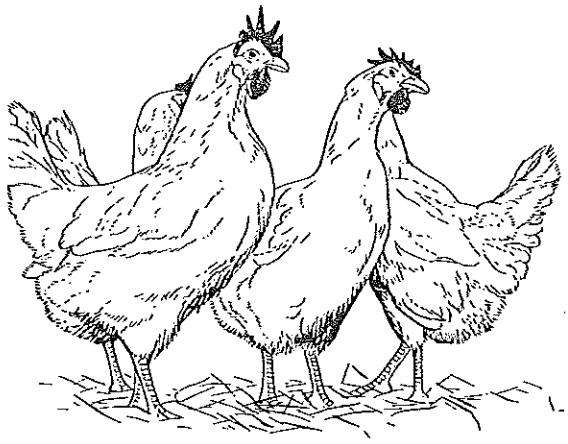
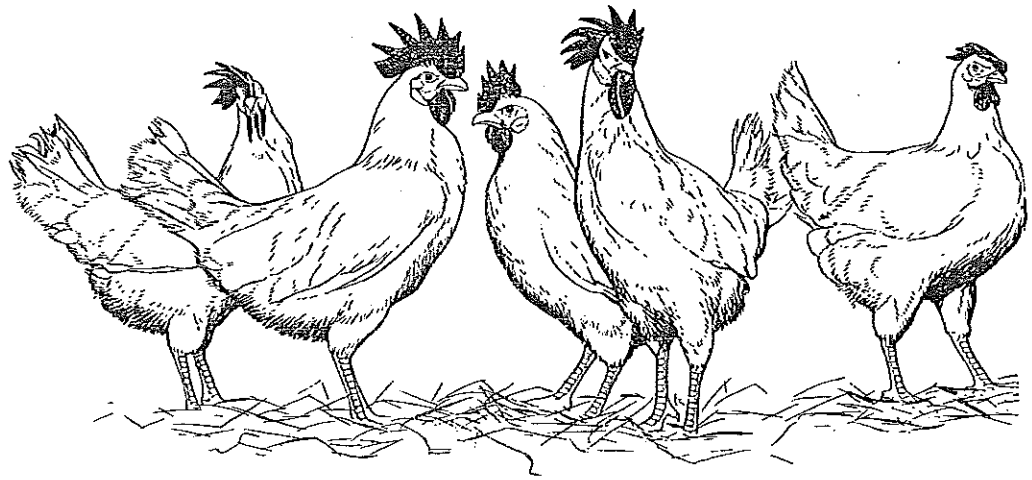


Avian Systems



THE REPRODUCTIVE SYSTEM

Female Reproductive System

(See Figure 3)

The female reproductive system of the chicken is divided into two main parts: the **ovary** and the **oviduct**. The **ovary** is a cluster of developing **yolks** or **ova** and is located midway between the neck and tail of the bird, attached along the back. The ovary is fully formed although very small when the female chick is hatched. It is made up of 13,000 to 14,000 minute yolks or ova which grow by the addition of yolk fluid. It starts out as a single cell surrounded by a **vitelline membrane** which keeps water out. The color of the yolk or ova comes from fat soluble pigments called xanthophylls (*zantho fills*) contained in the hen's diet.

Ovulation is the release of the mature yolk from the ovary into the second part of the female reproductive system. The ova or yolk, which is enclosed in a sac, ruptures along the **suture line** or **stigma**. This release of the ova occurs 30 to 75 minutes after the previous egg has been laid.

The second major part of the female chicken's reproductive system is the oviduct. The **oviduct** is a long convoluted tube (25 to 27 inches long) which is divided into five major sections. They are the **infundibulum** or **funnel**, the **magnum**, the **isthmus**, the **shell gland**, and the **vagina**. Unlike mammals, there is only one functional oviduct in the chicken; the oviduct on the left side of the chicken is functional, the right ovary is **rudimentary** (imperfectly developed).

The first part of the oviduct, the **infundibulum** or **funnel**, is 3 to 4 inches long, and it engulfs the ovum released from the ovary. The ovum or yolk remains here 15 to 18 minutes, and it also serves as a reservoir for spermatazoa so that fertilization can take place.

The next section of the oviduct is the **magnum** which is 13 inches long and is the largest section of the oviduct as its name implies. The ovum or yolk remains here 3 hours during which time the thick white or albumen is added.

The third section of the oviduct is the **isthmus** which is 4 inches long. The "egg" remains here for 75 minutes. The isthmus, as its name implies, is slightly constricted. In the isthmus, the shell membranes are added.

The next section of the oviduct is the **shell gland**. The shell gland is 4 to 5 inches long, and the "egg" remains here for 20-plus hours. As its name implies, the shell is placed on the egg here. The shell is made up of **calcium carbonate**, and the hen mobilizes 47 percent of her body calcium from her bones and her diet to make the egg shell. Pigment deposition is also done in the shell gland.

The last part of the oviduct is the **vagina** which is about 4 to 5 inches long and does not really play a part in egg formation. The vagina is made of muscle which helps push the egg out of the hen's body. There are also glands located in the vagina where spermatazoa are stored.

Male Reproductive System

(See Figure 4)

The male reproductive tract is comprised of two **testes**, both of which are functional. Inside the testes are the **seminiferous tubules**, where sperm is produced. Leading from the testes is the **ductus deferens** which move the sperm to the outside of the body.

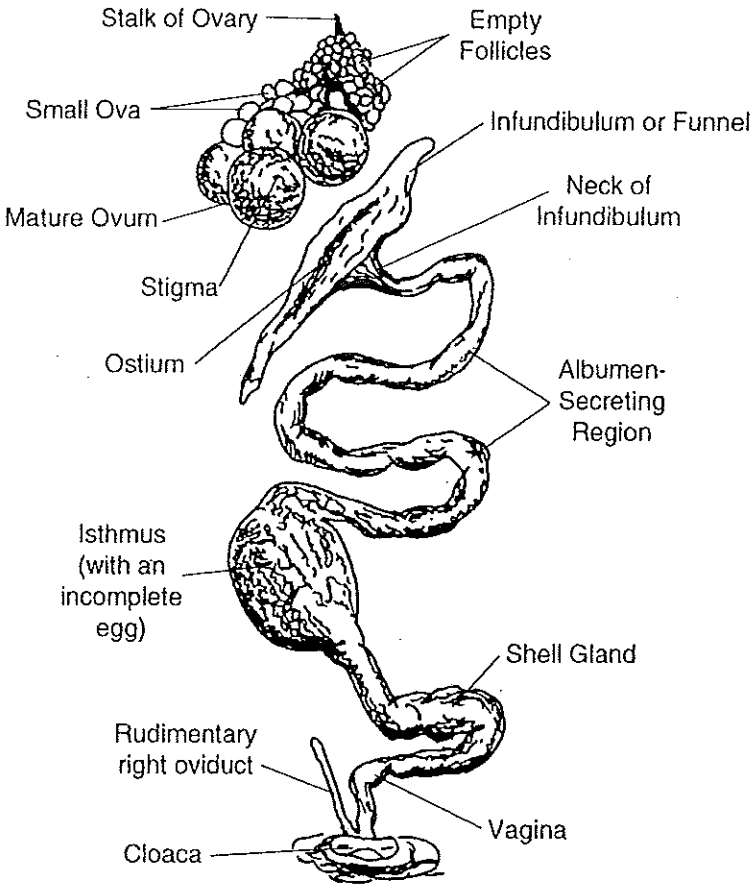


Figure 3. Female Reproductive System

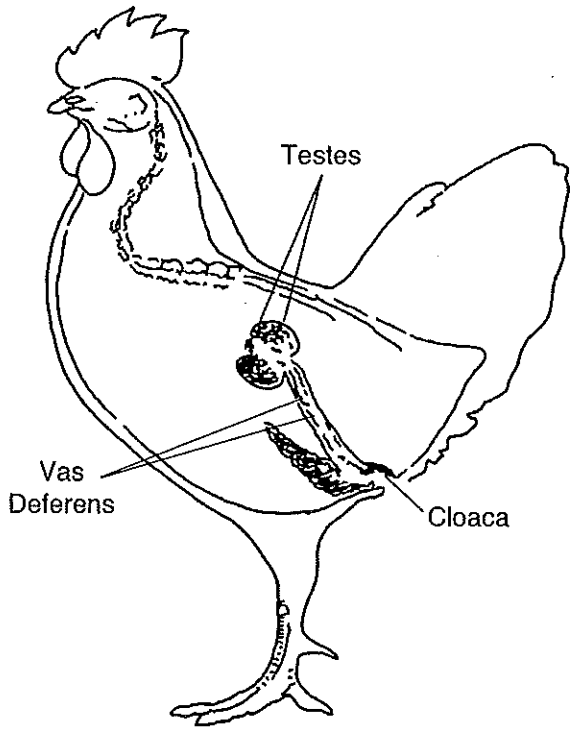


Figure 4. Male Reproductive System

THE CIRCULATORY SYSTEM

The chicken has a four-chambered heart similar to a human heart, including two ventricles and two atria. The heart rate of a Leghorn female is about 350 beats per minute, and a New Hampshire male has a heart rate of 250 beats per minute. The function of the circulatory system is to transport oxygen, carbon dioxide, metabolites, hormones, and nutrients throughout the body and to aid in temperature regulation, keeping the chicken's body temperature at 107 °F. The red blood cells and white blood cells are formed in the spleen. A bird's red blood cells are unique in that they are **nucleated** whereas a mammal's are not. This means there is a nucleus in the red blood. See Figure 5 below.

Figure 5. Red Blood Cells

THE NERVOUS SYSTEM

The nervous system is divided into two main parts which are the **central nervous system (CNS) and the autonomic nervous system (ANS).** The CNS is responsible for the voluntary actions of the body such as movement or flight, and the ANS is responsible for the coordination of involuntary actions of the organs, intestines, blood vessels, and glands. The primary function of the nervous system is to integrate the functions of the body.

THE EXCRETORY SYSTEM

(See Figure 7, page 42)

The main organ of the excretory system is the **kidney.** The functional units of the kidney are **nephrons.** The functions of the excretory system are to excrete water and metabolic wastes and to regulate the acid-base balance in the bird's body.

The primary component of poultry waste is **uric acid,** the major end product of protein utilization. Uric acid is a white, pasty substance. Poultry waste is comprised of urine and feces; these are not separate.

THE MUSCLE SYSTEM

Muscle is the principle contractile organ of the body which is responsible for movement. There are three types of muscle in a bird's body: **smooth, cardiac,** and **skeletal. Smooth** muscle is controlled by the **autonomic nervous system** and is found in the blood vessels, gizzard, intestines, and organs. The **cardiac** muscle is the specialized muscle of the heart. The **skeletal** muscle is the type of muscle responsible for the shape of the bird and for its voluntary movement. This is the muscle which makes up the edible portion of the carcass. The most valuable skeletal muscles on a poultry carcass are the breast, thigh, and leg.

THE SKELETAL SYSTEM

The skeletal system is important to the bird for **support** and has two additional functions which are unique: **respiration** and **calcium transport**. The skeletal system of the bird is compact and lightweight, yet strong. The tail and neck vertebrae are movable, and the body vertebrae are fused together to give the body sufficient strength to support the wings.

There are two special types of bones which make up the bird's skeletal system: they are **pneumatic bones** and **medullary bones**. The pneumatic bones are important to the bird for respiration. They are hollow bones which are connected to the bird's respiratory system and are important for the bird to breathe. Examples of pneumatic bones are the skull, humerus, clavicle, keel (sternum), pelvic girdle, and the lumbar and sacral vertebrae.

The medullary bones are an important source of calcium for the laying hen. Calcium is the primary component of egg shell and a hen mobilizes 47 percent of her body calcium to make the egg shell. Examples of medullary bones are the tibia, femur, pubic bone, ribs, ulna, toes, and scapula.

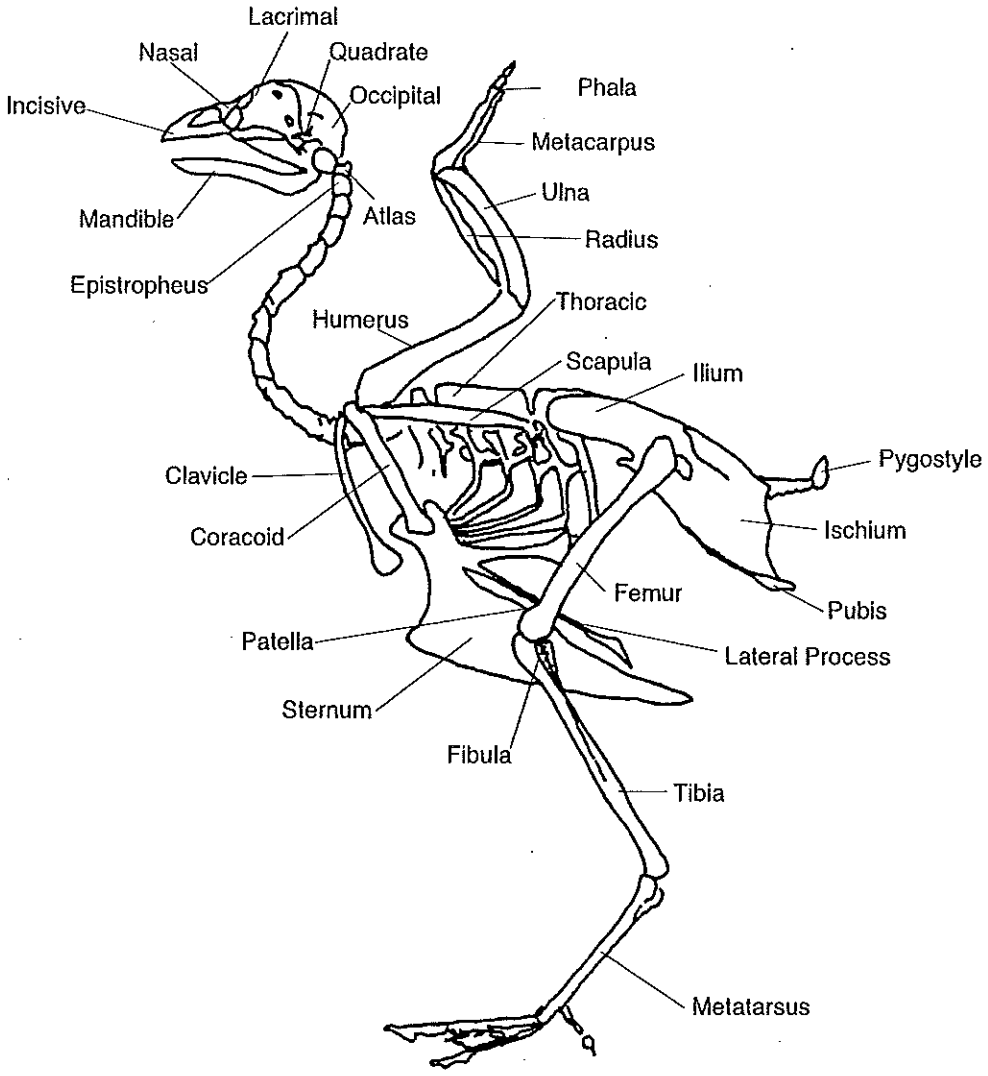


Figure 6. Skeletal System

THE RESPIRATORY SYSTEM

The respiratory system is made up of **lungs, pneumatic bones**, and **air sacs**. The lungs of the bird are different from that of a mammal's in that they are rigid. They function in the exchange of blood gases such as CO_2 and O_2. **Air sacs** are unique to the bird and are flexible. The air sacs open up to the pneumatic bones which aid in the exchange of air throughout the bird's body. There are four pair of air sacs and one single air sac, two **interclavicular** air sacs, two **abdominal** air sacs, two **anterior thoracic** air sacs, two **posterior thoracic** air sacs, and one **cervical** air sac. The respiratory system is important for air exchange and also for temperature regulation in the bird.

THE DIGESTIVE SYSTEM

(See Figure 7, page 42)

The digestive system functions to utilize food material for the maintenance of all the other systems of the bird's body. The bird's digestive system depends on enzymes (proteins) which chemically break down the food. The digestive system is made up of many different parts. The **mouth** contains salivary glands that secrete saliva containing enzymes which begin to break down food. A bird does not have teeth to chew its food but does have a tongue which pushes the food to the back of the mouth so that it can begin its passage down the rest of the digestive tract. The **esophagus** is the tube that connects the mouth with the rest of the digestive tract. The **crop** is located in the neck region and is used to store food until the bird is ready to digest more food. The **proventriculus** or **true stomach** secretes two enzymes: hydrochloric acid (HCl) and pepsin. Another unique part of the bird's digestive tract is the **gizzard**. The gizzard is made up of two smooth muscles and contains grit or stones and acts as the bird's teeth by grinding the food.

The **small intestine** is made up of the duodenum and the lower small intestine. The small intestine is important for the absorption of nutrients. The **cecum** are two blind pouches that, like our appendix, have no real function. The last portion of the digestive tract is the **rectum** or **large intestine** where additional absorption of water takes place.

The **pancreas**, which is in the center of the duodenal loop, secretes pancreatic juice which neutralizes the HCl secreted by the proventriculus and helps break down fat. The **liver** produces a dark green substance called bile which is necessary for the absorption of fats. The bile is stored in the gall bladder, and when food passes into the duodenum, it causes the gall bladder to empty the bile into the small intestine.

The **cloaca** is where the **digestive tract**, the **reproductive tract**, and the **excretory tract** all end up. The cloaca is important for absorbing any moisture from foodstuffs which will leave the body. It is also important since it is here that the egg from the female's reproductive tract is flipped in order that it will be laid large end first.

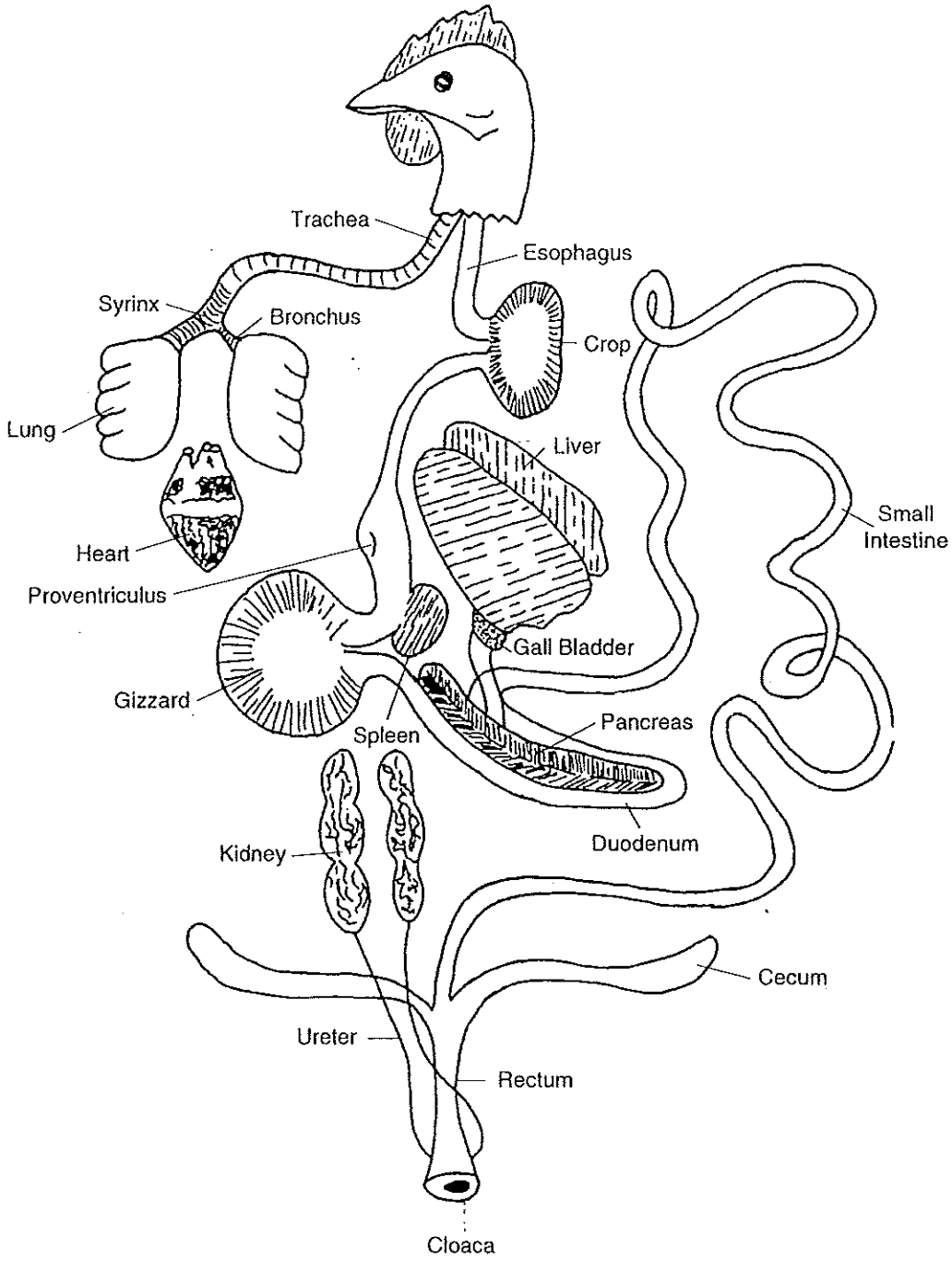


Figure 7. Digestive System and Excretory System

THE FEATHER

Although the feather is not a system of the bird, it is what makes the bird totally unique from all other animals. Figure 8 shows the parts of the feather. The feather is important for **flight, protection,** and **temperature regulation**. When a bird rearranges its barbules and barbicels, it is called **preening**. Birds also lose their feathers once a year during a **molt**. These feathers are replaced in about 21 days.

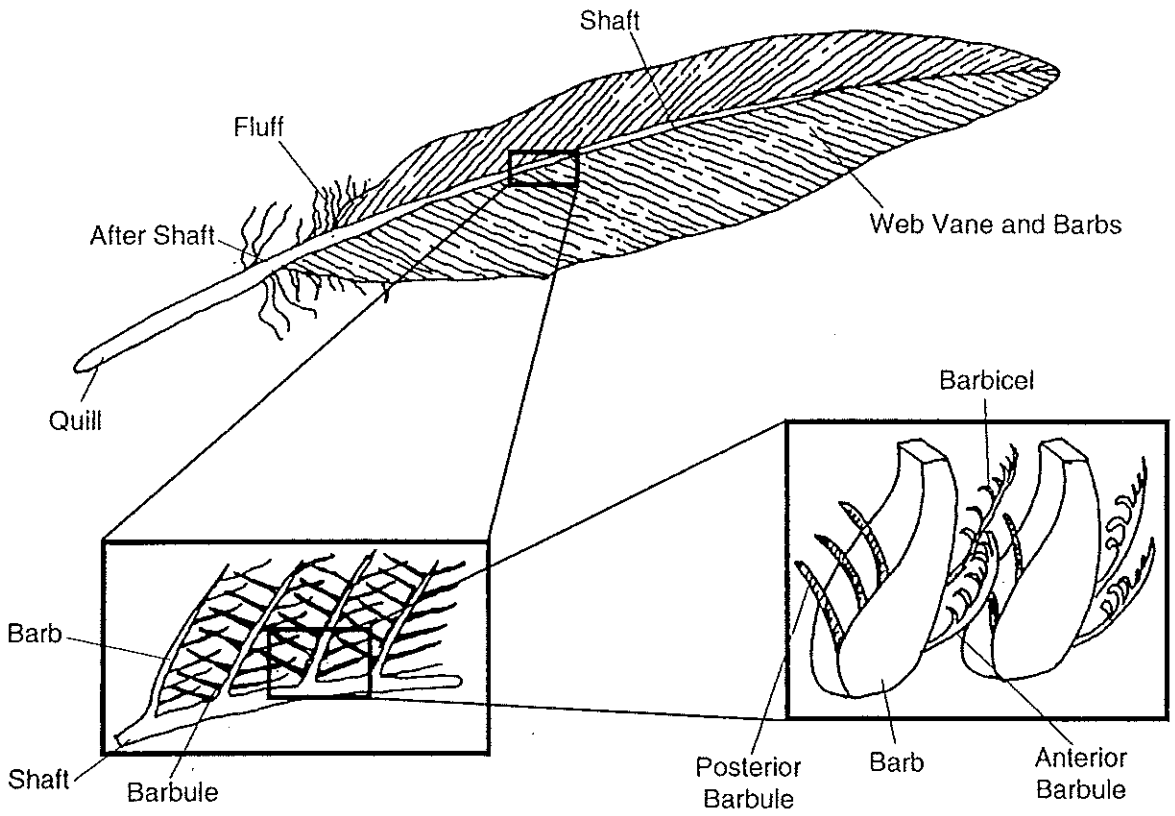
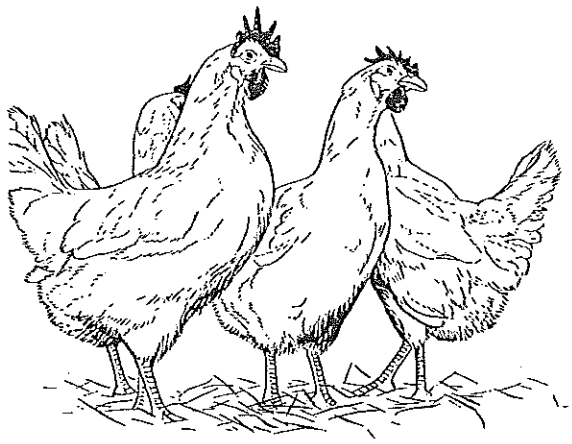
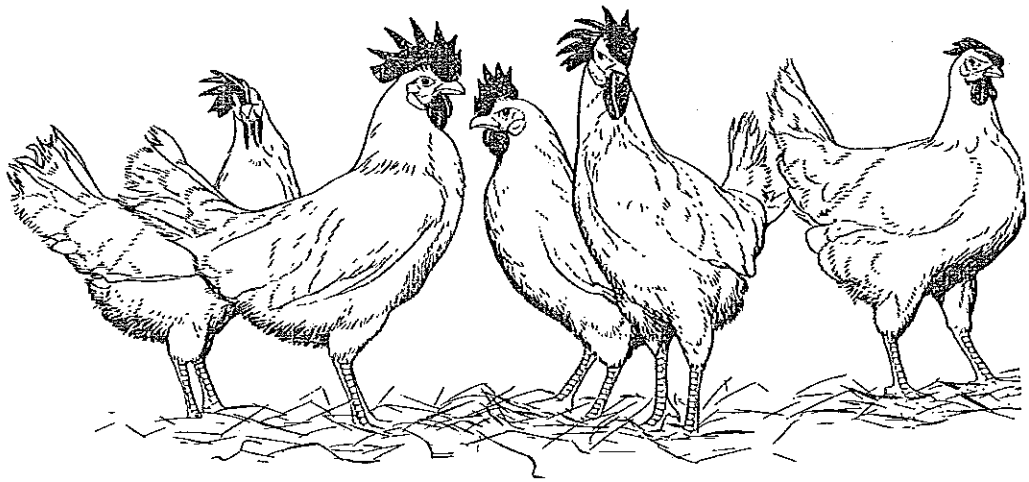


Figure 8. Parts of the Feather

Acknowledgments: Michelle A. Hall, Associate Professor, Animal & Veterinary Science Department, Clemson University



Small Turkey Flock Management



SMALL TURKEY FLOCK MANAGEMENT

Raising a small flock of turkeys can serve two basic purposes. First, you can produce some of your own food and have the freshest turkey possible. Second, you can involve the whole family in a project working with and learning about live animals. Then, too, you may be able to compete economically with commercial turkey growers.

A small number of turkeys can be raised in a relatively small area, but be sure to inquire about local laws and ordinances before starting your flock. Zoning regulations in some towns and suburbs prohibit keeping poultry. While little time is required to care for turkeys, their care must be regular — at least once a day and more often when the birds are young.

Buying Poults

The "breeds" of turkeys often referred to are actually varieties that originated from the wild turkey. The most commonly raised commercial variety is the Large White. Hens commonly reach a live weight of 17.4 pounds at 20 weeks of age and toms weigh about 34.4 pounds at 24 weeks. Smaller fryer-roasters can be produced by slaughtering the Large White turkey at an earlier age. Table 9 shows the expected average weights of Large White turkeys at various ages.

Table 9. Growth Rate and Feed Consumption of Turkeys (Hens and Toms Combined)

	Large White Hens			Large White Tom		
Age (weeks)	Average Live Weight (pounds)	Cumulative Feed Intake (pounds)	Feed Conversion (pounds feed per pound gain)	Average Live Weight (pounds)	Cumulative Feed Intake (pounds)	Feed Conversion (pounds feed per pound gain)
1	0.36	0.51	1.41	0.36	0.51	1.41
2	0.77	1.14	1.48	0.84	1.22	1.45
3	1.44	2.19	1.52	1.61	2.40	1.49
4	2.34	3.66	1.57	2.67	4.09	1.53
5	3.43	5.54	1.61	4.05	6.39	1.58
6	4.69	7.80	1.66	5.74	9.37	1.63
7	6.17	10.59	1.72	7.68	12.99	1.69
8	7.82	13.86	1.77	9.82	17.24	1.76
9	9.55	17.56	1.84	12.12	22.10	1.82
10	11.32	21.63	1.91	14.54	27.53	1.89
11	13.09	26.05	1.99	17.05	33.55	1.97
12	14.84	30.77	2.07	19.61	40.11	2.05
13	16.56	35.84	2.16	22.20	47.24	2.13
14	18.23	41.20	2.26	24.78	54.84	2.21
15	19.85	46.82	2.36	27.34	62.88	2.30
16	21.40	52.74	2.46	29.87	71.30	2.39
17	22.88	58.95	2.58	32.37	80.17	2.48
18	24.27	65.32	2.69	34.83	89.63	2.57
19	25.58	71.78	2.81	37.26	99.88	2.68
20	26.79	78.24	2.92	39.64	110.96	2.80
21				42.00	122.94	2.93
22				44.31	135.68	3.06
23				46.59	149.19	3.20
24				48.84	163.34	3.34

Source: *Commercial Management Guide*, published by British United Turkeys of America

The small flock is generally started after the threat of cold weather is past, anytime from April to June. This reduces the need for insulated housing and saves appreciably on fuel costs for brooding. Brooding is practical if you start at least 20 poults. For smaller flocks, try to purchase 6- or 8-week-old poults from a local commercial grower. At this age they should no longer require brooding if the weather is moderate.

When purchasing day-old poults, buy from a hatchery (locally if possible) that maintains healthy, good-quality stock. Poults should be free from pullorum, sinusitis, and other disease. To further reduce the threat of disease, raise turkeys away from other poultry. Sinusitis and blackhead can be serious problems in turkeys raised among chickens or on ground where chickens have been within the last three years.

Flock Size

When determining the number of turkeys you want to raise, consider the facilities, equipment, and space you have available. Crowding turkeys leads to problems and does not pay. Also consider the number of turkeys you can market live and the number you can slaughter and use or sell. Be sure to check state regulations regarding the use and sale of dressed (or ready-to-cook) turkeys. Some states (Indiana, for example) prohibit the sale of any turkeys unless dressed in an inspected plant, while others provide exemptions for growers of small turkey flocks. Available labor, however, should be only a minor consideration as little additional time is required to care for a greater number of birds.

Housing

Turkeys require a brooder house that can be kept warm, dry, well-ventilated, and free from drafts. Allow at least 1½ square feet of floor space per poult up to 8 weeks of age. From 8 weeks to market age, provide 5 to 8 square feet of housing space per bird depending on the size to which they will be grown. Ventilation becomes increasingly important as the turkeys get larger and as hot weather approaches.

Preparing Brooding Area

Well before the poults are due to arrive, clean the brooder house thoroughly. Brush loose dirt and cobwebs from the ceiling, walls, and floor. Wet down and scrape areas as needed to remove caked materials and then scrub the walls and floor with a good disinfectant, such as quaternary ammonium compounds. High-pressure washers do a good job of cleaning. After rinsing, allow the area to dry thoroughly and air out. Check roof and walls for leaks or cracks and make any necessary repairs. Rodents, wild birds, predators, and pets should be kept out of the turkey pen at all times. They can spread diseases or scare the poults, causing them to pile and smother. Check the electrical system and correct any faults. Clean and make needed repairs on feeders, waterers, brooders, and other equipment.

Cover the brooding area with at least 2 inches of litter. A good litter is clean, dry, absorbent, and relatively free from dust. Commonly used litter materials include wood shavings, chopped straw, peat moss, or other commercial litters. Since litter absorbs moisture and insulates the birds from the cold floor, it is important to remove any areas that become wet and then add more litter as needed. Do not cover litter with slick-surfaced materials (such as newspaper) as these can cause slipping—and serious leg injuries to the poults.

Set up the brooder and test its operation. When used, infrared lamp brooders should be hung at least 18 inches above the litter. Follow manufacturer's directions for other types of brooding units. Keep a spare lamp on hand to replace burned-out lamps.

A brooder guard is a barrier placed around the brooder to keep the poults near the heat source and to prevent drafts from reaching baby poults. The guard should be used for the first 7 to 10 days until the poults become familiar with the source of heat. The guard should be at least 1 foot high and long enough to form a complete circle about 3 to 5 feet from the brooder. Rolls of corrugated cardboard are sold for this purpose but other materials, such as tarred paper, can

be used. In hot weather, fine mesh wire can be used if the house is not drafty. Brace the brooder guard, if necessary, to ensure that it stays in place.

Set the feeders and waterers in place near the edge of the hover or form an open wheel pattern around the infrared brooder (see Figure 9). The number and size of feeders and waterers used depends on the number of poults in your flock and will be discussed later. It is advisable to have at least two of each in a pen to help the poults find feed and water. In addition to the regular feeders, place small piles of feed in shallow boxtops or paper plates for the first few days.

Brooding

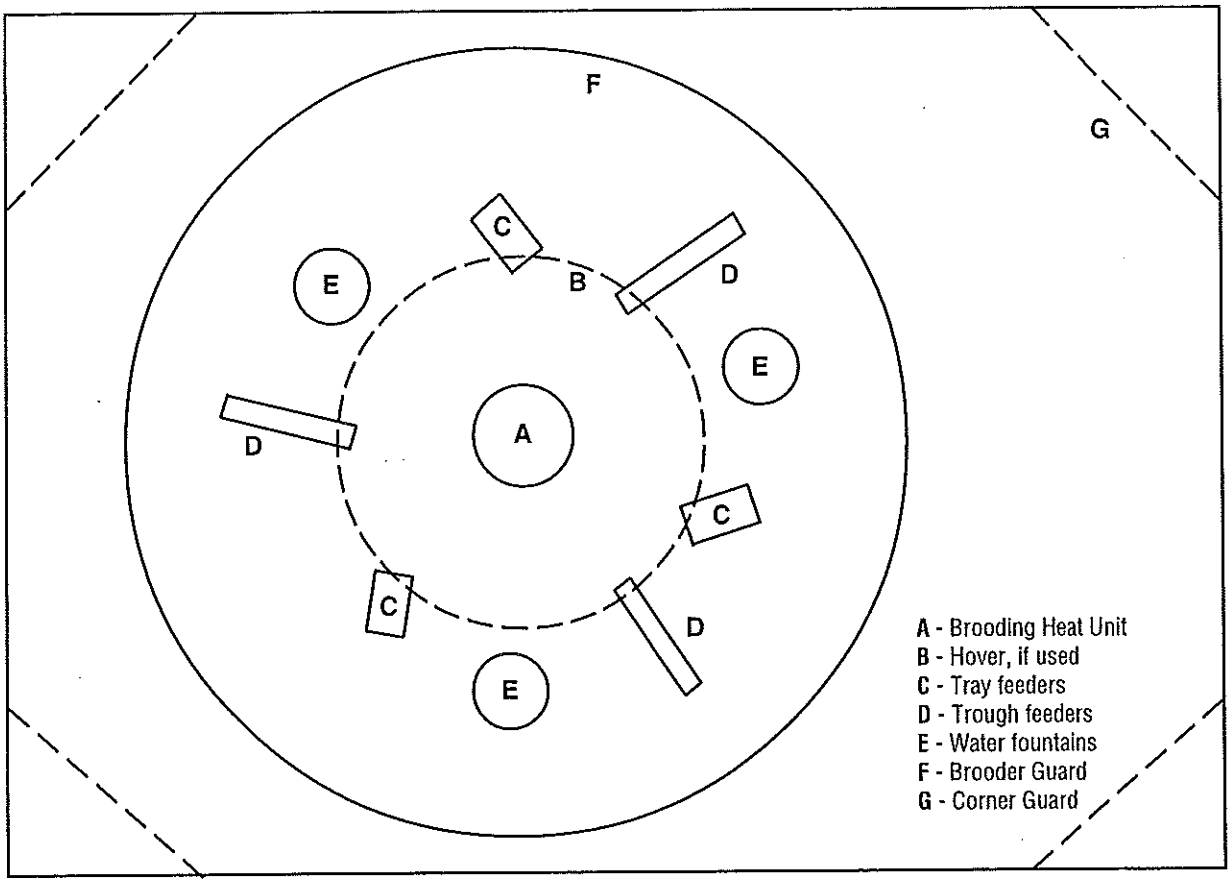


Figure 9. Brooding Arrangement

A dependable source of artificial heat is required to brood poults. Provide a uniform 90 to 95 °F temperature at the poults' level during the first week. Thereafter, lower the temperature by 5 degrees each week until it reaches 70 °F. Maintain this level until supplementary heat is no longer needed. The length of time supplementary heat should be provided will vary with weather conditions. After the poults are 6 to 8 weeks of age, heat is generally needed only during abnormally cold spells.

Brooders using infrared heat bulbs can be made or purchased for a small flock. Using two-bulb brooders is recommended as they offer a safety factor in case one bulb burns out. A single-bulb unit, however, will normally be adequate for late spring and early summer brooding. Single-bulb units do not have thermostats. This makes uniform heat maintenance more difficult when the weather changes. Multiple-bulb units, on the other hand, often have a thermostat which allows one bulb to be on constantly and turns on additional bulbs as needed. Common types of brooders are illustrated in Figure 10.

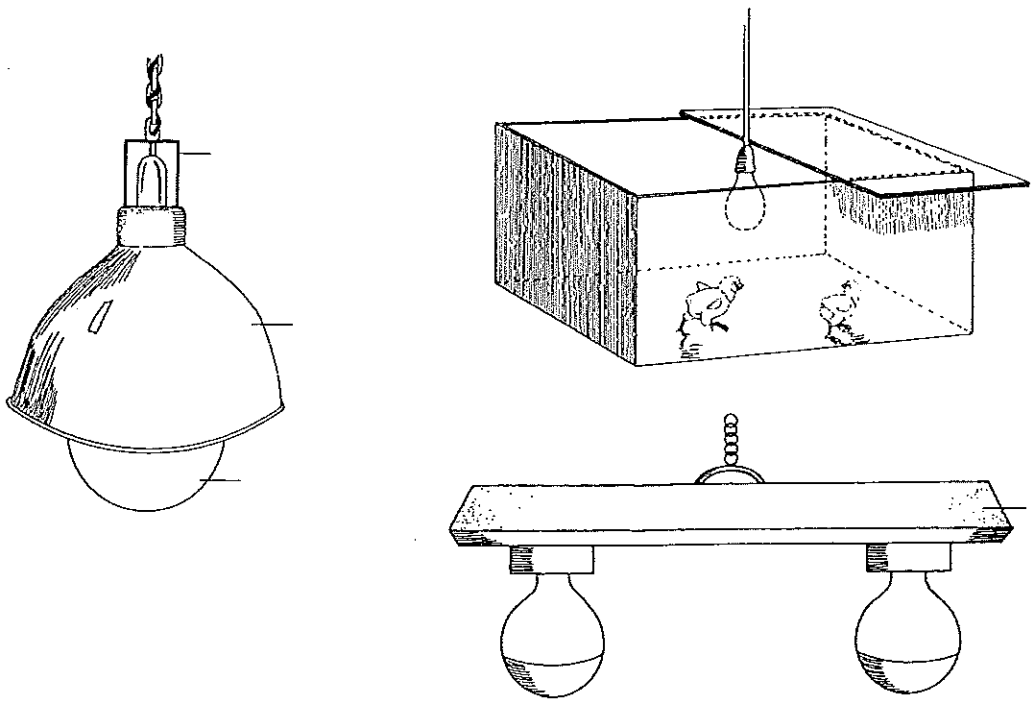


Figure 10. Brooders Commonly Used for Small Flocks.

A commercial-type electric or gas brooder can be used for brooding 100 or more poults. These usually include automatic controls and a hover that directs the heat down on the poults. Gas brooders with an open flame must be carefully maintained to eliminate fire hazards. Several types of gas catalytic brooders, which work on an infrared principle instead of having an open flame, are also available.

Start the brooder the day before the poults are to arrive as a final check on its operation and to prewarm and dry the brooding area for the poults. Use a thermometer to check the brooder and see that it steadily maintains the desired starting temperature of 90 to 95 °F. After some experience observing poults, you will be able to tell whether they are comfortable. If, for example, more heat is needed, poults will tend to huddle together under the center of the brooder. If they move away from the heat source, the temperature is too high. If they consistently occupy one side of the brooding area, they are trying to escape a drafty area. Comfortable poults, on the other hand, will spread uniformly under and around the edge of the brooder.

Fill the feeders and waterers before the poults arrive so they can be placed under the brooder immediately upon arrival. Lukewarm water should be provided for the first several days. Turkey poults are subject to dehydration. To help them learn to drink, dip their beaks into the water fountains when placing them under the brooder. Repeat this process with several poults later in the day if there is any doubt about their having found the water. Keep a frequent check, too, on the brooder temperature and the poults during the first week.

Range Rearing

Turkeys can be raised to maturity in confinement, but most small flock owners will range turkeys during the summer and fall months. Turkeys should not be allowed to run with chickens, or on a range used for chickens in the past three years. These precautions, once

again, help control diseases. Chickens can appear normal while carrying and shedding organisms that cause blackhead disease. These disease organisms can survive for long periods of time in the soil.

Allow at least 30 square feet of good grass or clover range per turkey. Select a well-drained area with adequate shade from trees or with shelters that allow birds protection from the midday sun without crowding. Heavy turkeys, especially as they near maturity, do not tolerate high temperatures well. Range shelters also provide needed protection from rain. Move range feeders and waterers weekly to prevent complete trampling of grass immediately surrounding the equipment.

Enclose the range area with a 4-foot fence having sufficiently small mesh to keep out potential predatory animals. Roosts are not necessary for the turkeys but can be provided if desired by laying 2 by 4-inch boards flat, 24 inches apart and 15 inches above the ground. Allow 10 to 12 inches of roost space per turkey.

In mild weather, turkeys can be put on range at 8 weeks of age if they have access to the house or a range shelter. During cooler weather, wait until they are 12 weeks of age or allow the birds outside only during warm periods. Schedule your flock placement so the birds will be marketed before the threat of cold weather. If this is not possible, be sure to provide adequate housing in the late fall or early winter.

Feeding

Turkeys are fast-growing and efficient converters of feedstuffs to high-quality meat. The feeding of properly balanced rations will result in the best performance. Poults should be given a 28-percent protein turkey-starting mash for 6 to 8 weeks. This gets the birds off to a good start while their feed intake is relatively low. From that point a turkey-growing ration (mash, crumbles, or pellets) containing 22 percent protein is recommended. Do not change abruptly from mash to pelleted feeds.

Feed containing less protein can be fed after 12 weeks of age. Complete growing rations with lower protein levels may be purchased, or whole or cracked grains (about 10 percent protein), such as corn and oats, can be fed along with the growing ration to increase the energy and reduce the protein intake. For example, one part grain to three parts of the 22-percent protein growing ration will provide a 19-percent protein mixture which is satisfactory for turkeys from 12 to 16 weeks. From 16 weeks of age to market, mix equal parts of grain and the growing ration to provide 16 percent protein. Grit should be available if whole or cracked grains are used.

Check the protein level of the finishing ration to determine whether mixing grains with the ration should be continued. The protein level should not drop below 14 percent. The amount of each type of feed needed can be estimated from Table 9, depending on the type of turkeys (large or small) raised and the market age and size you choose. Check the feed manufacturer's directions and follow them. Some growing feeds contain drugs to control disease. The feeding of these drugs must be discontinued for a specified length of time before the turkeys are slaughtered. This information should be given on the feed tag. Feed manufacturers can provide finishing rations without drugs.

Feed should be available to the growing turkeys at all times. Observe the poults during the first 2 days to be sure they are eating. Some flocks seem to have trouble finding the feed early, resulting in death loss from "starve outs." If necessary, set some of the poults in the shallow boxtops or plates containing feed to help them start. Others will usually soon follow their example.

Adequate feeder space ensures that all birds in the flock have an opportunity to eat. See Table 10 for feeder size recommendations. To determine the feeder length needed, total the length of both sides of trough-type feeders; a 2-foot feeder provides 48 inches of trough length.

*Table 10. Recommended Minimum Feeder Space for Turkeys for Trough-type Feeders**

Age of Poults	Feeder Length	Feeder Depth
0 to 4 weeks	2" per poult	2 to 3"
4 to 8 weeks	4" per poult*	5" with lip
Over 8 weeks	6" per poult*	8" with lip

*Feeders space requirements may be reduced by about 25 percent when using tube-type or other round feeders.

Start poults with at least two well-filled small trough feeders and with several shallow boxtops or paper plates with a small handful of feed. Once the poults are eating well, reduce the level of feed in the trough for the second week to about three-quarters full and not more than half-full thereafter. Poults will waste feed if the trough is overfilled.

Adjust the feeders so all birds can eat easily. The proper height is about even with the top of the birds' backs. A reel or grill on trough feeders will help prevent feed wastage by keeping the poults out of the feeder. Make sure, however, that it does not interfere with the birds' ability to get to the feed. Running a finger along the inner edges of the trough feeder will attract the poults to the feed, and ridging the feed along the center of the trough will make it more visible. Tube-type feeders, often used for turkeys after 4 weeks of age, have a reservoir of feed which requires less-frequent filling.

Water

Adequate water of good quality is essential for all kinds of poultry. Start your poults with at least two water fountains and at least one 1-gallon fountain for each 50 poults. Glass or plastic fountains are usually used for the first 2 weeks and gradually replaced with larger metal fountains, pans, or troughs. If water is available in or near the pen or range area, an automatic waterer that connects to a heavy garden hose can be used. The minimum amounts of linear waterer space should be one-half an inch per poult to 4 weeks of age; 1 inch per poult to 8 weeks of age; and $1^1/_2$ inches per turkey to market age.

Raise the waterers as the turkeys grow and place the larger waterers on a wire platform to contain spilled water and keep litter out of the water. As new waterers are introduced, leave some of the smaller units in place until the flock becomes used to the new system. Depending on the type of waterers used, it may be necessary to anchor waterers in place to keep them from being upset by turkeys as they grow larger.

Choose waterers that are easily cleaned and designed so that turkeys will not get their feet into the water. Waterers should be cleaned and refilled with fresh water daily.

Lighting

Young poults appear to have poor vision, so adequate lighting will help them find feed and water more readily. Infrared brooder lamps will provide adequate light for poults brooded under this system. If other brooding systems are used, artificial lights should be used to provide a minimum of 15 foot-candles of light at the feeders and waterers for the first 3 weeks. Thereafter, dim lights providing about one foot-candle of light will help reduce restlessness, nervousness, and flightiness in the flock. (Note: To judge light levels, 15 foot-candles is approximately the amount of light you would have in a well-lit room in your home. With one foot-candle of light, you would just be able, with some difficulty, to read newsprint.) Range turkeys should do well with only natural daylight.

Disease Prevention

Management is the key to maintaining the health of your flock. Good sanitation and elimination of other birds and animals that may carry disease organisms are important factors in maintaining a healthy flock. Keeping the pen and range areas dry will also help. Vaccines, available for several turkey diseases, may not be necessary for a small flock unless previous disease problems existed on your premises or on nearby farms. Other disease problems can be controlled through the use of medicated feeds, if necessary. However, clean stock, clean premises, and good management are the best lines of defense.

If your flock does become sick, an accurate diagnosis and recommended treatment should be obtained. State diagnostic laboratories usually offer low-cost or free diagnostic services. Take typically sick or fresh, dead birds to the laboratory for evaluation. Along with the birds, take a complete flock history including age, feeding program, vaccinations, or drugs used and a description of the course of the current problems.

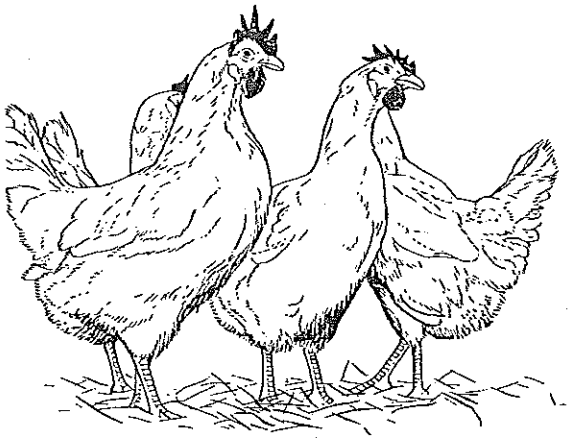
Some death loss is normal and should be expected, especially during the first 2 weeks. However, it is important to get an early diagnosis of disease problems in order to stop the spread of disease throughout the flock. A good feed or hatchery serviceperson can give you helpful advice on many day-to-day problems.

Marketing and Processing

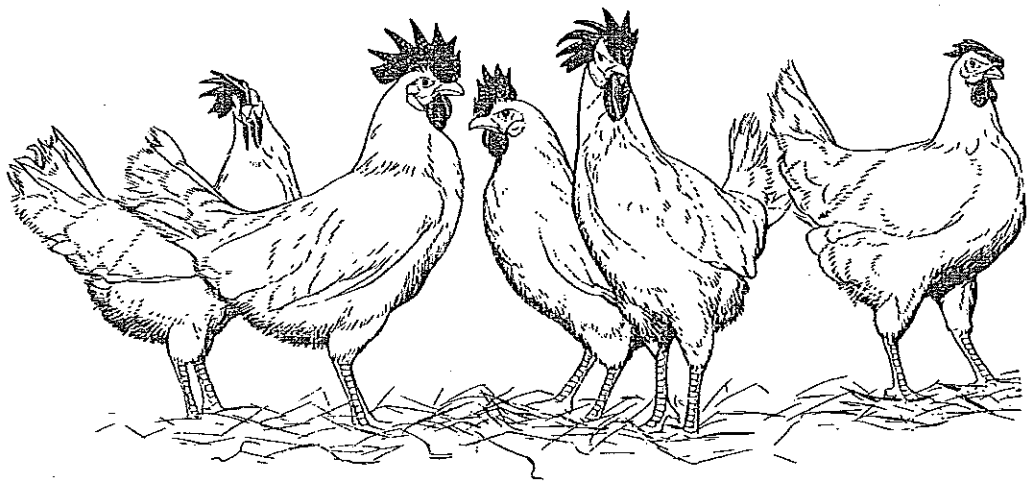
If you have more turkeys than you will need, you may be able to sell some, either alive or dressed. State and federal laws regulate the sale of processed birds but limited processing for direct sale to consumers is exempt in some cases. For details on regulations, contact your Extension Service or State Department of Agriculture personnel.

Processing turkeys at home is not really difficult but you may find it more convenient to have them custom processed. For information on home processing and other aspects of turkey flock management, contact your county or State Extension Service office.

Acknowledgments: Louis C. Arrington, University of Wisconsin, Cooperative Extension Service



Breeds, Varieties, and Strains



CONTINENTAL CLASS

Northern European

Hamburgs

Varieties: Golden Spangled, Silver Spangled, Golden Penciled, Silver Penciled, Black, White.

Standard weights: Cock, 5 pounds; hen, 4 pounds; cockerel, 4 pounds; pullet, 3½ pounds.

Skin color: White.

Eggshell color: White.

Use: An ornamental fowl capable of laying fair numbers of relatively small eggs.

Origin: Hamburgs carry a German name but are generally considered to have originated in Holland.

Characteristics: Hamburgs are active, flighty birds. They are trim and stylish with delicate features and are wild in nature. They forage well and are capable of flying long distances. Although good egg producers, their eggs are often very small.

Campines

There are two varieties of campines, Golden and Silver. Campines are a fairly small, closely feathered breed with solid-colored hackles and barred bodies. They are chiefly an ornamental breed but will lay a fair number of white-shelled eggs and are non-broody. They are thought to have originated in Belgium.

Lakenvelders

An old German breed best know for its color pattern (black hackle and tail on a white body). They are quite small, non-broody, lay white-shelled eggs, and are rather wild and flighty.

Polish

Polish

Varieties: White Crested Black, Non-Bearded Golden, Non-Bearded Silver, Non-Bearded White, Non-Bearded Buff Laced, Bearded Golden, Bearded Silver, Bearded White, Bearded Buff Laced.

Standard weights: Cock, 6 pounds; hen, 4½ pounds; cockerel, 5 pounds; pullet, 4 pounds.

Skin color: White.

Eggshell color: White.

Use: Strictly an ornamental fowl.

Origin: Probably eastern Europe, although they are so old that their history has been obscured.

Characteristics: Polish are an unusual and beautiful breed. They have a crest (some also possess a beard and muffs) and are small, tightly feathered birds, fairly active despite restricted vision due to their large "head gear." They need plenty of space to avoid damaging each other's crests by picking. Ice forming in their crests from drinking water can be a problem in colder weather. Sometimes their crests restrict vision and cause them to be easily frightened.

French

Houdans

Varieties: Mottled, White.

Standard weights: Cock, 8 pounds; hen, 6½ pounds; cockerel, 7 pounds; pullet, 5½ pounds.

Skin color: White.

Eggshell color: White.

Use: An ornamental fowl that is also a good egg producer and fairly good as a meat bird.

Origin: Houdans originated in France where they enjoy a good reputation as a high-class table fowl.

Characteristics: Houdans possess a crest, beard, and muffs and have five toes on each foot. Their rectangular bodies are set on fairly short legs. They are one of the better ornamental breeds for general utility use. Because of their crest, they require plenty of space and feed and water containers that prevent them from getting the crest wet and dirty, especially in cold weather. Because of the fifth toe, baby Houdans often walk with a skipping gait.

Faverolles

An interesting breed that combines a beard and muffs with a single comb and feathered legs and feet. Faverolles are a medium-sized breed and fairly loosely feathered, giving them a rather large appearance. They also have a fifth toe on each foot and while chiefly ornamental, do possess some utility characteristics as well.

Crevecoeurs

A very rare, crested breed, solid black in color, Crevecoeurs are strictly an ornamental fowl.

La Fleche

A very rare breed with a pair of spikes in place of a conventional comb. La Fleche are black, of medium size, and very active. They are strictly an ornamental fowl.

All Other Standard Breeds Class

Games

Old English

Varieties: Black Breasted Red, Brown Red, Golden Duckwing, Silver Duckwing, Red Pyle, White, Black, Spangled.
Standard weights: Cock, 5 pounds; hen, 4 pounds; cockerel, 4 pounds; pullet, 3½ pounds.
Skin color: White.
Eggshell color: White or light tint.
Use: Old English Games are strictly an ornamental fowl.
Origin: Old English Games are the modern-day descendants of the ancient fighting cocks. They are associated with England, but their heritage is almost worldwide and they have changed little in shape or appearance in more than 1,000 years.
Characteristics: A small, tightly feathered bird, Old English Games are very hardy, extremely active, and very noisy. Old English have figured in the development of many other breeds. The mature cocks should be dubbed (have the comb and wattles removed) with a characteristic cut. This is in keeping with their heritage. Old English hens usually show broodiness but are so small and aggressive as well as defensive that they are not always the best choice as mothers. Old English are capable of considerable flight and may revert to a feral (wild) state in some areas. They are the domestic breed most like the old jungle fowl in appearance.

Modern Games

Varieties: Black Breasted Red, Brown Red, Golden Duckwing, Silver Duckwing, Birchen, Red Pyle, Black, White.
Standard weights: Cock, 6 pounds; hen, 4½ pounds; cockerel, 5 pounds; pullet, 4 pounds.
Skin color: White.
Eggshell color: White or light tint.
Use: Strictly an ornamental fowl.
Origin: Modern Games were developed in Great Britain.
Characteristics: A tightly feathered bird with long legs and neck, which give it a tall, slender appearance. The males of the Modern Games should have their combs and wattles removed to enhance their long, slim shape. The feathers of Modern Games should be short, hard, and held very close to their bodies. They do not stand cold weather well because of their short feathers and need plenty of exercise to maintain muscle tone.

Orientals

Malays

Varieties: Black Breasted Red.
Standard weights: Cock, 9 pounds; hen, 7 pounds; cockerel, 7 pounds; pullet, 5 pounds.
Skin color: Yellow.
Eggshell color: Brown.
Use: Strictly an ornamental fowl.
Origin: A very old breed coming from Asia, they have changed little in modern times.
Characteristics: Maylays are very tall and appear bold and perhaps cruel due to their projecting eyebrows. They are closely feathered with short feathers and carry their bodies inclined upward with tail low or drooping. They are rugged and have a reputation for vigor and long life. They require exercise to maintain muscle tone and hardness of feather. Most hens will go broody but are not a good choice because their long legs do not fit easily in a nest.

Sumatras

Varieties: None.
Standard weights: Cock, 5 pounds; hen, 4 pounds; cockerel, 4 pounds; pullet, 3½ pounds.
Skin color: Yellow.
Eggshell color: White or light tint.
Use: Strictly an ornamental fowl.
Origin: Sumatras come from the island of Sumatra from which they take their name.
Characteristics: Sumatras are a distinctive fowl which look less like domestic poultry than other chickens. They have rather long tails carried low enough to appear drooping. They have multiple spurs on each leg, dark purple faces, and a high degree of greenish luster on jet black plumage.

Cubalayas

A hardy bird developed in Cuba, they resemble a Sumatra in shape. Cubalayas exist in three varieties and should be considered a strictly ornamental fowl.

Miscellaneous

Sultans

Sultans come from Turkey. They are strictly an ornamental fowl of very distinctive appearance. They have a large crest, muffs and beard, together with profuse feathering of the feet and legs.

Frizzles

While listed in the *Standard of Perfection* as a breed, frizzling is a genetic modification that can be easily introduced into any population of chickens. It causes each feather to curl back toward the bird's head instead of lying naturally pointed toward the tail.

Naked Necks

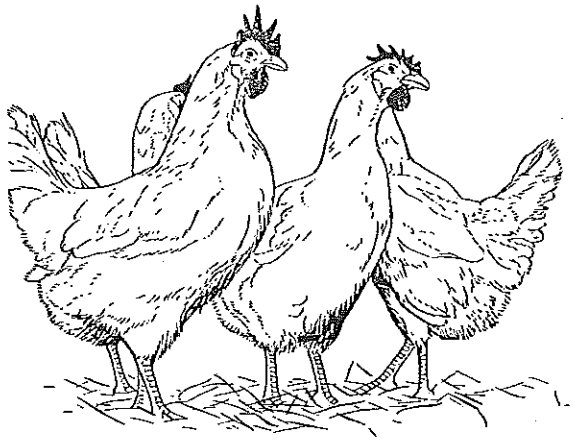
Turkens

The Transylvania Naked Neck is often called Turken. Some people think it is a cross between a chicken and a turkey because of the unfeathered area on the neck. This skin turns red when exposed to the sun, further paralleling the turkey. However, this is actually the result of a single gene that affects the arrangement of feather-growing tracts over the chicken's body. It can be easily introduced into any breed. Turkens have no feathers on a broad band between the shoulders and the base of the skull. They also have a reduced number of feathers on their bodies, but this is not evident until the bird is handled. Turkens should be given protection from extremely cold temperatures as they have far less insulation than their normally feathered cousins. This characteristic is a novel feature that does not detract from the utility of the bird.

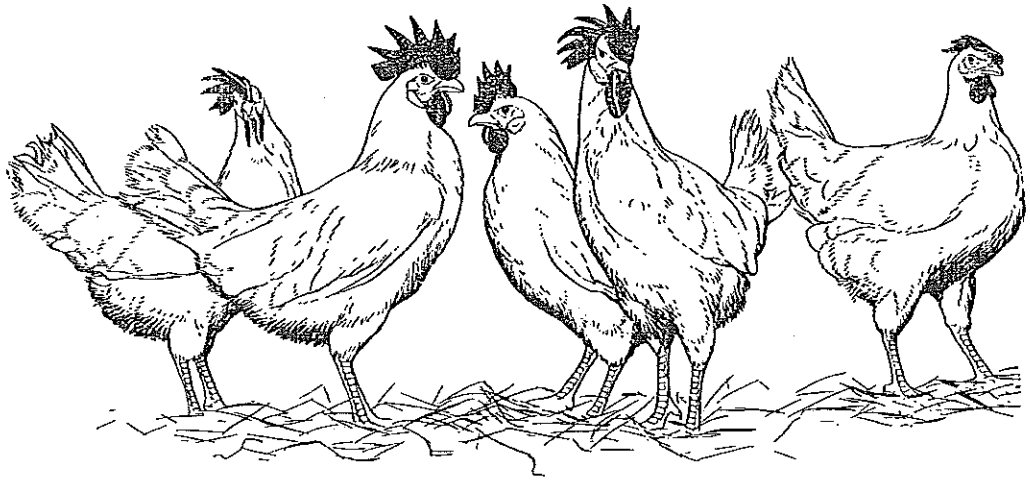
Araucanas

These fowls were discovered in South America. A few were brought to the United States but have been crossed with other chickens so much that characteristics of size, shape, etc., were dispersed. The trait of laying blue or greenish eggs persisted and now breeders are attempting to standardize the physical make-up of the population and gain them recognition as a breed. Some of the Araucanas were rumpless and possessed some interesting ear tufts. Probably at some time in the future, these fowls will be developed into an interesting breed with both economic and ornamental attributes.

Acknowledgments: John L. Skinner, Cooperative Extension Service, University of Wisconsin



Eggcyclopedia



Pickled Eggs

Marinated hard-cooked eggs. The marinade may be made from vinegar and pickling spices, although spicy cider or pickle juice works well, too. The juice from pickled beets is one of the most popular marinades. When sliced, the lovely red color is a pretty contrast to the yolk and white.

Pickled eggs can be served as a snack or appetizer; cut in wedges and added to tossed green salads; included on cold cut platters; sliced and used as garnish for cooked vegetables and potato salads; or prepared as deviled eggs.

If the container is not opened, pickled eggs will keep several months without refrigeration. Although the acidity of the pickling solution prevents the growth of bacteria, it eventually causes the eggs to disintegrate. Refrigerate opened containers and, to avoid introducing bacteria, use a clean implement to remove eggs from the solution.

Use several small containers, quarts or less, if the pickled eggs are to be consumed intermittently over a period of time. *—see Cooking Methods, hard-cooked; Peeling*

Poached Egg

—see Cooking Methods, poached

Popovers

An egg-rich, hollow bread baked in small cups or pans. A very hot oven creates the steam inside the batter that pops them to magnificent heights.

Preservation

Refrigeration, drying, and freezing are the best ways to preserve egg quality. Fresh eggs are so readily available that long storage periods are rarely necessary. However, centuries before modern methods of egg production, transportation, and refrigeration became known, man did his ingenious best to preserve the egg intact.

The ancient Chinese stored eggs up to several years by immersion in a variety of such imaginative mixtures as salt and wet clay; cooked rice, salt, and lime; or salt and wood ashes mixed with a tea infusion. Although the Chinese ate them with no ill effects of which we are aware, the eggs thus treated bore little similarity to fresh eggs, some exhibiting greenish-gray yolks and albumen resembling brown jelly.

Immersion in different liquids too numerous to mention was explored, lime water being a favorite in the 18th century. During the early 20th century, water glass was used with considerable success. Water glass, a bacteria-resistant solution of sodium silicate, discouraged the entrance of spoilage organisms and evaporation of water from eggs. It did not penetrate the egg shell, imparted no odor or taste to the eggs, and was considered to have somewhat antiseptic properties. However, it did a rather poor job at relatively high storage temperatures. Eggs preserved in a water glass solution and stored in a cool place keep 8 to 9 months.

Dry packing in various substances ranging from bran to wood ashes was used occasionally, but costs of transporting the excess weight of the packing material far exceeded the dubious advantages. In an attempt to seal the shell pores to prevent loss of moisture and carbon dioxide, a great variety of materials including cactus juice, soap, and shellac were investigated with varying degrees of success. The only coating considered fairly efficient was oil which is still used today.

Thermostabilization, immersion of the egg for a short time in boiling water to coagulate a thin film of of albumen immediately beneath the shell membrane was rather extensively practiced by housewives of the late 19th century. Mild heating destroyed spoilage organisms but did not cook the eggs. If kept in a cool place, thermostabilized eggs coated with oil keep several months although some mold growth may take place.

During the first half of the 20th century, storing eggs in refrigerated warehouses was a common practice. Preservation was later improved with the introduction of carbon dioxide into the cold storage atmosphere. Today, very few, if any, cold storage eggs find their way to the retail market. *—see Cold Storage; Oiling*

Price Per Pound

An easy way to compare the price of eggs with other protein foods. —*see Buying*

Production

Prior to World War II, most egg production came from farm flocks of less than 400 hens. By the early 1960's, improved technology and the development of sophisticated mechanical equipment were responsible for a shift from small farm flocks to larger commercial operations. In the major egg producing states, flocks of 100,000 laying hens are not unusual, and some flocks number more than 1 million. Each of the 235 million laying birds in the U.S. produces from 250 to 300 eggs a year.

Factors That Influence Egg Production

Genetic pattern of the breed of hen: Maximum production of top-quality eggs starts with a closely controlled breeding program emphasizing favorable genetic factors. The Single Comb White Leghorn hen dominates today's egg industry. This breed reaches maturity early, utilizes its feed efficiently, has a relatively small body size, adapts well to different climates, and produces a relatively large number of white-shelled eggs, the color preferred by most consumers. Because brown-shelled eggs are favored in the New England region, the Rhode Island Red, New Hampshire, and Plymouth Rock Breeds predominate in that area of the country.—*see Color*

Hen's age at egg-laying maturity: Although early starters lay more eggs, maturity too early results in many small eggs.

Resistance to disease: Selective breeding is reinforced by good sanitation and vaccination.

Light control: Of primary importance both during the growing and laying periods, controlled, low-intensity light can be used to delay sexual maturity until the bird's body is big enough to produce larger eggs. Today's laying hen doesn't need to depend upon the fickle sun to tell her when laying time has arrived. Intensity and duration of light can be adjusted to regulate production.

Quality of feed: Since more is known about the nutritional requirements of the chicken than of any other domestic animal, it is not surprising that rations are scientifically balanced to assure layer health along with optimum quality eggs at least cost.

Temperature: Laying houses maintained between 57 and 79 °F (14 and 26 °C) are desirable.

Humidity: A relative humidity between 40 and 60 percent is best.

Replacing or molting the flock: Molting, or loss of feathers, is a natural occurrence common to all birds regardless of species. As the hen ages, egg quality declines and, at about 18 to 20 months of age, molting occurs and egg production ceases. While some flocks are sold for slaughter at this point, replacement is costly. A fairly common practice is to place the flock into a controlled molt. After a rest period of 4 to 8 weeks, the birds start producing again. Poultrymen have found that with two periods of controlled molting, one at 14 months of age and another at 22 months, egg quality is more consistent than with one molt at 18 or 20 months.

The laying house: In today's egg-laying facilities, temperature, humidity, and light are all controlled, and the air is kept circulated. The building is well-insulated, windowless (to aid light control), and is force-ventilated. Birds are either given the run of the floor area or are housed in cages. Most new construction favors the cage system because of its sanitation and efficiency, but floor operations are also in use.

Feeding: Because care and feeding of hens, maintenance, sanitation, and egg-gathering all require time and money, there is a strong trend toward automation whenever possible.

Automatic feeders, activated by a time clock, move mash through troughs in the floor or past the cages. Birds at floor level drink from troughs. Those in cages may sip from such sophisticated accessories as self-cleaning drinking cups or nipple valves.

Most poultry rations are of the all-mash type. They are made of sorghum grains, corn, cottonseed meal, or soybean oil meal depending upon the part of the country in which the ration is produced and which ingredient is most available. The feed is carefully balanced so that the hen gets just the right amounts of protein, fat, carbohydrates, vitamins, and minerals. Today's hen eats a better balanced diet than many people!

The hen's ration may contain the same types of additives approved for human food. Antioxidants or mold inhibitors (also used in mayonnaise and bread) are added to maintain the quality of the feed. And, like people, chickens occasionally require an antibiotic.

An additive is not approved for use in poultry feed unless adequate research has been undertaken to determine its pharmacological properties and possible toxicity and to discover any potentially harmful effects on animals. Hormones are not fed to poultry in the United States.

How much a hen eats depends upon the hen's size, the rate of egg production, temperature in the laying house, and the energy level of the feed. In general, about 4 pounds of feed are required to produce a dozen eggs. A Leghorn chicken eats about 1/4 pound of feed per day. Brown-egg layers are slightly larger and require more food.

Egg quality is affected by the type of feed. Shell strength, for example, is determined by the presence and amounts of vitamin D, calcium, and other minerals in the feed. Too little vitamin A can result in blood spots. Yolk color is influenced by pigments in the feed. Maximum egg size requires an adequate amount of protein and essential fatty acids.

Handling: The moment an egg is laid, physical and chemical changes begin to conspire against freshness. Warm temperatures encourage those changes, so newly laid eggs must be gathered frequently and refrigerated quickly.

Some eggs are still gathered by hand, but in most production facilities automated gathering belts do the job. Gathered eggs are moved into refrigerated holding rooms where temperatures are maintained between 40 and 45 °F (5 and 7 °C). Humidity is relatively high to minimize moisture loss but should not exceed 80 percent. Sometimes eggs are oiled as they are gathered. *—see Oiling*

Processing and distribution: Some producers sell their eggs nest run (ungraded) to processing firms which clean, grade, size, and carton the eggs and ship them off to retail outlets. Other farms and ranches carry out the entire operation.

—see Egg Products, Egg Products Inspection Act, Grading, Nest Run

Protein

A combination of amino acids, some of which are called essential because the human body needs them but can't synthesize them. The human diet must regularly supply protein which contains all of the essential amino acids. The egg boasts them all: histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine. They are present in a pattern that matches very closely the pattern the body needs, so the egg is often the measuring stick by which other protein foods are measured.

In addition to the nine essential amino acids, there are nine other amino acids in an egg. Altogether, each Large egg provides a total of 6.25 grams of high quality, complete protein. For this reason, the egg is classified with meat in the food categories. One egg equals 1 ounce of

lean meat, fish, or poultry. A Large egg provides 10 to 13 percent of the Daily Reference Value for protein and varying amounts of many other nutrients, too. *—see Biological Value, Buying, Daily Reference Values (DRVs), Nutrient, Nutrient Density*

Pullet

A young hen, less than 1 year old.

Quiche *(keesh)*

An unsweetened, open-faced custard pie served hot or cold as an entree, appetizer, or snack. It requires only a few ingredients—eggs, milk, seasonings, and whatever else you might wish to add in the way of chopped vegetables, meat, poultry, seafood, or shredded cheese. Quiche can be made in a conventional pie plate or pan or in a special dish called a quiche dish.

Quiches are traditionally made in a pastry crust, but crusts can be made from mashed potatoes, cooked rice, or spinach. Bread crumbs or cereals are also delicious and do not contain the high fat content of pastry. *—see Cooking equipment, quiche dish*

Quiche Lorraine

Frenchmen claim that this savory custard pie originated in the province of Lorraine, but the Germans insist it started in Alsace. The classic version includes bacon and Swiss cheese.

Raw Eggs

There have been warnings against consuming raw or lightly cooked eggs on the grounds that the egg may be contaminated with *Salmonella,* a bacteria responsible for a type of food poisoning.

With eggs and all other raw foods from animals, there is a small possibility of *Salmonella* food poisoning. The risk is greater for those who are pregnant, elderly, or very young, and those with medical problems which have impaired their immume systems. These individuals should avoid raw and undercooked animal foods.

Healthy people need to remember that there is a very small risk and treat eggs and other raw animal foods accordingly. Use only properly refrigerated, clean, sound-shelled, fresh, grade AA or A eggs. Avoid mixing yolks and whites with the shell. Refrigerate broken-out eggs, prepared egg dishes, and other foods if you won't be consuming them within an hour.

For summer outings, use ice or coolant in an insulated bag or cooler to keep cold foods cold (40 °F or lower) and thermal containers to keep hot foods hot (140 °F or higher). When toting raw eggs on outings, leave them in their shells. Immediately consume, refrigerate, or freeze raw or lightly cooked egg dishes. Eggnog and homemade ice cream should be based on a cooked, stirred custard to ensure safety.

The kitchen, too, can be a source of bacteria. Clean hands and equipment, sanitary food handling practices, proper cooking, and adequate refrigeration are essential in safely preparing all foods.

Raw Egg Whites: Although it is possible for *Salmonella* to be in both the white and the yolk of the egg, the white does not readily support bacterial growth. Cold souffles, mousses, and chiffons containing raw beaten whites require refrigeration to maintain their character, an added safety factor. Such dishes might be considered low-risk for healthy individuals.

For further safety, combine the whites with the sugar in the recipe (using a minimum of 2 tablespoons of sugar per white) and beat over hot water or over low heat in a heavy saucepan until the whites stand in soft peaks. Without sugar, the whites will coagulate too rapidly and produce an unsatisfactory meringue. This is the same procedure used in making 7-minute frosting and can be used to make royal icing or other frostings ordinarily containing raw whites. If using an unlined aluminum saucepan, do not add cream of tartar. It will react with the aluminum to produce an unattractive gray product.

Raw Egg Yolks: Raw egg yolks are a fine growth medium for bacteria. It is best to cook yolks for use in such dishes as cold souffles, chiffons, mousses, mayonnaise, and hollandaise sauce.

To cook yolks, the recipe must contain at least 2 tablespoons of liquid per yolk. Less liquid will produce scrambled eggs. Simply combine the yolks with the liquid in the recipe. Cook in a heavy saucepan over very low heat, stirring constantly, until the mixture coats a metal spoon, bubbles at the edges, or reaches 160 °F. Cool quickly and proceed with the recipe. *—see Avidin, Biotin, Custard, Salmonella*

Recommended Dietary Allowances (RDAs)

A term used to denote recommendations for 26 nutrients for 18 different population subgroups. RDAs are based on information on nutrient allowances for healthy people from the National Research Council of the National Academy of Sciences. This information is revised about every 5 years and is used to determine the Daily Value and Reference Daily Intake figures used on food labels. *—see Daily Reference Values (DRVs), Daily Values (DVs), Reference Daily Intakes (RDIs), U.S. Recommended Daily Allowances (U.S. RDAs)*

Reference Daily Intakes (RDIs)

A new term that replaces the familiar U.S. Recommended Daily Allowances (U.S. RDAs). RDIs are based on a population-weighted average of the latest RDAs for vitamins and minerals for healthy Americans over 4 years old. RDIs are not recommended daily intake figures for any particular age group or sex. They are simply average values for the entire U.S. population.

The RDI for protein for everyone over 4 years of age is 50 grams and, for those under 4, is 14 grams. For vitamins and minerals, RDIs are:

Vitamins

A*	5000	IU
C*	60	mg
D	400	IU
E	30	IU
Thiamin (B_1)	1.5	mg
Riboflavin(B_2)	1.7	mg
Niacin	20	mg
B_6	2	mg
Folic Acid	0.4	mg
B_{12}	6	mcg
Biotin	0.3	mg
Pantothenic Acid	10	mg

Minerals

Calcium*	1000	mg
Iron*	18	mg
Phosphorus	1000	mg
Iodine	150	mg
Magnesium	400	mg
Zinc	15	mg
Copper	2	mg

*Listing the percentage of RDI for this nutrient is mandatory on new food labels. Listing the percentage of RDI for other nutrients is optional. *—see Daily Reference Values (DRVs), Daily Values (DVs), Recommended Dietary Allowances (RDAs), U.S. Recommended Daily Allowances (U.S. RDAs)*

Restricted Eggs

Undergrade eggs, specifically checks, dirties, incubator rejects, inedibles, leakers, and loss eggs.

- *Checks* have a broken shell or a crack in the shell, but shell membranes are intact so that the egg contents do not leak.
- *Dirties* may have adhering dirt, prominent or conspicuous stains, or moderate stains covering more than a quarter of the shell surface.

• *Incubator rejects* have been subjected to the incubation process for a period of time.
• *Inedibles* are moldy, musty, or sour; or exhibit rot, blood rings, green whites, stuck yolks, or embryo chicks.
• *Leakers* have a crack or break in both shell and shell membranes so that the contents are leaking.
• *Loss eggs* are leakers, inedibles, and any egg that has been cooked, frozen, or contaminated.

The Egg Products Inspection Act (EPIA) controls the disposition of such eggs to prevent their getting into consumer channels. Checks and dirties are allowed to move to official USDA egg products plants where they can be properly handled and processed. They cannot be sold in the shell to restaurants, bakeries, food manufacturers, or consumers unless such sales are specifically exempted by Section 15 of the Act and not prohibited by state law. All other restricted eggs must be disposed of according to approved procedures.

Roasted Egg

A roasted egg which appears on the Jewish Passover plate as part of the ritual. The egg is hard-cooked then roasted in the oven until the shell becomes brown.

Salmonella

One of several types of bacteria which can cause food poisoning (salmonellosis) if ingested in large numbers. It is found in the intestinal tract of animals, birds, insects, reptiles, seafood, and people. The bacteria can easily be passed from the intestinal tract to the hands and on to food.

Although the inside of the egg was once considered almost sterile, *Salmonella enteritidis (S.e.)* has been found recently inside a small number of eggs (much less than 1 percent). If an egg does contain *S.e.*, the numbers in a freshly laid egg probably will be small and, if the eggs are properly refrigerated, will not multiply enough to cause illness in a healthy person.

The majority of salmonellosis outbreaks have been attributed to foods other than eggs—chicken, beef, and fish—to human carriers, and through them, to utensils and other foods during preparation. Of the outbreaks involving eggs, almost all have occurred in the foodservice sector and have been the result of inadequate refrigeration and insufficient cooking.

S.e. will not grow at temperatures below 40 °F and is killed at 160 °F. Temperatures between 40 °F and 140 °F, known as the danger zone, are ideal for rapid growth.

Illness from *S.e.* can be avoided through adequate refrigeration, proper cooking, and sanitary kitchen and food handling procedures. *—see Buying, Cooking Methods, Raw Eggs, Storing*

Saturated Fat

—see Fat

Sauces

Eggs are a time-honored thickener for sauces, but they fill more than that primary function. Eggs enrich flavor, add color, and increase nutritive value.

Milk or cream sauces thickened with eggs are used to bind casseroles and meat loaves. When sweetened, such sauces are served with desserts.

Eggs are also used in butter sauces which are emulsions of butter and other liquids. On heating, the egg both thickens and strengthens the emulsion. Hollandaise is the best known sauce of this type.

Other egg sauces include those in which chopped hard-cooked eggs are an ingredient, such as polonaise sauce. *—see Custard, stirred; Hollandaise Sauce*

Scrambled Egg

—see Cooking Methods, scrambled

Shell

The egg's outer covering, accounting for about 9 to 12 percent of its total weight, depending on egg size. The shell is the egg's first line of defense against bacterial contamination.

The shell is largely composed of calcium carbonate (about 94 percent) with small amounts of magnesium carbonate, calcium phosphate, and other organic matter including protein.

Shell strength is greatly influenced by the minerals and vitamins in the hen's diet, particularly calcium, phosphorus, manganese, and Vitamin D. If the diet is deficient in calcium, for instance, the hen will produce a thin or soft-shelled egg or possibly an egg with no shell at all. Occasionally an egg may be prematurely expelled from the uterus due to injury or excitement. In this case, the shell has not had time to be completely formed. Shell thickness is also related to egg size which, in turn, is related to the hen's age. As the hen ages, egg size increases. The same amount of shell material which covers a smaller egg must be "stretched" to cover a larger one, hence the shell is thinner.

Seven to 17 thousand tiny pores are distributed over the shell surface, a greater number at the large end. As the egg ages, these tiny holes permit moisture and carbon dioxide to move out and air to move in to form the air cell. The shell is covered with a protective coating called the cuticle or bloom. By blocking the pores, the cuticle helps to preserve freshness and prevent microbial contamination of the contents.

Uses for eggshells vary from the thrifty (compost) to the creative (decorating). *—see Air Cell; Bloom; Color, shell; Composition; Decorating Eggs; Formation; Oiling*

Size

Several factors influence the size of an egg. The major factor is the age of the hen. As the hen ages, her eggs increase in size. The breed of hen from which the egg comes is a second factor. Weight of the bird is another. Pullets significantly underweight at sexual maturity will produce small eggs. Environmental factors that lower egg weights are heat, stress, overcrowding, and poor nutrition.

All of these variables are of great importance to the egg producer. Even a slight shift in egg weight influences size classification and size is one of the factors considered when eggs are priced. Careful flock management benefits both the hens and the producer. *—see Buying, Grading, Production, Treatment of Hens*

Size Equivalents

Although any size egg may be used for frying, scrambling, cooking in the shell, or poaching, most recipes for baked dishes such as custards and cakes are based on the use of Large eggs. To substitute another size, use the following chart.

Large	Jumbo	X-large	Meduim	Small
1	1	1	1	1
2	2	2	2	3
3	2	3	3	4
4	3	4	5	5
5	4	4	6	7
6	5	5	7	8

You can also figure how many of which to use by cup measurement.

To Make 1 Cup:	Egg Size	Whole	Whites	Yolks
	Jumbo	4	5	11
	X-Large	4	6	12
	Large	5	7	14
	Medium	5	8	16
	Small	6	9	18

—see Buying

Soft-cooked Egg

—see Cooking Methods, soft-cooked

Souffle

A puffy, delicate, light-as-air creation. Savory or sweet, hot or cold, souffles are sensational and impressive whether served as a main dish, accompaniment, or dessert.

Strictly speaking, a true souffle consists of a thick white sauce blended with beaten egg yolks and leavened by stiffly beaten whites. It may also contain finely chopped or pureed meats, cheese, seafood, or vegetables and is always served hot. Condensed cream soups or quick-cooking tapioca cooked in milk are sometimes substituted for the white sauce. For sweet or dessert souffles, sugar is added to the sauce.

Like so many skills, making a successful souffle is easy when you know how. A mastery of the following basics will have you turning out souffles with the best of them.

If you don't have a traditional souffle dish, use a straight-sided casserole dish or even a straight-sided uncoated saucepan of the proper size. For individual servings, large custard cups or ovenproof coffee or soup mugs are satisfactory. As it bakes, the souffle will increase in volume two to three times, so container size is important. If the container is too large, the mixture will not rise above the rim and have the lofty look that is part of a souffle's charm. If the container is too small, the mixture may run over. Usually a four-egg souffle will fit a 1½- to 2-quart container. Use a 2- to 2½-quart container for a six-egg souffle. The container may be filled to within half an inch of the top.

A souffle needs to cling to the sides of the container to reach its maximum height, so the container should not be buttered. However, buttering the sides and bottom of the container and then dusting them lightly with grated Parmesan cheese, cornmeal, or very fine crumbs lends flavor and a nice crusty texture. For dessert souffles, dust with sugar.

If you find your technique produces souffle mixtures which are especially light and voluminous, or if you don't have a container of the suggested size, you can keep the souffle in bounds by fitting a collar around the top of the container. Make a 4-inch band of triple thickness aluminum foil long enough to go around the container and overlap 2 inches. Butter and dust the band. Wrap it around the outside of the dish with the buttered side in and fasten with paper clips or string. The collar should extend 2 to 3 inches above the rim of the container.

Recipe

Basic Savory Souffle
(Four side or two main-dish servings)

With this modern, streamlined method, a souffle is not as difficult to make as you might think. This basic formula can be used for almost any savory souffle combination you can imagine! Add up to 1½ cups total of shredded cheese and/or any shredded or finely chopped, well-drained cooked food and a pinch of a complementary seasoning to the sauce.

¼ cup butter
¼ cup all-purpose flour
½ teaspoon salt
1 cup milk
1½ cups additional ingredients, optional
Seasoning, optional
4 eggs, separated
½ teaspoon cream of tartar

In medium saucepan over medium-high heat, melt butter. Stir in flour and salt. Cook, stirring constantly, until smooth and bubbly. Stir in milk all at once. Cook and stir until mixture boils and is smooth and thickened. Stir in cheese and seasoning, if desired, until cheese is melted. Set aside.

In large mixing bowl, beat egg whites with cream of tartar at high speed until stiff but not dry, just until whites no longer slip when bowl is tilted. Stir egg yolks into reserved

sauce until thoroughly blended. Stir in additional ingredients, if desired. Gently but thoroughly, fold yolk mixture into whites. Carefully pour into 1½- to 2-quart souffle dish or straight-sided casserole.

For a "top hat," hold spoon upright and circle mixture to make ring about 1 inch from side of dish and 1 inch deep. Bake in preheated 350 °F oven until puffy and delicately browned, and until souffle shakes slightly when oven rack is moved gently back and forth, about 30 to 40 minutes. Serve immediately.

Some tips:

• An unbaked souffle can wait in its dish in the refrigerator for up to 2 hours before you send it to the oven.

• Don't open the oven door to peek for at least the first 25 minutes of baking time. A cool draft might deflate it.

• Hurry the finished souffle to the table. It is an age-old rule that guests wait for the souffle, not the souffle for the guests!

• Serve by gently breaking the souffle into portions with two back-to-back forks. Spoon out lightly, including some of the top and side crusts and softer center with each serving.

Souffle, Cold

A term loosely applied to a number of airy egg dishes with a texture closely resembling a souffle. For the purist, however, they are more accurately known as snows or sponges, chiffons, or bavarians.

Snows or sponges are clear gels plus egg whites. A basic gelatin mixture is partially set, unbeaten egg whites are added, and the mixture is beaten until soft peaks form and chilled until firm.

Chiffons are custard gels to which beaten egg whites are added. Egg yolks are cooked with gelatin to make a custard base, stiffly beaten egg whites are folded in, and the mixture chilled. Chiffons can be enjoyed as they are or used for pie fillings.

Bavarians are custard gels made with egg yolks to which both beaten egg whites and whipped cream are added.

Although such recipes are usually made with raw whites and/or yolks, some can be cooked. *—see Raw Eggs*

Sponge Cake

An airy foam cake similar to angel food cake except that sponge cake may be made with egg yolks or with whole eggs. True sponge cakes contain neither shortening nor baking powder. *—see Angel Food Cake, Foams*

Storage Eggs

A technical term for eggs held under refrigeration for more than 30 days rather than being sold immediately. Almost no retail eggs today are storage eggs. *—see Cold Storage, Preservation*

Storing

The refrigerator is where you should store your eggs. Unless you seldom open the door, it's best to place the eggs on an inside shelf. Repeated opening and closing of the door causes temperature fluctuations and slamming can result in breakage. The carton in which you purchase them helps keep the eggs from picking up odors and flavors from other foods and helps prevent moisture loss—a particularly important factor if you have a frost-free refrigerator.

Fresh, uncooked eggs in the shell can be kept refrigerated in their cartons for at least 4 to 5 weeks beyond the pack date. Properly handled and stored, eggs rarely "spoil." If you keep them long enough, they are more likely to simply dry up! But don't leave eggs out. They'll age more in 1 day at room temperature than they will in 1 week in the refrigerator.

As soon as you've cooked them, refrigerate hard-cooked eggs in their shells in their cartons and use them within 1 week.

When storing hard-cooked eggs, you may notice a "gassy" odor in your refrigerator. It may be more noticeable when the refrigerator is opened infrequently. The odor is caused by hydrogen sulfide which forms when the eggs are cooked. It is harmless and usually dissipates within a few hours.

For outdoor eating occasions, eggs can be kept refrigerator-cold with ice or commercial coolant in an insulated bag or picnic cooler as long as the ice lasts or the coolant remains almost at freezing. Unless it's quite cold weather, for hiking, backpacking, camping, and boating when refrigeration or cooler facilities aren't available, it's better to use dried eggs. Usually available in sporting goods stores, dried eggs can be reconstituted with purified water and used in most of the ways you would use fresh eggs. Specially coated hard-cooked eggs which keep without refrigeration for a considerable length of time are also available in some areas.

Pickling and other forms of preservation are additional possibilities.

If a recipe calls for only whites or only yolks, refrigerate the leftover whites in a covered container up to 4 days. Store yolks in water in a covered container in the refrigerator and use in a day or two. If you can't use the yolks quickly enough, hard-cook them. Carefully place them in a single layer in a saucepan and add enough water to come at least 1 inch above the yolks. Cover and quickly bring just to boiling. Remove from heat and let stand, covered, in the hot water for about 15 minutes. Remove with a slotted spoon and store in a tightly sealed container in the refrigerator up to 4 or 5 days.

If you find yourself with more eggs than you will use in several weeks, freeze them. *—see Egg Products, Freezing, Leftover Egg Parts, Pickled Eggs, Preservation*

Strata

A custard mixture poured over layers of bread and cheese and baked. The strata was created to use up stale bread and cheese.

Treatment of Hens

Laying hens are an egg producer's living and are treated with care. Like humans, hens seem to be more productive when they're healthy. In 1945, the average hen laid 151 eggs per year. Now, as a result of breeding and better nutrition, housing, and general management of facilities, the average hen lays between 250 and 300 eggs per year.

Although the housing and caging of laying hens may seem to limit their freedom, the system is actually designed for the welfare of the birds as well as for production efficiency. In the hen house, the birds may more readily be protected from the elements, from disease, and from both natural and unnatural predators (such as cars).

Housing the hens also makes it possible to control their diet, which results in better-fed hens and eggs of more uniform quality. Scientifically balanced feed ensures that the birds are protected from improper or inadequate diets—a vast improvement over the days when hens foraged for food in barnyards or ate household scraps.

Chickens, like some other animals, may exhibit cannibalistic tendencies. To protect the birds from each other, part of their upper beaks or both lower and upper beaks are cut off. The beak-trimming process is done by a special machine which cauterizes the beak and may be compared to clipping a dog's claws. Of course, the birds are still able to eat and drink.

Some hens are even treated to piped-in music. *—see Production*

Thickener

—see Cooking Functions, Sauces

Tempering

The technique used to blend uncooked eggs into hot mixtures. Eggs are beaten and a little of the hot mixture is stirred into them to warm (temper) them. The warmed eggs are then stirred into the remaining hot mixture. Tempering helps to prevent the eggs from curdling. *—see Curdling*

Unsaturated Fat

—see Fat

Uses, Other

• **Cosmetic:** Egg white has long been used as a facial. Egg yolk is used in shampoos and conditioners.

• **Animal Feed:** Both shells and interiors of eggs are used.

• **Experimental Uses:** Egg white is used as a protein reference in feeding laboratory animals. Egg yolk and egg products are used in laboratories as a medium for the growth of microorganisms.

• **Medical and Pharmaceutical:** Fertile eggs are used to manufacture many vaccines, as a source of purified proteins, and as an aid in the preservation of bull semen for artificial insemination.

U.S. Recommended Daily Allowances (U.S. RDAs)

A term that once indicated suggested intake levels for nutrients. U.S. RDAs simplified the RDAs of the National Academy of Sciences by providing a single recommended allowance for the general healthy population. With few exceptions, these allowances were based on the highest RDA for each nutrient—the amounts required for young adult males. Since these values were excessively high for children, women, and the elderly, U.S. RDAs have now been replaced by RDIs which represent average RDAs. *—see Daily Values (DVs), Daily Reference Values (DRVs), Recommended Dietary Allowances (RDAs), Reference Daily Intakes (RDIs)*

Vegetarian Diets

Eggs can be an important source of complete protein in diets that omit meats. One egg equals 1 ounce of lean meat, fish, or poultry. *—see Nutrient, Protein, Reference Daily Intakes (RDIs)*

Vitamins

An egg contains varying amounts of 13 vitamins but no vitamin C. *—see Biological Value, Nutrient, Reference Daily Intakes (RDIs)*

Vitelline Membrane (vi-tel'-an)

—see Composition, membranes

Water Bath

Also known as a *bain marie*. Some delicate dishes, such as custard, are cooked in the oven in a water bath. The baking dish or pan is placed in a larger baking pan and very hot water is added to within half an inch of the top of the custard. The water promotes even cooking. *—see Custard, baked*

Water Glass

A solution of sodium silicate formerly used to preserve eggs. *—see Preservation*

Weeping

—see Curdling; Meringue, soft meringue

Weight

—see Buying, Grading, Size

Well-beaten

—see Cooking Terms

White

—see Albumen; Color, white; Composition; Foam

Yolk

The yolk or yellow portion makes up about 33 percent of the liquid weight of the egg. It contains all of the fat in the egg and a little less than half of the protein.

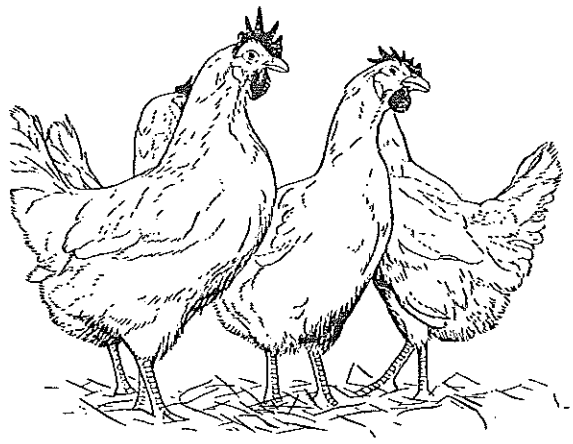
With the exception of riboflavin and niacin, the yolk contains a higher proportion of the egg's vitamins than the white. All of the egg's vitamins A, D, and E are in the yolk. Egg yolks are one of the few foods naturally containing vitamin D.

The yolk also contains more phosphorus, manganese, iron, iodine, copper, and calcium than the white, and it contains all of the zinc. The yolk of a Large egg contains about 59 calories.

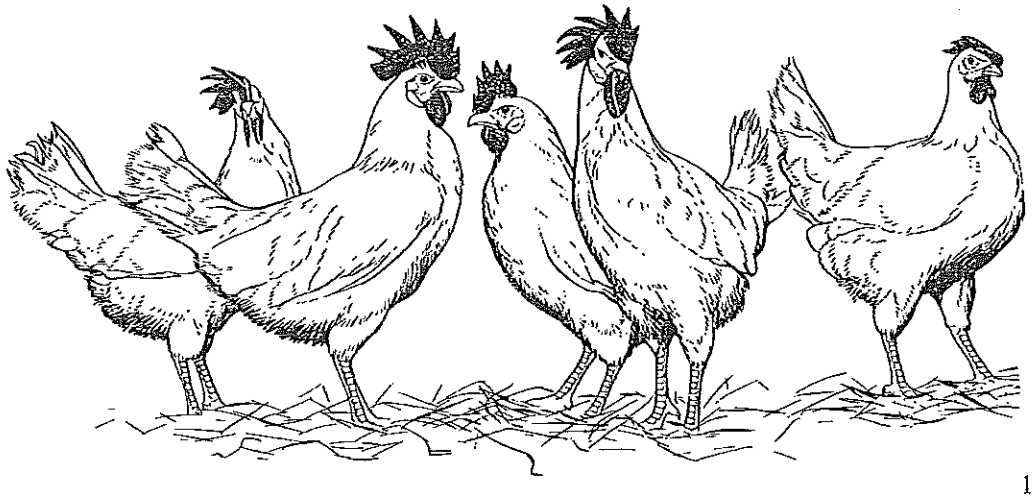
Double-yolked eggs are often produced by young hens whose egg production cycles are not yet completely synchronized. They're often produced, too, by hens who are old enough to produce Extra Large eggs. Genetics is also a factor. Occasionally a hen will produce double-yolked eggs throughout her egg-laying career. It is rare, but not unusual, for a young hen to produce an egg with no yolk at all.

In fertilized eggs, the yolk is the site of embryo formation.

It is the yolk which is responsible for the egg's emulsifying properties. *—see Breakout; Color, yolk; Composition; Cooking; Fat; Functions; Fertile Eggs; Formation; Germinal Disc; Grading; Nutrient*



Raising Your Home Chicken Flock



Raising Your Home Chicken Flock

A successful home chicken flock requires good breeding stock combined with careful management, disease control, and a feeding program adequate for the production or growth level expected for the flock.

Why Have a Small Flock?

A small flock offers the convenience of having fresh eggs or poultry meat right at home and the possible reduced costs of production incurred by using available housing and farm feedstuffs.

Poultry also can be kept as a hobby or as a learning experience for 4-H or FFA projects. Purebred poultry can be exhibited at fairs and poultry shows. There is also the pleasure of observing different shapes and colors in a home poultry flock. Purebred poultry may include chickens (large fowl and bantams), geese, ducks, turkeys, game birds, and guineas. Bantams are ideal for those who have only a small space available to keep chickens.

Before You Plan a Flock

Some local, county, state, and even federal zoning and environmental regulations prohibit poultry flocks. Zoning regulations are usually specific about animals and environmental considerations, such as flies, odor, and noise. Check with your county Extension agent or representatives of government agencies for approval before planning a flock. Also consider the proximity of your neighbors and their opinions.

Home flocks—even small ones—require water, food, and daily care including weekends, vacations, and holidays. The time and effort required for this care should be considered in weighing your desire for a home flock against other possible uses of your time and labor.

What Kind of Chicken?

There are two basic choices in the type of poultry to keep: a strain bred primarily for egg production or one that is bred for meat production.

Commercially available White Leghorn strains produce approximately 250 to 300 white eggs each year on a small amount of feed. Sexlinked hens, which are a little larger than Leghorns and lay brown eggs, produce approximately 180 to 240 eggs per year. Egg-producing stock can be bought as day-old chicks or as started pullets at 18 to 22 weeks of age. Yearling hens (hens with one year of production) can be purchased from a commercial egg flock.

The most economical meat production comes from commercial broiler-type birds, which can be used for broiler, roaster, and capon production. These meat birds typically produce few eggs.

Housing Requirements

Housing for home poultry production must keep the flock comfortable in all kinds of weather. The house should be tight, well-ventilated, and insulated. It is important to provide adjustable ventilation for adequate air movement in hot summer months and reduced air movement in cold weather. Litter is material such as shavings or sawdust spread on the chicken house floor. A concrete floor is recommended for sanitation and litter management; however, sandy soil may be adequate. Use a $\frac{1}{2}$-inch ($1\frac{1}{4}$-centimeter) mesh hardware cloth over windows to keep out birds, rodents, and predators.

Floor space in the house should allow 3 square feet (one square meter) per bird for layers and 1 square foot (315 square centimeters) per bird for broilers and bantams. Hanging cages are recommended as a means of preventing disease.

Brooding Equipment

Brooders

Baby chicks need heat during the first few weeks of rearing. There are many types of chick brooders that can be adapted to a small flock. Standard hover brooders can be used for starting a flock of up to 1,000 chicks. Battery brooders with feeders and waterers built in do a good job of starting chicks as well as supplying feeders and waterers for several weeks. The common infrared lamp is an inexpensive way to brood a small, 25- to 100-chick flock. The heat lamp should be at least 18 inches (45 centimeters) above the litter. In winter, make sure that the room temperature is warm enough to allow the heat lamps to be effective. A two-lamp unit provides safety in case one burns out during cold weather. Table 21 gives a temperature guide for brooding, but the behavior of the chicks is a better indicator of their comfort. If the chicks have loud, sharp chirps and are bunched near the heat source, they are cold. If they are panting and bunched in the corner away from the heat source they are too warm. A brooder guard usually is used to keep chicks near the heat source during the first week to 10 days. The guard is a circular barrier, 15 to 16 inches (38 to 46 centimeters) high, made of cardboard or other solid material, that confines the chicks and reduces drafts of cold air.

Feeders

Manufactured chick-feeder designs vary from the commercially used cardboard or plastic feeder lid to the metal trough type. Homemade boxes, egg flats, and similar low, open designs are acceptable as long as the chicks have easy access to the feed, and feed waste is controlled. Provide enough space so that nearly all the chicks can eat at the same time. To avoid feed waste, gradually change chicks to regular tube or trough feeders so that open feeders can be removed when the chicks are 10 days old.

Hanging tube and trough feeders for all ages are available from farm supply dealers. Hanging tube feeders are adjustable and can be used for chickens from one week through adulthood. Trough feeders have a limited capacity for adjustment, which makes it necessary to use at least three different sizes of feeders during the growing cycle of replacement pullets, roasters, or capons. At least two different sizes are needed to rear broilers.

A feeder can be built from scrap lumber, but it is critical that it be designed to avoid feed waste. The feeder must have a reel, grill, or other device to keep chickens from roosting on it or scratching in it. The feeder must have a lip to keep the feed from being spilled out. It is also essential that the feeder be the correct height (the back height of the chickens). See Table 21 for feeder space needs.

Waterers

Chicks must have easy access to water; much early chick mortality occurs when weak chicks cannot find water. Manufactured chick waterers are usually gallon or quart jars that screw onto special bases. Once filled, the waterers are inverted and the chicks drink out of the base. A simple homemade fountain, satisfactory for a dozen chicks, can be made by punching a hole with a 10-penny nail in the side of a standard can one-eighth of an inch (0.3 centimeters) to one-fourth of an inch (0.6 centimeters) from the open end. The can is filled with water and inverted in a deep saucer. Water fountains must be cleaned daily and filled as necessary.

Manufactured trough or low-pressure hanging waterers are usually used for growing flocks or adult home poultry flocks. Regardless of the waterer you use, make sure it has the following construction details: correct size and height from the floor (2 inches shorter than the back height of the chickens); a device to prevent roosting and wading; a design to control spillage; and a design for easy cleaning. Trough waterers usually can be adjusted for height; pan waterers do not have adjustments, but they work well over a pit area that catches spillage. Clean waterers daily so chickens have access to clean water at all times. Refer to Table 21 for water space needed.

Nests

Chickens kept for egg production should have access to nests at 19 to 20 weeks. Giving young pullets the opportunity to find nests 1 to 2 weeks before they start laying helps prevent them from developing the habit of laying in the litter. Both individual and colony nests are satisfactory. Leghorns should have a 12 by 14 by 12-inch (30 by 36 by 30-centimeter) individual nest; heavier hens should be provided with a 14 by 14 by 12-inch (36 by 36 by 30-centimeter) nest. Nail or glue a strip on the front of the nest to keep 1 to 2 inches (2½ to 5 centimeters) of nesting material in the nest. Provide one individual nest for every four hens in the flock.

A 2 by 6-foot (60 by 180-centimeter) colony nest is adequate for 50 hens. Nests may be placed on end walls or partitions. They should be installed high enough so hens can walk under them. Place nests with openings in the darker part of the house. Hens do not like to lay in nests with excessive light.

Roosts

Roosts provide comfortable sleeping for hens, replacement pullets, and capons. Roosts can be made easily by rounding edges of 2 by 2-inch (5 by 5-centimeter) or 2 by 4-inch (5 by 10-centimeter) boards. Allow 6 to 7 inches (15 to 18 centimeters) of roost space per bird. Dropping pits help with litter management: They catch a good portion of the birds' feces as well as water spillage. The dropping pit should be wire-covered and at least 12 to 16 inches (30 to 40 centimeters) off the floor. Clean the dropping pit regularly, particularly if wet conditions develop.

Light

Artificial light benefits all classes of poultry. One 40-watt bulb provides adequate light for 200 square feet (18 square meters) of floor space. If the ceiling is painted white or a light reflector is used, the quality of light is enhanced. A combination of natural and artificial light to give layers 14 hours of light is effective in maintaining egg production throughout the year. Broilers and roasters grow well with 24-hour light, but can be grown with only 8 to 10 hours, such as that provided by natural light.

Cages

Commercial table egg production utilizes cages in multiple tiers for more than 90 percent of eggs produced. Capital investment in cage layer facilities is high but labor efficiency is excellent. If hens are managed correctly and housed in well-built and well-ventilated buildings, their performance is comparable to that of floor layers. Odor and flies are major problems with cage rearing.

Table 21. Equipment Management Schedule

Chicken age	Brooding temperature	Feeding space	Water space
1 day to 1 week	90-95 °F (32-35 °C)	1 feeder lid per 100 chicks or 1 inch (2.5 cm) per chick trough (remove at 10 days)	1 gal (3.8L) per 100 chicks (remove at 10 days)
1 week to 3 weeks	1 to 2 weeks 85-90 °F (29-32 °C) 2 to 3 weeks 80-84 °F (27-29 °C)	2 inches (5 cm) per chick (one side of trough) or 3 tube feeders per 100 chicks	0.3-0.4 inch (0.75-1 cm) per chick (one side of trough with automatic fill or several 1 gal [3.8 L] fountain waterers or equivalent)

continued on next page

Chicken age	Brooding temperature	Feeding space	Water space
4 to 9 weeks	3 to 4 weeks 75-80 °F (24-27 °C) 4 to 5 weeks 70-75 °F (21-24 °C) After 5 weeks 70 °F (21 °C) room temp	3 inches (7.5 cm) per bird (one side of trough) or 4 tube feeders per 100 birds	0.5 inch (1.25 cm) per bird (one side of trough) or Several 2- to 5-gal waterers
10 to 20 weeks	Comfort zone 55-75 °F (13-24 °C)	3 to 4 inches (7.5-10 cm) per bird (one side of trough) or 5 tube feeders per 100 birds	1 inch (2.5 cm) per bird (one side of trough) or Several 2- to 5-gal waterers
Layers	Comfort zone 55-75 °F (13-24 °C)	4 inches (10 cm) per bird (one side of trough) or 5 tube feeders per 100 birds (oyster shell or soluble grit feeders should be 12 inches [30 cm] per 100 birds)	1 inch (2.5 cm) per bird (one side of trough)

Feeding the Flock

Feed represents about two-thirds of the cost of raising a chicken. Commercial poultry farms use bulk feed programs in which a single delivery of 12 to 30 tons of commercial poultry feed is common. Such high-volume handling results in a relatively low cost per pound (or kilogram) of feed and explains why supermarket prices for poultry products are also relatively low.

The small flock owner deals in smaller quantities of feed—typically 50 or 100 pounds (22.5 or 45 kilograms)—and thus pays a higher cost per unit for feed.

Chickens must be fed an adequate diet for maximum productivity. Birds of different ages and utility have specific nutrient requirements, which are met by mixing together different feed ingredients. The scientific balancing of poultry rations is too complex for the home flock owner; therefore, commercial feed should be purchased, even if it seems expensive.

Table 22 outlines typical feeding programs for chickens of different ages and utility. When commercial programs differ from those outlined in the table, the commercial program should be followed. Use Table 22 only as a guide.

Commercial dealers usually have three different types of feed programs: all mash, mash and grain, and grain and supplement. Any of these feed-mixing methods are acceptable as long as the birds' nutrient needs are met. When part of the nutrient requirements for layers are expected to be met by whole grains, extra attention should be given to supplying adequate calcium.

All mash (crumble or pellet) feed is a complete ration and, when used, should be the only feed. Mash and grain feeds are formulated so that grain can be added to the mash. This feeding technique is useful for floor layers—feeding small amounts of grain in the litter causes the layers to scratch in the litter, thereby keeping it in better condition.

The grain and supplement program is convenient and economical for flock owners who have their own grain. When whole grains are provided it is recommended that a higher protein layer feed be used to ensure adequate nutrients to maintain high egg production.

Table 22. Typical Feeding Programs[a]

Layer	Layer replacement[b]	Capon[b]	Broiler[b]	Roaster[b]
20 weeks-production cycle Laying mash	0-6 weeks Starter	Same as layer replacement to 10 weeks.	0-3 weeks Starter 3-6 weeks Finisher 6 weeks-market Withdrawal	Same as broiler to 7 weeks of age.
May be fed all mash or mash-grain method.	6-13 weeks Grower or Pullet developer (15% protein)	Grower or Developer and grain prior to market. Grain gradually increased in diet up to 2 weeks prior to marketing.		Broiler Finisher and corn or whole grains until 2 weeks prior to marketing at 12-14 weeks. Insoluble grit may be fed if whole grain is used.
Free choice: Calcium (oyster shell or limestone) may be fed for good egg shells. Soluble grit may be fed if whole grain is used.	13-20 weeks Developer	Feed high protein mash, crumbles or pellets only during last 2 weeks.		

[a] This schedule should be used as a guide only. Commercial company programs may vary from the one proposed. Choose a company's feeding program and follow it.

[b] A suitable coccidiostat must be included in feed for young chickens (see poultry disease section). Read the feed tag or make sure your feed store provides a starter or grower with a coccidiostat.

Disease Management

It is important to consider several factors that relate to the quality and health of the flock once the type or breed has been chosen. Purchase stock only from reputable breeders or hatcheries. Stock purchased from magazine advertisements, especially bargain offers, can mean serious problems later. Stock should be purchased from pullorum/typhoid-clean flocks under the National Poultry Improvement Plan (NPIP). Pullorum/typhoid is a highly contagious disease. NPIP breeders, hatcheries, and facilities have been checked for proper management and sanitation and the absence of seriously diseased birds.

Diseases

Because of the similarity of many diseases, diagnosis should be left to a professional veterinarian. With an accurate diagnosis, proper treatment can be given to the flock. When there is an outbreak in the flock, take one or two birds showing typical symptoms to a diagnostic laboratory. When the diagnosis has been made, treat the disease under the direction of a professional veterinarian or with the advice of your county Extension agent or Extension specialist.

Respiratory diseases. Respiratory diseases affect the respiratory tract and are the most common diseases in chickens. Table 23 shows some of the common respiratory diseases; most can be prevented by vaccination.

Leukosis (Marek's). Leukosis, also called Marek's, is one of the most common killers of chickens of all ages. Birds with leukosis show many symptoms. Visceral leukosis results

in tumors on the liver and other organs; the bird becomes thin and dies. Another symptom, enlarged nerves, results in paralysis, with the bird eventually lying on its side unable to move. Gray eye is another form of leukosis, in which the iris shrinks, the eye turns gray, and the bird goes blind. Leukosis also can cause visibly enlarged bones.

Coccidiosis. Coccidiosis is the single most common cause of death in young birds. It is caused by single-celled coccidia that attack different parts of the intestinal tract, causing an irritation of the lining that prevents the absorption of food. In minor outbreaks, the birds are droopy, have ruffled feathers, and lose weight. Egg production in older birds declines. Severe cases result in hemorrhage and death. Practically all poultry house litter contains coccidia; it is important to keep litter dry and to purchase feed that contains a coccidiostat. Chickens kept in cages normally do not have problems with coccidiosis.

Table 23. Common Respiratory Diseases

Disease	Symptoms
Infectious bronchitis	Rapid spread; gasping; wet eyes; coughing; swollen sinuses; drop in egg production; misshapen eggs; rough- or soft-shelled eggs; watery egg whites; death
Newcastle	Rapid spread; gasping; rattling; loss of appetite; coughing; huddling; paralysis of legs; twisted neck (stargazer); walking backward; drop in egg production; soft or misshapen eggs; death
Laryngotracheitis	Slow spread; coughing; sneezing; sitting hunched on floor; emitting a cawing sound; coughing bloody mucus; nasal discharge; swollen head and wattles; drop in egg production; death
Fowl pox	Skin - White to yellow bumps on comb, face, or wattles turning to scabs Internal - Cankers in membranes of mouth, throat and windpipe; difficulty breathing; nasal or eye discharge
Coryza	Thick nasal discharge with odor; swollen sinuses; ruffled feathers; difficulty breathing
Mycoplasma	Difficulty breathing; ruffled feathers; nasal discharge; rattling; facial and nasal swelling; weakness; drop in egg production; swollen joints; yellowish feces
Cholera	Droopiness; difficulty breathing; loss of flesh; drop in egg production; purplish swollen head, comb, and wattles; paralysis

External parasites. External parasites cause losses if proper prevention and treatment procedures are not followed. Chickens should be checked once a week for signs, as shown in Table 24. Consult with your county Extension agent for procedures and chemicals for prevention and control. Follow directions on packages of chemicals.

Internal parasites. Internal parasites are worms found in the digestive and respiratory tract. Often insects, such as beetles, act as the intermediate host. Insects carry the worm eggs, which are deposited in the chicken after the chicken eats the insect. Common internal parasites are listed in Table 25. Chemicals for the prevention and treatment of internal parasites should be administered under the direction of a competent authority.

Other diseases. Other diseases are not as common and require a professional diagnosis. Moldy feed causes mycotoxins and losses. Chickens develop nutritional deficiencies if they are not given a well-balanced diet. Highly pathogenic transmissible diseases, such as Exotic Newcastle and Avian Influenza, can be avoided with proper management and biosecurity measures.

Table 24. Common External Parasites

External parasite	Symptoms
Chiggers	Red, pimple-like irritations
Lice	Large, yellowish, transparent insects on the skin; low weight; blackish discoloration (dirty) in the vent and tail area; drop in egg production
Mites	
Red (roost)	Loss of weight; red specks; death
Northern fowl	Red or black specks around vent; unthrifty; drop in egg production
Feather	Loss of feathers; webs irregular with only shafts left in some cases
Scaley leg	Enlarged shanks and toes with raised, crusty scales

Table 25. Common Internal Parasites

Internal parasite	Symptoms
Large roundworm	Long, yellow-white worms in intestine; droopiness; weight loss; diarrhea; death
Capillary worm	Hair-like worms in crop and upper intestine; droopiness; weight loss; death
Cecal worm	Short worms in the ceca; unthrifty; weak; loss of flesh
Tapeworm	Long, white, flat, segmented worms in intestine; unthrifty; slow growth; weakness
Gapeworm	Red, forked worms in trachea; gasping; coughing

Sanitation

Lack of cleanliness is often the cause of poultry disease. There are several sanitation measures that should be taken in a home chicken flock: 1) complete cleaning and disinfecting of house and equipment before starting baby chicks or housing layers; 2) daily cleaning of waterers; 3) screened manure pits under roosts, feeders, and waterers; 4) managing litter to keep it dry and clean; 5) incinerating, burying, or composting all dead chickens; 6) raising young stock away from adult chickens; 7) isolating the flock from outside traffic (chickens raised off the farm, neighbors, birds, dogs, etc.); 8) practicing good housekeeping and rodent control; and 9) disposing of litter and manure by spreading and plowing or spading the manure under soil. Manure and litter should be spread or stored in areas not used by poultry.

Biosecurity

Biosecurity includes management practices that prevent the entrance of germs and disease into the flock and into neighboring flocks. There are several biosecurity measures that must be taken: 1) purchase healthy stock; 2) keep your birds confined—do not let them run loose; 3) keep dirty equipment and materials from other flocks away from yours; 4) do not mix domestic birds with wild or caged birds, such as parrots and canaries; 5) medicate properly and follow directions; 6) keep unfamiliar people and others who might be carriers of disease away from your birds; 7) control vermin, such as rats and mice; 8) practice an insect-control program; and 9) keep pen areas weed- and debris-free and keep buildings in good repair. Rely on professionals, such as veterinarians, Extension agents, animal health suppliers (those who sell vaccines and medicines), and universities for educational materials and help.

Beak Trimming

Chickens are cannibalistic. The best way to control cannibalism is with beak trimming. The chicken's beak is just like a human fingernail; this procedure is not painful. If chicks are beak trimmed at 1 day old in the hatchery, and again once or twice before they reach 16 weeks, they probably will not develop the pecking habit.

With a knife or scissors, cut off at least one-third of the upper and one-eighth of the lower beak. Commercial equipment uses electricity to cut and cauterize the beak (sear the cut tip). Cauterizing can also be simulated with a hot iron after the beak is cut. If cauterizing is not possible, cut only the amount of beak that can be removed without severe bleeding, in most cases about one-fourth.

Home Processing

The quality of a ready-to-cook chicken is only as good as the live bird. When choosing chickens to be processed, look for healthy, well-finished chickens that are free of pinfeathers. Consider the weight and age that are desirable for your particular need.

For good flavor, it is essential that the chicken be well bled. One of the best methods of killing and bleeding is to cut the jugular vein (on each side of the neck). During this process, the chicken should be hung so it will not bump other objects or get soiled.

Immersing the chicken in hot water so that feathers are easily removed is called scalding. Scald water temperatures for broilers, roasters, and capons should be 128 to 130 °F (53 to 54 °C) and 155 to 160 °F (68 to 71 °C) for older chickens (spent layers, etc.). Scald for approximately 1½ minutes for adequate feather removal.

Remove the head, feet, and viscera. Wash the eviscerated chicken with clean water and chill it in ice water for several hours to reduce body heat. Chilling is necessary to produce a quality product and prevent spoilage. Add a teaspoon of chlorine bleach to each ten gallons of ice water for added protection.

Egg Handling

The egg is called nature's perfect package, but if it is soiled or broken, the package is of little value. A clean nest, ample nesting material, adequate space, and twice-a-day gathering (more often in hot weather) are the most important factors in producing sound, clean eggs. Once gathered, eggs should be refrigerated.

Poultry Product Sales

There may be times that you have a surplus of product and wish to sell it. Home flock products often command a premium price because of their quality and freshness. Become familiar with quality factors for meat and eggs before selling your product. Study educational materials on grading factors, packaging, storage, and marketing. Remember, you face the same risks in selling products as large producers do, and you want to ensure repeat sales to your customers.

Residues

Be sure that you do not sell products that contain residues of chemicals or drugs used on or around your home chicken flock. Residues are chemical compounds in meat or eggs. They are difficult to eradicate and can cause health problems in people who eat the products. The chemicals may have been in the flock's feed or water or come from pesticides or herbicides dusted or sprayed around birds or facilities. It is important to follow label instructions when using any chemicals around poultry. There is a withdrawal period for most drugs used in feed or drinking water; be aware of this period. Consult professionals when you have a question on the use of any chemical or drug product.

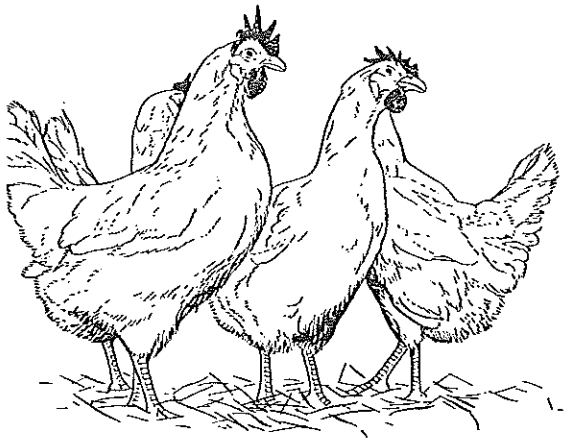
Exhibiting Poultry

Many small flock owners like to exhibit their birds at fairs or in poultry shows. You can enter commercial or purebred poultry in most fairs; poultry shows accept purebred poultry only. Purebred birds are shown by breed or class as identified in the American Poultry Association's *The American Standard of Perfection* or American Bantam Association's *The Bantam Standard*, which list the classes and descriptions for each breed and variety. A variety may be the shape, color, or comb type for a particular breed. Many breeds have several varieties. Selecting birds and carefully preparing for the fair or show are essential to providing a good exhibit and increasing your chances to receive a prize.

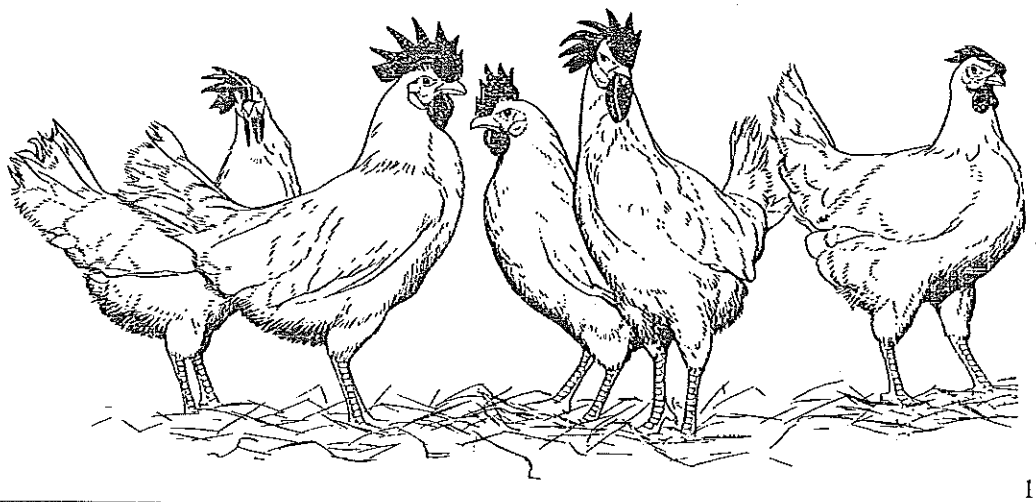
Conclusion

Raising a home chicken flock can be a good experience and a source of enjoyment. As a family project it teaches about living beings and responsibility. The home chicken flock also can be an excellent source of low-cost, high-quality poultry products. This chapter should provide the basic tools to start a successful flock.

Acknowlegments: Charles J. Wabeck, Extension Poultry and Food Products Specialist Lower Eastern Shore Research and Education Center, Princess Anne Facility



Fact Sheets



CONTRIBUTIONS OF POULTRY TO THE DEVELOPMENT OF SCIENCE

BACTERIOLOGY (study of bacteria)

Anthrax, an infectious disease which causes high fever and even death in affected animals, was a huge problem in livestock in the 1800's. Louis Pasteur (1822-1895) suggested that chickens did not get the disease because they have a high body temperature (41.5 °C). He injected a normal hen with anthrax bacteria and she lived. He injected another hen with anthrax bacteria and submerged her partially in water to lower her body temperature. The hen with the lowered body temperature died from anthrax.

Pasteur also worked with the disease known as fowl cholera. He found that if he cultured the bacterium that caused the disease (by growing it in a fluid especially prepared to nourish the cells) and gave a drop of culture to a chicken, the chicken would die. However, if he gave a drop of an OLD culture of the disease to a chicken, it exhibited a mild form of the disease and became immune (resistant) to the disease.

With this information, Pasteur was able to develop an attenuated virus vaccine against anthrax. Attenuated means that the strength of the disease-causing agent has been reduced by passing it either through animals other than the animal that normally contracts the disease or through culture. An example would be growing cattle plague bacteria in a chick embryo to make a vaccine that protected sheep from anthrax. This process also led to the work that developed vaccines against diseases such as tetanus and typhoid.

BEHAVIOR

T. Schjelderup-Ebbe (1894-1976) provided the first scientific observation of social behavior in animals in 1935. He described the ranking behavior or "peck order" that exists in a group of hens, documenting how one hen will always be dominant to all the other hens.

Konrad Lorenz (1903-1989) received the Nobel Prize for demonstrating imprinting with ducks. He showed that ducklings will identify as their parent the first object or person they see when they hatch.

BIOLOGICAL ASSAYS

It's often necessary to establish the vitamin content of various foods. A vitamin is a substance present in natural foods which is essential for good health. An animal may synthesize a vitamin in its own body; however, by definition the animal cannot make all of the vitamins it requires for good health. Since young chicks are very susceptible to vitamin deficiencies, they have been used as a biological check for chemical methods that measure the vitamin content of foods.

EMBRYOLOGY (study of formation and development of embryos)

Hieronymous Fabricius (1533-1619) pioneered the study of embryological development using the chick embryo.

ENDOCRINOLOGY (study of hormones and hormone-producing glands))

Arnold A. Berthold (1803-1861) has been called the father of endocrinolgy. In 1849, he removed the testes from one cock. The cock's comb became smaller and grew pale. When he transplanted testes into a capon (a castrated male), the bird again took on the appearance of a normal male. This was the typical sequence of events as long as the transplanted testes established a good blood supply. However, if a blood connection failed to form with the transplanted testes, the bird continued to lack the male appearance. This established the fact that the testes were producing some substance that traveled in the blood and gave the chicken its sex characteristics.

GENETICS

Johann Gregor Mendel (1822-1884), the Catholic monk known as the father of genetics, conducted his pioneering research on peas. In 1866, he described what was to become known as Medelian genetics. In 1898, William Bateson

(1861-1926), working with chickens, was the first to demonstrate that Mendel's laws applied to animals. Bateson found that both rose combs and pea combs were dominant to single combs.

GNOTOBIOTICS (study of organisms raised in germ-free conditions)

Louis Pasteur addressed the French Academy of Sciences in 1885 on the topic of "germ-free hosts." In order to study the influence of microflora (the microscopic and specialized organisms found in an animal's digestive tract) on its host, the scientist must also be able to study hosts that are germ-free. It's difficult to produce a germ-free mammal. Pasteur proposed that the chick was the most suitable model. If eggs are obtained from healthy hens, are incubated in a sterile incubator, and upon hatching are fed sterile food and water, they will be germ-free.

IMMUNOLOGY (study of mechanisms by which organisms resist and overcome infection and disease)

In 1956, Bruce Glick found that lymphocytes (a specific type of white blood cell) in the chicken's Bursa of Fabricius (the small, sack-like structure found in the cloaca of young birds) were responsible for antibody production. These lymphocytes became known as B-lymphocytes (B for bursa-derived).

VIROLOGY (study of viruses and viral diseases)

The first evidence that a virus could cause cancer came in 1911 when Francis Peyton Rous (1879-1970) discovered that the Rous sarcoma virus caused cancer in chickens. Rous won the Nobel Prize in 1966 for this work.

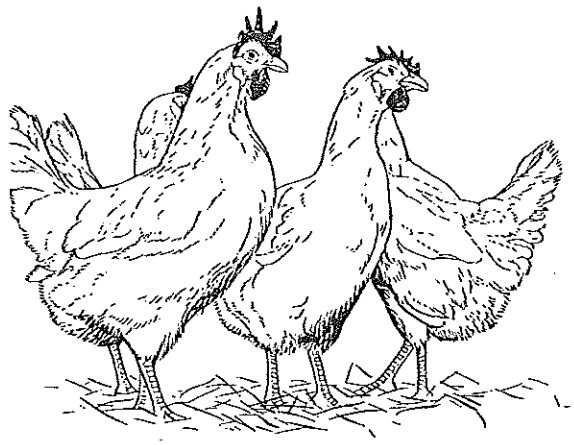
In 1969, A. Churchill developed a vaccine against the Marek's disease virus. This was the first control of a significant neoplastic (cancerous growth) disease in any species.

VITAMIN DISCOVERY

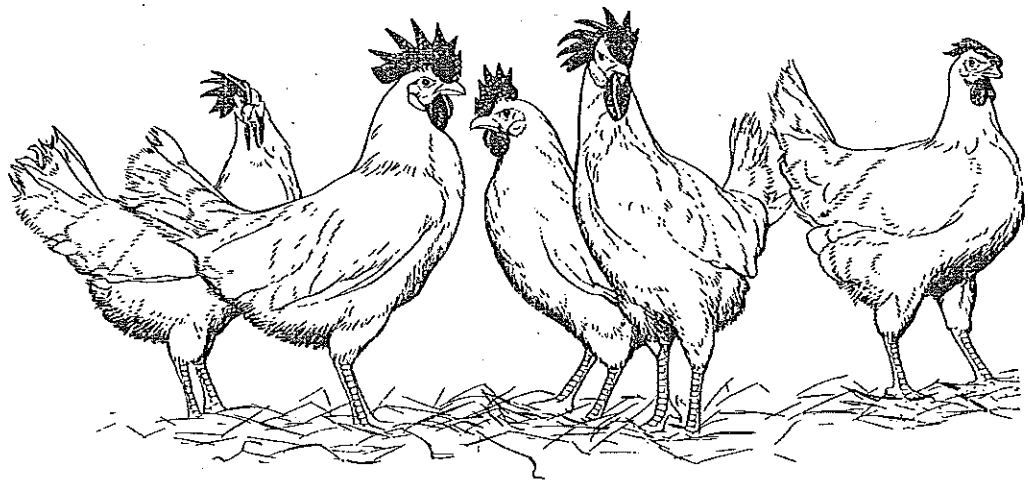
In 1897, Christian Eijkman (1858-1930), a Dutch physician working in Java, discovered that hens fed a diet of polished rice became paralyzed. The chickens' paralysis looked very much like the symptoms of human patients in the clinic where he worked. Humans were suffering from Beriberi (an impairment of the nerves and heart). When the birds were fed unpolished rice, they recovered. Eijkman's discovery paved the way for the whole concept of vitamins. The pioneering work of Dr. Eijkman culminated in the discovery and isolation of vitamin B1, or thiamine. This important compound was contained in the bran or outer layers of rice; the bran had been removed when the rice was polished.

In 1930, Henrik Dam (1895-1976) found that chicks fed diets very low in fat developed an illness that caused them to hemorrhage. The blood of these chicks did not clot as fast as the blood from chicks fed a normal diet. In 1935, Dam discovered that the substance needed for good blood clotting was a factor that was found in green leaves and certain vegetables. He called it the "Koagulations" vitamin; in his native Danish, "coagulation" is spelled with a "k." Therefore, the factor was named vitamin K.

Francine A. Bradley, Ph.D., Poultry Specialist,
Avian Sciences, University of California, Davis



Embryology



GLOSSARY

albumen - a combination of the four layers of a whitish watery substance with protein that surrounds and contains the yolk within the center of the egg shell.

allantois - an organ in the embryo of birds which functions as a respiratory organ in the developing embryo. Its blood vessels transport oxygen to the embryo and carry away the carbon dioxide.

amnion - a thin, membranous, fluid-filled sac surrounding the embryo.

avian - of, or pertaining to, Aves or birds.

bacteria - microscopic single-celled organisms.

blastoderm - the collective mass of cells produced by the splitting of a fertilized ovum from which the embryo develops.

blastodisc - the germinal spot on the ovum from which the blastoderm develops after the ovum is fertilized by the sperm.

brood - (*n.*) baby chicks hatched from one nest (setting) of eggs.
- (*v.*) care for baby chicks.

candling - observing the shell and the contents of the egg (blood vessels, embryonic development, blood or meat spots, air cell, etc.) through the shell by holding the egg up to a bright light that is focused on and behind the egg shell.

cell - a mass of protoplasm (usually microscopic) within a semi-permeable membrane, containing a nucleus, and capable of functioning as an independent unit.

chalazae - prolongations of the thick inner-white that are twisted like ropes at each end of the yolk. Their function is to anchor the yolk in the center of the egg shell cavity.

chorion - a membrane enveloping the embryo, external to and enclosing the amnion.

chromosomes - a series of paired bodies in the nucleus, constant in number in any one kind of plant or animal.

cloaca - in birds, the common chamber into which the intestinal, urinary and reproductive tract come together.

dorsal - of, on or near the back.

dry-bulb thermometer - expresses a temperature reading in number of degrees Fahrenheit (F) or centigrade/Celsius (C).

egg (avian) - the female reproductive cell (ovum) surrounded by a protective calcium shell and, if fertilized by the male reproductive cell (sperm) and properly incubated, capable of developing into a new individual.

egg tooth - also called "chicken tooth". The temporary horny cap on the chick's upper beak which serves for pipping (breaking through) the shell. Usually dries and falls off within 18 hours after chick hatches.

embryo - a fertilized egg at any stage of development prior to hatching. In its later stages, it clearly resembles the fully developed chick.

embryology - the study of the formation and development of plant and animal embryos.

evaporation - changing of moisture (liquid) into vapor (gas).

fat - organic combination of carbon, hydrogen, and oxygen in such relative quantities that the caloric value of the compound is high.

fertile - capable of reproducing.

fertilized - an ovum impregnated by a sperm.

follicle (ovarian) - the thin membrane of the ovary which encloses the developing yolk; the yolk sac.

gene - an element in the chromosome of the germ plasm that transmits hereditary characteristics.

hatching egg - a fertilized egg, one with the potential of maturing.

humidity - see "relative humidity".

incubate - to maintain favorable conditions for developing and hatching fertile eggs.

incubator - a container with the proper humidity and temperature to allow fertile eggs to hatch.

infundibulum - any of various hollow, conical organs or parts thereof.

membrane - a thin, soft, pliable sheet or layer of tissue covering an organ.

nutrient - food that contains substances necessary to sustain life and growth.

ovary - the female reproductive gland in which eggs are formed.

oviduct - the tube through which eggs pass after leaving the ovary.

ovum - the female reproductive cell.

papilla - any small, pimple-like or teat-like projection.

peristaltic action - involuntary movement of the muscles of the oviduct that forces the egg onward.

pipping - a baby chick breaking from its shell.

pores - thousands of minute opening in the shell of an egg through which gases are exchanged.

protein - one of a group of nitrogenous compounds commonly known as amino acids.

pituitary - a small, oval, two-lobed vascular body attached to the infundibulum of the brain that secretes hormones affecting growth.

relative humidity - the amount of moisture in the air compared with the amount that the air could contain at specific temperatures. Expressed as a percentage.

semen - secretion of the reproductive organs of the male; composed of spermatozoa, epithelial cells, secretions of seminal vesicle.

spermatozoa (pl.) - mature male germ cells, the specific output of the testes.

spermatozoon - one of the mature germ cells of the male.

still-air incubator - a container for hatching chicks that does not have mechanical ventilation.

system - functioning unit of the anatomy, such as the skeletal, muscular, glandular, respiratory and digestive systems.

testes - the male genital glands (plural).

testicle, testis - the male genital gland (singular).

vitamin - a fat- or water-soluble substance necessary, in very small amounts, to allow for normal growth and maintenance of life.

vitelline - of, pertaining to, or like, the yolk of an egg.

wet-bulb thermometer - a device to measure the amount of moisture or water vapor in the air.

yolk - a globular mass of yellow, nutritious semi-liquid contained in a transparent membrane (the vitelline membrane) and located in the center of an egg. The yolk is the chick's food during its pre-hatching life and its first food after it emerges from the shell.

Acknowledgments: Phillip Clauer, Extension Poultry Specialist, Pennsylvania State University