°F and contained a sanitizing agent. The eggs were submerged for about three minutes. In commercial settings, eggs could be washed for different lengths of time and in water that could be dirty, or at the wrong temperature or without sanitizer. As a result of this possibility, Britain prohibited the washing of Class A table eggs. There was a price penalty for dirty eggs, and dry cleaning was encouraged

when necessary. Around the same time, the U.S. Department of Agriculture (USDA) published a 34-page report titled Improved Methods, Techniques, and Equipment for Cleaning Eggs. Based on this report, several key recommendations were made for egg cleaning in commercial egg-processing facilities in the United States:

1. Do not attempt to clean excessively dirty eggs.
2. Avoid the use of wash water containing more than 2 ppm of iron.
3. Do not recirculate the wash water.
4. Use odorless cleaning materials.
5. Wash eggs as soon as practical after they are laid.
6. Maintain wash water at a temperature that is at least 20°F (~11°C) higher than that of the eggs through all washing operations (wetting, cleaning, and rinsing).
7. Moisten eggs with stained shells and adhering dirt before eggs are submitted to cutting-spray wash and brushes.
8. Have a water spray with sufficient force to cut away loose dirt before brushing.
9. Use abrasive materials in brush bristles to increase the abrasive power of ordinary brushes.
10. Maintain an accurate control of the sanitizer-detergent level within the wash water.
11. Use a final rinse for the washed eggs.
12. Dry washed eggs completely before packing them.

Egg washing can reduce the number of microorganisms on the shell of an egg. Egg washing does have its risks, however, if not done properly. In an early egg survey in Hawaii (1991), of the 106 dozen eggs tested for salmonella, 10 cartons were positive and seven of the 10 were traced back to a processor with a faulty egg-washing process. In addition, washing eggs using immersion type washers is not allowed in commercial egg-processing facilities in the U.S..

Assuming that you are given a choice in your state, what should you do? Recent research from North Carolina State University would strongly recommend washing eggs. Regardless of the production system, an egg that appears clean will still have bacteria on the shell (reported as the number of colony-forming units growing from a swab of the surface; the higher the number, the more bacteria on the egg shell). These bacteria including many types, of which salmonella is only one. Unwashed clean eggs were found to have log(10) 4.5 colony-forming units. This can be reduced to log(10) 0.5 after proper washing. By comparison, unwashed eggs with fecal material will have log(10) 9.5 colony-forming units which is reduced to only log(10) 4.5 with proper washing.

For a small layer flock, egg washing does not need to be as extensive as that recommended for larger commercial operations. The first recommendation, however, holds true for all egg operations, regardless of size: do not use eggs that are excessively dirty. Eggs should be washed before they are put in the refrigerator, with running water (no immersion) that is warmer than the temperature of the egg. Use a brush if necessary. If a detergent is used, rinse the eggs. Dry the eggs completely before packing them.

## Refrigeration – Important or Not

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In the United States, all eggs must be stored at or less than 45°F shortly after being laid and throughout the entire distribution system. As a result, you will find eggs in refrigerated displays, often near the milk and other dairy products. In many European countries, however, eggs are typically sold on an unrefrigerated shelf, often near the bakery supplies. Why the dramatic differences? Eggs are not refrigerated in Europe because of the concern for condensation that can form on eggs when they go from cold to warm environments as would occur when eggs are taken from a refrigerated display and transported home in a warm car. This condensation was speculated to facilitate the growth of bacteria on the shell, increasing the probability of bacteria making their way into the egg. The rules, therefore, stress that eggs should not be refrigerated before sale to the final consumer. However, there is no research to support this position. Recent research has shown that condensation, or "sweating," on eggs has no influence on the internal microbial population of properly washed eggs.

In Europe, it is realized that eggs should be kept cool. The Chartered Institute of Building Services Engineers requires that supermarket temperatures should be 66.2° to 69.8°F in the winter and 69.8° to 73.4°F in the summer. Room temperature is considered to be between 68° to 77°F. Britain recommends that once eggs are taken home, they be kept at less than 68°F. This is considerably higher than the 45°F required in the United States, possibly because Britain requires vaccination against *Salmonella enteritidis*, so it considers a lower storage temperature acceptable. Salmonellae reach the inside of the egg in two ways. The contamination of the shell is one way, but *Salmonella enteritidis* can settle in the reproductive tract and be shed with the eggs. Because of Britain's vaccination requirement against *S. enteritidis*, the likelihood of contaminating the eggs is considerably less. Britain estimates that it costs 14¢ per hen to vaccinate a flock. If each hen lays about 260 eggs, that works out to 0.05¢/egg or 0.65¢/dozen.

## Storage Conditions

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Eggs should be stored in a clean carton on a shelf in the refrigerator. Placing them in the door opens them to frequent changes in temperature and the possibility of damage as the door is opened and closed throughout the day. It is also best to store the eggs large end up. When storing with the small end up, the yolk tends to get stuck in the small end and will break when the egg is cracked open.


## References

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Hutchison, M.L., J. Gittins, A. Walker, A. Moore, C. Burton, and N. Sparks. 2003. Washing table eggs: a review of the scientific and engineering issues. *World's Poultry Science Journal* 59:233-248.

## Salmonella and Backyard Chickens

 [articles.extension.org/pages/70621/salmonella-and-backyard-chickens](http://articles.extension.org/pages/70621/salmonella-and-backyard-chickens)



Outbreaks in humans of *Salmonella* infection, or salmonellosis, linked to live poultry in backyard flocks continue to occur. In an outbreak occurring during 2014, the two types of *Salmonella* involved are *Salmonella* Infantis and *Salmonella* Newport. As of May 27, 2014, the [Centers for Disease Control and Prevention](http://www.cdc.gov) (CDC) reported that 126 people from 26 states had been infected. Although 35 percent of the infected people required hospitalization, no deaths were reported. Signs of salmonellosis in humans include diarrhea, vomiting, fever, and abdominal cramps. In most cases, recovery is quick, with no lasting effects.

Investigations to trace the origins of the 2014 outbreak identified Mt. Healthy Hatcheries in Ohio as the source of the infected chicks and ducklings. Mt. Healthy Hatcheries has been associated with multiple outbreaks of salmonellosis in the past, including outbreaks in 2012 and 2013.

People raising backyard flocks, as well as the general public, should understand that salmonellosis can result from many animal sources, including reptiles, turtles, and rodents. In fact, the likelihood of getting salmonellosis is greater with other pets than with poultry. Because animals infected with *Salmonella* can appear healthy, care should be taken when handling any animal.

### Common Questions

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## How do people get salmonellosis from chicks?

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Poultry can have *Salmonella* in their manure and on their feathers, feet, and beaks. Yet they may appear completely healthy and clean. Also, *Salmonella* can get on housing, equipment, bedding, and soil in the area where the birds are kept. The bacteria can be transferred to the hands, shoes, and clothing of those who handle the birds or work or play where the birds have been. People become infected when they put contaminated hands or items in or around their mouths.

## I received chicks from Mt. Healthy Hatcheries. What should I do?

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Mt. Healthy Hatcheries ships thousands of chicks each week from a variety of breeder flocks. The majority of the chicks they ship are not infected, so your chicks may be fine. If you are concerned, you can euthanize the flock and start fresh. Regardless of where you obtained your chicks, however, using safe handling practices is imperative.

All chicks have the potential to be infected with different types of *Salmonella*. Chicks carry *Salmonella* in their digestive tracts, and the bacteria are shed with the chicks' manure. As with other animals infected with *Salmonella*, infected chicks may appear healthy and clean and show no signs of illness. As a result, contact with live poultry and their environment requires attention to sanitation. The following safe practices should be followed when handling any poultry:

- Wash your hands after touching poultry or equipment in their surroundings, using proper hand-washing techniques. Proper hand-washing techniques include using soap and warm, running water; rubbing your hands vigorously with soap and water for 20 seconds (about the time it takes to sing the alphabet song); washing the backs of your hands, your wrists, between your fingers, and under your fingernails; rinsing well; drying thoroughly with a paper towel; and turning off water faucets with your elbow or a paper towel.
- If you do not have access to a hand-washing facility, use hand sanitizer until you are able to wash your hands.
- Ensure that a child handling chicks keeps his or her hands away from the face, especially the mouth and eyes.
- Do not snuggle or kiss chicks.
- Do not let poultry inside the house or in outdoor-living spaces, especially in areas where food and drink are prepared, served, or stored. Such areas include kitchens and outdoor patios.
- Do not clean poultry equipment in areas where food and drink are prepared, such as a kitchen sink. It is better to wash such equipment outside the house.

## Why is Mt. Healthy Hatcheries still open and allowed to sell chicks?

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Since the outbreak was traced back to the facility, Mt. Healthy Hatcheries has worked with personnel from the US Department of Agriculture's [National Poultry Improvement Plan](#) (NPIP) program to clean up the hatchery. The NPIP program has a [Best](#)

Management Practices Handbook for the mitigation of *Salmonella* contamination at poultry hatcheries. Mt. Healthy Hatcheries does not maintain breeder flocks for all the breeds of chicks they sell. Instead, like most large hatcheries, they obtain many of their hatching eggs from contracted sources. They have suspended purchases of hatching eggs from outside suppliers until contaminated breeder flocks can be identified.

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## **For More Information**

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CDC [Advice to Consumers](#)

CDC [Publications and Brochures](#)

[Safe Handling of Chicks](#) (University of Kentucky)

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