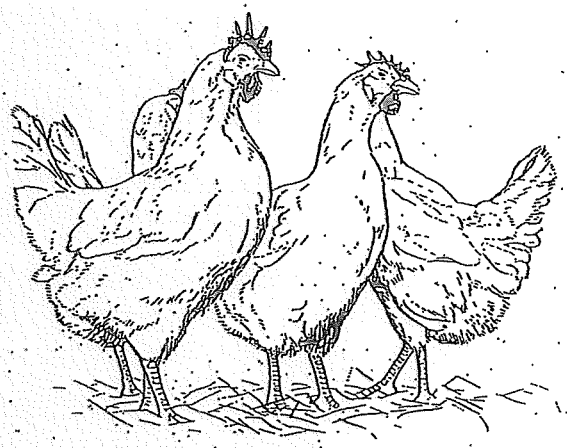
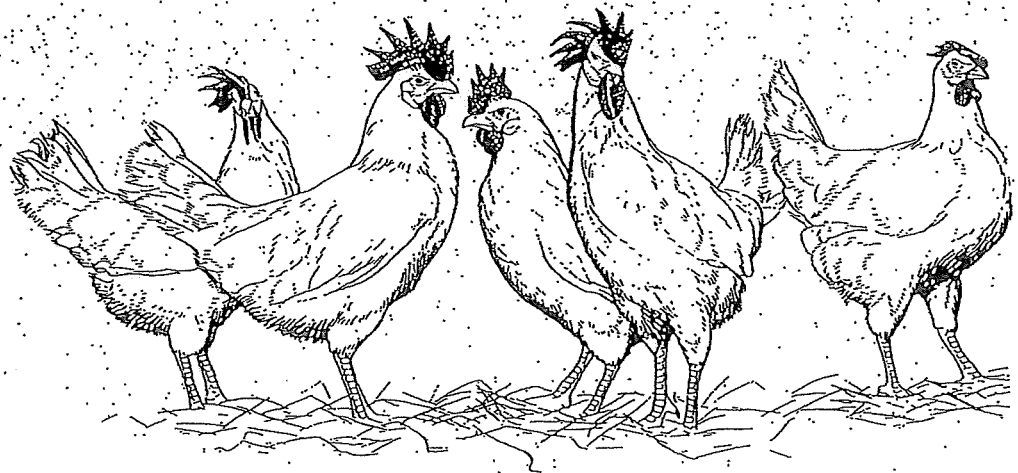


Prologue



Prologue to the Avian Bowl Manual

This would come after the cover and before the table of Contents.
Would have the page identification of "I."

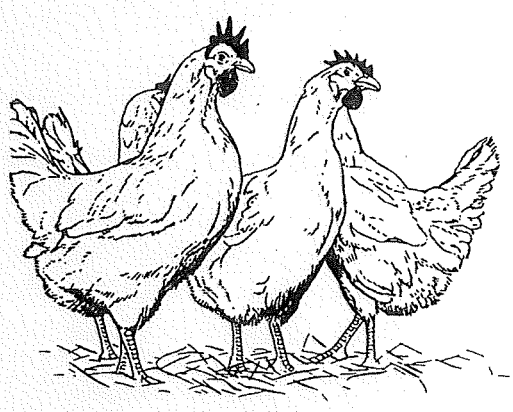
As you use the Avian Bowl Manual, and this applies to coaches, leaders, and Avian Bowl team members, it is important to understand its function. The Manual is an essential part of the mission of Avian Bowl. That is, encouraging youth to study the many aspects of avian sciences. For many readers, it may be a first exposure to certain topics: poultry diseases, egg cookery, and game bird production, to name just a few. While **questions and answers for the contest only come from the Manual**, the reader may certainly use the Manual as a starting point for exploring many other publications.

The bulk of the Manual is comprised of excellent publications from Land Grant Universities across the country. The field of avian sciences not only deals with birds, but the people who raise, enjoy, and utilize them in many different ways. As always, when humans are involved, philosophies, practices, and legislation change.

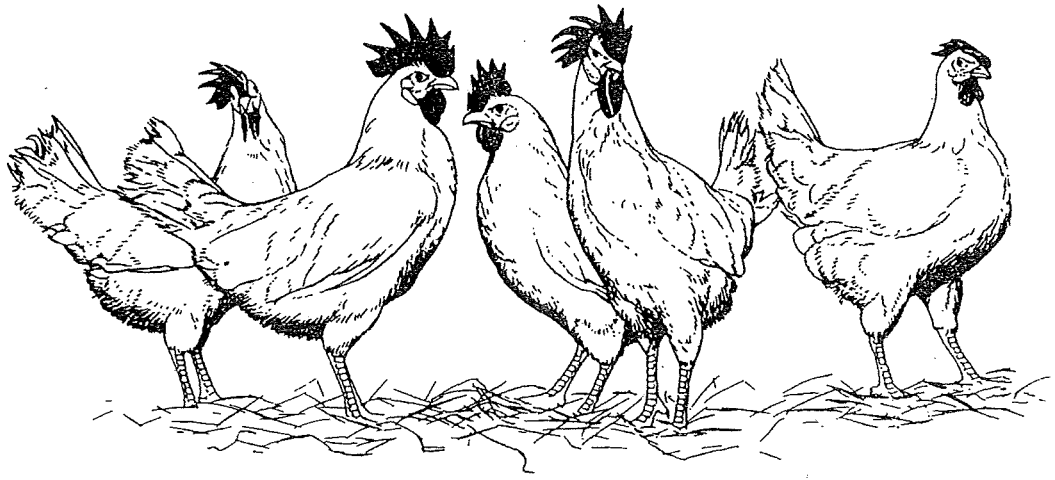
Do not be concerned that the text in Breeds, Varieties, and Strains section does not list every breed and or variety you know to be in The American Standard of Perfection. The American Poultry Association publishes this extensive book. As new editions are released, often new breeds and/or varieties are added, Therefore, readers of the Avian Bowl Manual are encouraged to consult the latest editions of the APA, as well as the American Bantam (ABA) Standards of Perfection. Poultry housing is another topic that is in flux. Some states and countries have moved from caged housing of layers to free range management, However, in times of a catastrophic disease threat, the free range operators may be told to place their birds in confined housing, for greater protection.

The Avian Bowl Manual is updated regularly. The short Fact Sheets in the Manual lend themselves to more frequent revisions and organizers update these, as needed.

While leaders may find the Manual to be a helpful source of information for club meetings, in no way is it intended to be a curriculum for the 4-H Poultry Project. To emphasize once again, think of the Manual as a passport to a much wider world of literature in avian and poultry sciences. Use it as your exclusive study guide for the contest, but let it entice you to visit other science-based information.



Avian Systems



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 106 °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 cell. 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)

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. Vetebra is singular, vertebrae is plural.

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.

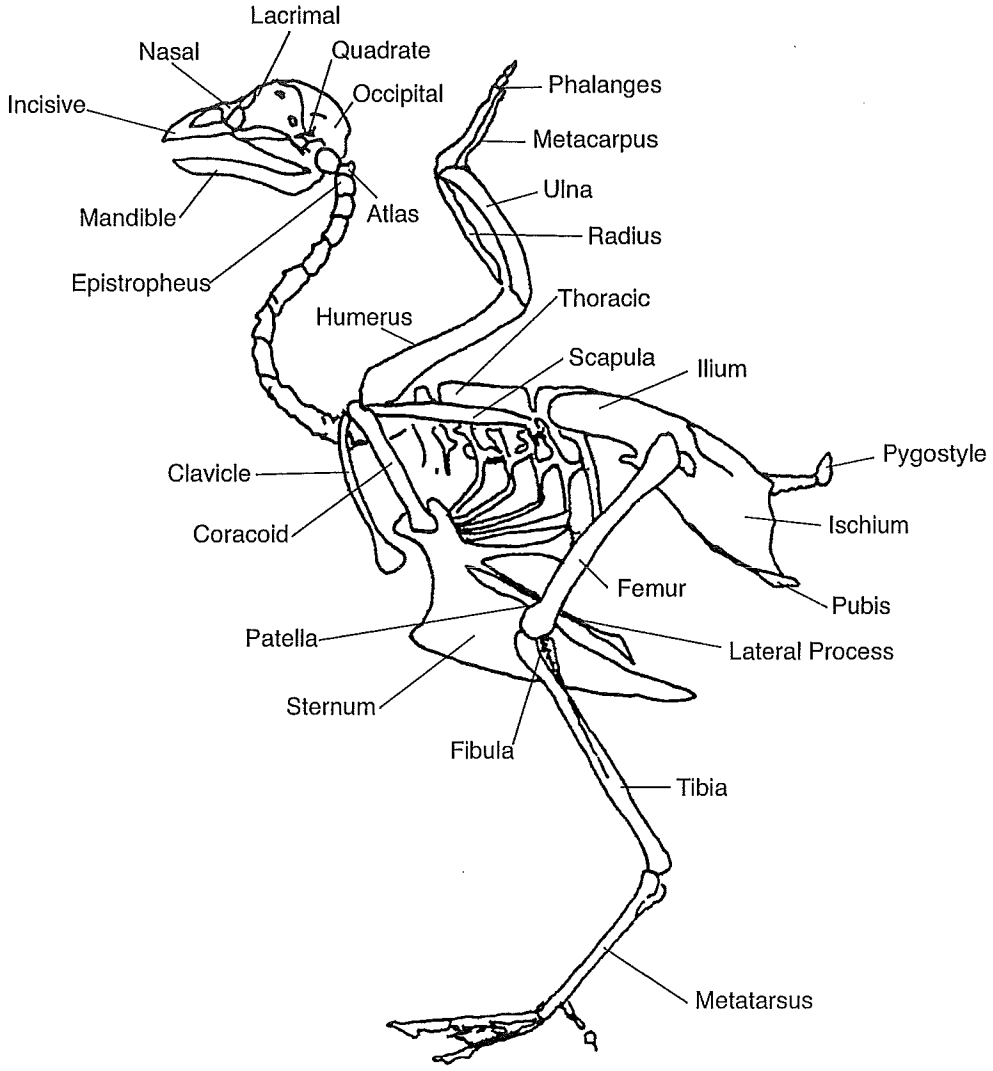
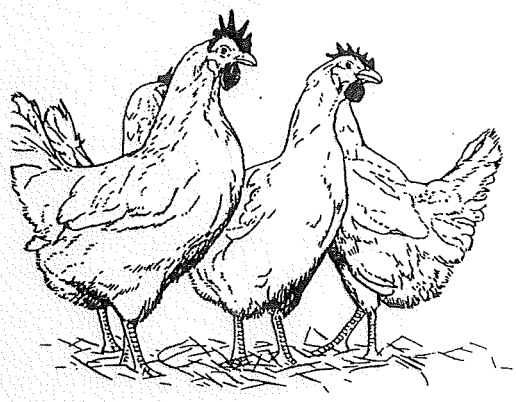
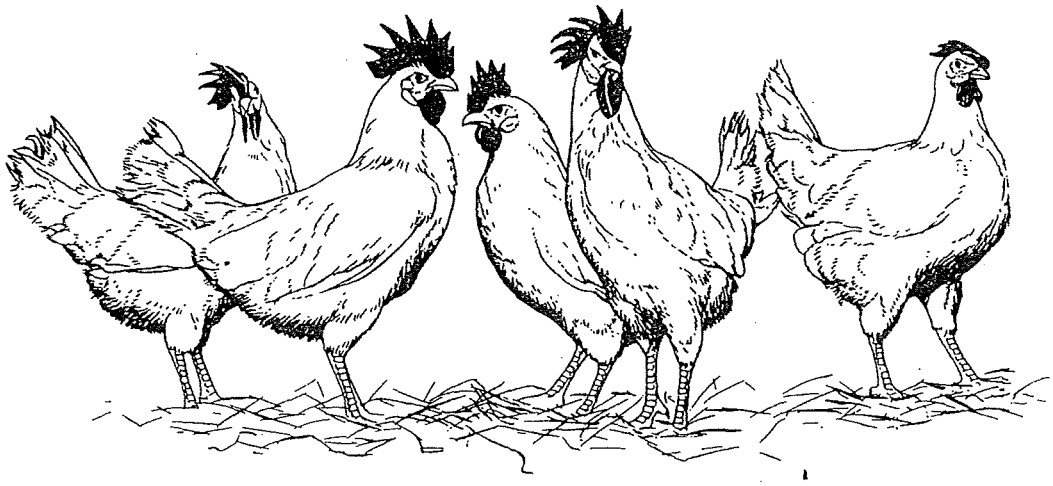


Figure 6. Skeletal System



Breeds, Varieties, and Strains



BREEDS, VARIETIES, AND STRAINS

This is a brief description of the breeds, varieties and strains of chickens and in no way takes the place of the American Poultry Association Standard or the American Bantam Standard.

Chickens exist in many colors, sizes, and shapes. There are more than 350 combinations of physical features. In order to be able to identify and classify each of these, we have established a system of designations known as classes, breeds, and varieties.

A class is a group of breeds originating in the same geographical area. The names themselves indicate the region where the breeds originated, such as Asiatic, Mediterranean, or American. The breeds of chickens in this chapter are arranged first according to their class, and then alphabetically by breed name within each class. Lesser known classes, breeds, and varieties are at the end of the text.

Breed means a group, each of which possesses a given set of physical features, such as body shape or type, skin color, carriage or station, number of toes, and feathered or non-feathered shanks. If such an individual is mated to one of its own kind, these features will be passed on to the offspring.

Variety means a sub-division of a breed. Differentiating characteristics include plumage color, comb type, or presence of a beard and muffs. Examples exist in almost all breeds. In Plymouth Rocks, there are several colors, including Barred, White, Buff, and Partridge. In each case the body shape and physical features should be identical. The color is the only difference and each of these colors is a separate variety. Another example is the Leghorn breed where most varieties exist in Single Comb and Rose Comb with all features other than comb type being identical.

Strains are families or breeding populations possessing common traits. They may be subdivisions of a breed or variety or may even be systematic crosses. However, a strain shows a relationship more exacting than that for others of similar appearance. Strains are the products of one person or one organization's breeding program. Many commercial strains exist. Such names as DeKalb, Hyline, Babcock, and Shaver are organizations that have bred specific strains of chickens for specific purposes.

Most of the breeds and varieties we know in the United States today were developed between 1875 and 1925. During that time the emphasis throughout the poultry world was on breeds and varieties. Success was measured in terms of the excellence of individual birds. As

The commercial egg and poultry meat industries developed, the emphasis changed from the individual bird to the average for the entire flock. This caused some breeders to adopt intensive selection programs based on the performance of certain outstanding families while others worked with breed crosses and crosses of strains within a given breed. Today the commercial poultry industry is based almost 100 percent on the strain approach. However, foundation breeders are constantly looking for additional material for gene pools. This must come from fanciers and hobbyists who maintain the various breeds for personal and aesthetic reasons rather than strictly for the production of meat and eggs.

The American Poultry Association issues a book called *The American Standard of Perfection*. This book contains a complete description of each of the more than 300 recognized breeds and varieties. Such things as size, shape, color, and physical features are described and illustrated in detail.

For more information on chicken breeds, consult *The American Standard of Perfection*, American Poultry Association, and *The Bantam Standard*, put out by the American Bantam Association.

BANTAMS

Bantams are the miniatures of the poultry world. The word bantam is the overall term for the more than 350 kinds of true breeding miniature chickens. They exist in almost every breed and variety that we see in large chickens. In addition, there are some kinds of bantams that have no large counterpart. The term "'Banty" or "Bantie" is often used to describe any nondescript, undersized chicken. This is misleading. Bantams are not unhealthy miniatures. They are raised

primarily for exhibition, a purpose for which they excel. The American Bantam Association issues a book of standards for bantams and licenses persons qualified to judge them at exhibitions.

Bantams have the same requirements for shape, color, and physical features as do the large fowl. They should weigh about one-fifth of their larger counterparts. They should be referred to by the name of their breed and variety plus the word bantam; for example Buff Cochin Bantams.

Bantams are kept for their beauty, for exhibition, or as pets or companion animals. Their wide array of shapes, colors, and personalities give Bantams broad appeal. However, they can be quite useful for the production of eggs, and their meat is fine-grained and nutritious. Often, bantams can be kept in areas too small for regular chickens. They are, in fact, the "compacts" of the poultry business.

AMERICAN CLASS

Jersey Giants

Varieties: Black, White.

Standard weights: Cock, 13 pounds; hen, 10 pounds; cockerel, 11 pounds; pullet, 8 pounds.

Skin color: Yellow.

Eggshell color: Brown.

Use: A very heavy meat-type fowl for heavy roaster and capon production. Fairly good layers. The dark-colored pigment from the shanks tends to move up into the edible portion of the carcass which has hurt the Jersey Giant in commercial circles.

Origin: Developed in New Jersey in the late 1800's, when there was a demand for heavy fowl for capon production, particularly for the New York market. Size was a prime consideration.

Characteristics: Jersey Giants are the largest breed in the American Class. They should be rugged, with an angular shape, single comb, and black (with yellowish tinge) shanks in the Black variety and dark willow shanks in the White variety. Jersey Giants will go broody but are not the best choice for incubating and brooding because of their size. Their tendency to grow a big frame first and cover it with meat later make them a poor fit for today's conditions. The meat yield is disappointing until they are 6 months or older. No fowl with black plumage or dark or willow shanks has ever remained popular in this country for long, although they used to be more widespread. However, good specimens do have an appeal, mainly because of their size.

New Hampshire Reds

Varieties: None.

Standard weights: Cock, $8^1/_2$ pounds; hen, $6^1/_2$ pounds; cockerel, $7^1/_2$ pounds; pullet, $5^1/_2$ pounds.

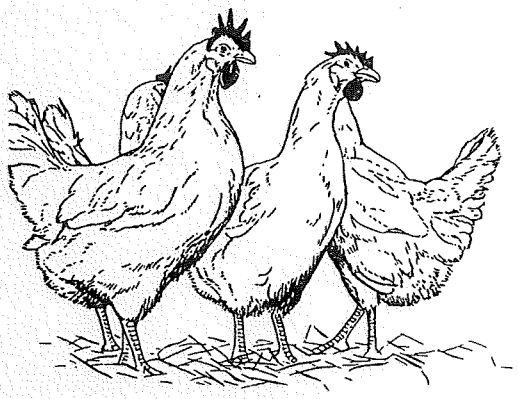
Skin color: Yellow.

Eggshell color: Brown.

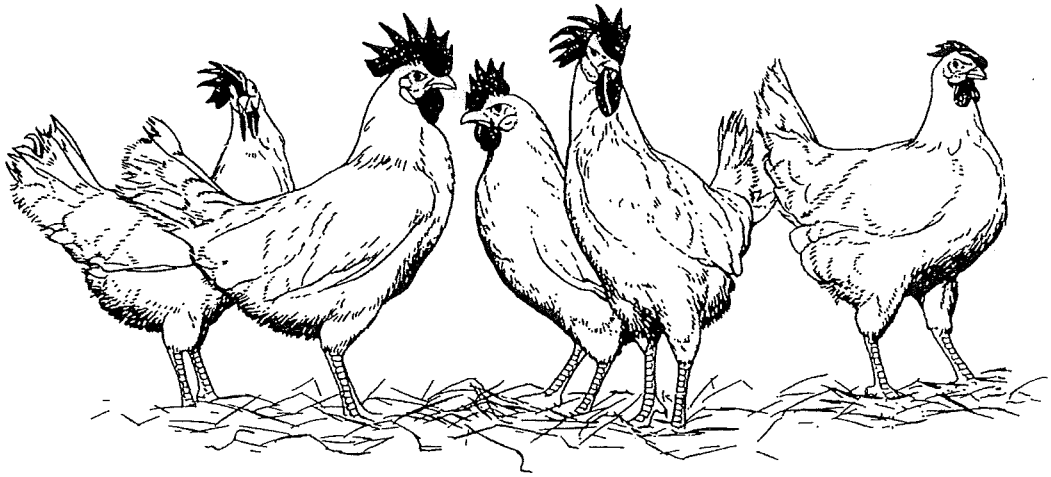
Use: A dual-purpose chicken, selected more for meat than egg production. Medium-heavy in weight, it dresses a nice, plump carcass as either a broiler or a roaster.

Origin: New Hampshires are a relatively new breed, having been admitted to the Standard in 1935. They represent a specialized selection out of the Rhode Island Red breed. By intensive selection for rapid growth, fast feathering, early maturity, and vigor, a different breed gradually emerged. This took place in the New England states, chiefly in Massachusetts and New Hampshire from which the breed takes its name.

Characteristics: They possess a deep, broad body, grow feathers vary rapidly, are prone to go broody, and make good mothers. Most pin feathers are a reddish buff in color and, therefore, do not detract from the carcass appearance very much. The color is a medium to light red and often fades in the sunshine. The comb is single and medium to large in size; in the females it often lops over a bit. These good, medium-sized meat chickens have fair egg-laying ability. Some strains lay eggs of a dark brown shell color. New Hampshires are competitive and aggressive. They were initially used in the "Chicken of Tomorrow" contests, which led the way for the modern broiler industry.



Eggcyclopedia



Eggs from A to Z

Exquisitely simple, yet enormously complex, the egg is one of nature's marvels. Within this section are facts and figures, definitions and diagrams, graphs and even a few giggles—all related to various aspects of the egg. From air cell to yolk with such diverse topics as games and mythology, cooking tips and nutrient content tucked in between, the information is arranged alphabetically by subject for ease of reference. We hope it adds to your understanding and enjoyment of the incredible edible egg.

Nutrient Density of the Egg

Percentage of Reference Daily Intake (RDI)*
Provided by One Large Egg

Vitamin A	6%
Thiamin	2%
Riboflavin	15%
Calcium	3%
Iron	4%
Vitamin D	6%
Vitamin E	3%
Vitamin B_6	4%
Folic Acid	6%
Vitamin B_{12}	8%
Sodium	3%
Potassium	2%
Phosphorus	9%
Magnesium	1%
Zinc	4%
Biotin	3%
Pantothenic Acid	6%

**Based on a 2,000-calorie diet. You may need more or less depending on your calorie needs.*

Aioli

Garlic mayonnaise popular in the Provence region of southern France. - *See Mayonnaise*

Air Cell

The air-filled pocket between the white and shell at the large end of the egg.

When an egg is newly laid, it is about 105°F (41°C) and has either no air cell or a very small one. As the egg cools, the liquid contents contract more than the shell and the inner shell membrane separates from the outer shell membrane to form the air cell. As the egg ages, moisture and carbon dioxide leave through the pores of the shell, air enters to replace them and the air cell becomes larger. The flattened end of a peeled, hard-boiled egg shows you where the air cell once was.

The formation of the air cell and the separation of the shell membranes are the reasons that a slightly older egg is easier to peel after hard-boiling. Storing eggs upright in their cartons in the refrigerator helps to keep their air cells in place and maintain egg quality. Although the air cell usually forms in the large end of the egg, it occasionally moves freely toward the uppermost point of the egg as the egg is rotated. It is then called a free or floating air cell. If the main air cell ruptures, resulting in one or more small separate air bubbles floating beneath the main air cell, it is known as a bubbly air cell.

Candlers use the size of the air cell as one basis for determining grade.

Albumen

Also known as egg white. Depending on the size of the egg, albumen accounts for most of an egg's liquid weight, about 66%. The white contains more than half the egg's total protein, a majority of the egg's niacin, riboflavin, magnesium, potassium, sodium, and none of the fat. The white of a large egg contains about 17 calories.

Albumen color is opalescent and doesn't appear white until an egg is beaten or cooked. The cloudy appearance comes from carbon dioxide. As eggs age, carbon dioxide escapes, so the albumen of older eggs is more transparent than that of fresher eggs.

The albumen consists of four alternating layers of thick and thin consistencies. From the yolk outward, they are designated as the inner thick or chalaziferous white, the inner thin white, the outer thick white and the outer thin white. As an egg ages, the egg white tends to thin out because its protein changes in character. That's why fresh eggs sit up tall and firm in the pan while older ones tend to spread out.

When you beat egg white vigorously, it foams and increases in volume six to eight times. Egg foams are essential for making meringues, puffy omelets, soufflés, angel food and sponge cakes.

– See Breakout; Chalazae; Color, White; Composition; Cooking Functions; Cooking Terms; Foam; Formation; Grading; Nutrient.

American Egg Board

American Egg Board (AEB) is the promotion (advertising, marketing communications), education and research organization for the U.S. egg industry. The Board is composed of 18 members and 18 alternates. All members are egg producers who have been appointed by the Secretary of Agriculture to administer the program on behalf of all egg producers in the 48 contiguous states.

The Board was authorized by the Egg Research and Consumer Information Act passed by the 93rd Congress. The purpose of the law is "to enable egg producers to establish, finance and carry out a coordinated program of research, producer and consumer education and promotion to improve, maintain and develop markets for eggs, and egg products." The activities of the AEB are conducted under the oversight of the U.S. Department of Agriculture (USDA).

The staff of the AEB implements the programs and policies of the Board. Major programs consist of a national advertising and public relations campaign, as well as egg product, foodservice and retail marketing outreach and nutrition education activities, which are conducted through the AEB-funded Egg Nutrition Center.

Angel Food Cake

A cake, tall and light in texture, leavened only by beaten egg whites. Visit www.IncredibleEgg.org for an Angel Food Cake recipe.

Angel Pie

- See Hard or Swiss Meringue

Antibiotic-Free Eggs

Antibiotics are not used on a continuous basis in the egg industry. If hens become ill and antibiotics are needed, they're used on a therapeutic level under the supervision of a veterinarian. If hens are given an antibiotic at this level, their egg production is likely severely depressed. Any eggs produced would be diverted from human consumption according to FDA regulations.

Avian Influenza

Avian influenza (AI), also referred to as bird flu, is a virus that infects all types of avian species, including wild birds and domestic poultry. AI is an animal health issue that causes mild to severe symptoms in birds and, in its most extreme form, can be fatal to infected birds. Pathogenicity refers to an organism's ability to cause disease. There are two types of AI associated with domestic poultry, high pathogenicity (HPAI) and low pathogenicity (LPAI). LPAI is common in many areas of the world, may cause mild symptoms in birds and poultry, and is of no risk to human health. HPAI is more serious and causes severe illness in birds and poultry. In egg-laying hens, symptoms include respiratory problems, decreased food intake and slowed or stopped egg production.

In addition to pathogenicity (HP and LP), AI is also classified by the proteins on the surface of the virus. These proteins are hemagglutinin (H proteins) and neuraminidase (N proteins). There are 16 H proteins and 9 N proteins, so 144 different virus combinations are possible. Only two H proteins, H5 and H7, have been found to cause HPAI. All other H proteins are only found in LPAI and cause mild bird illness. The virus strain that is most talked about worldwide is H5N1. This strain is commonly found in Asia and has caused illness in millions of birds and in hundreds of people who have been in very close contact with the secretions or execretion of sick birds. The spread of AI viruses from one person to another is extremely rare.

The U.S. egg industry, local animal health officials, and many federal government agencies, including U.S. Department A – B 5 of Agriculture (USDA) have had years of experience in dealing with and preventing AI in commercial poultry flocks as well as protecting the health of consumers. USDA and the egg industry are well equipped to identify AI outbreaks quickly and to eradicate them immediately. There are many levels of protection built into commercial egg production. Most importantly, veterinarians monitor flock health daily and quickly identify any problems. The combination of daily monitoring with a nationwide, routine AI testing program is very effective at detecting illness. During regular testing of domestic flocks, it's not unusual to occasionally find LPAI. Outbreaks of HPAI, however, are rare. As of March 2012, there have been only three outbreaks of HPAI in the U.S. in the last 100 years. All three outbreaks were quickly eradicated and no human illnesses occurred.

If an HPAI outbreak were to occur, USDA and the egg industry have plans in place to quarantine and monitor the affected flock and surrounding area, eradicate the disease, as well as disinfect the premises and test to make sure the farm/s are free from AI virus. Under current regulations, eggs from an HPAI-positive flock will be destroyed immediately.

Another level of protection is that proper cooking destroys all AI virus particles. The USDA, the Food and Drug Administration and the World Health Organization all agree that thoroughly cooked eggs are safe to eat. Cook basic egg recipes until whites are firm and yolks thicken. Cook or bake any dishes containing eggs until they reach an internal temperature of 160°F (71°C).

– See Cooking Methods, Doneness Guidelines, Egg Safety, Partnership for Food Safety Education, Raw Eggs

Avidin

A protein found in small amounts (about 0.05%, five one-hundredths of 1%) in egg white. Avidin is inactivated by heat.

– See Biotin

Bain Marie

– See Water Bath

Baked Eggs

– See Cooking Methods, Baked

Beak Trimming

The old phrase "pecking order" comes from the fact that chickens do peck at one another, sometimes inflicting considerable injury and even death. To prevent this, the majority of commercial egg farms trim beaks when chicks are 10 days old or younger, when there is little stress, a practice supported by the scientific community. The process is similar to clipping a dog's nails or trimming a horse's hooves. Of course, chicks and hens with trimmed beaks can still eat and drink. Research has shown that mortality in flocks that are not beak-trimmed is considerably higher than in flocks that are beak-trimmed.

Bearnaise

– See Hollandaise Sauce

Beverages

You can make many beverages with eggs. When recipes call for raw eggs, to eliminate risk and ensure food safety, eggs need to be heated to 160°F (71°C) or use pasteurized shell eggs or egg products. Eggnog, for example, is a well-known beverage made from eggs and milk. Visit www. IncredibleEgg.org for an eggnog recipe.

– See Doneness Guidelines, Eggnog, Egg Safety, Raw Eggs

Biological Value

A measurement of protein quality expressing the rate of efficiency with which protein is used for growth.

The egg is a complete protein food because egg protein has all nine of the essential amino acids (as well as all nine of the non-essential amino acids). Scientists often use egg protein as the standard against which they judge all other proteins. Based on the essential amino acids it provides, egg protein is second only to mother's milk for human nutrition. A large egg contains 6.29 grams of high-quality protein, about 12.6% of the Daily Reference Value (DRV) for protein.

– See Nutrient, Protein

Biological Values of Protein

On a scale, with 100 representing top efficiency, these are the biological values of proteins in several foods.

Whole egg	93.7
Milk	84.5
Fish	76.0
Beef	74.3
Soybeans	72.8
Rice, polished	64.0
Wheat, whole	64.0
Corn	60.0
Beans, dry	58.0

Source: Food and Agriculture Organization of the United Nations. The Amino Acid Content of Foods and Biological Data on Proteins, Nutritional Study #24. Rome (1970).

Biotin

One of the B vitamins which plays an important role in cell metabolism and the utilization of fats, proteins and carbohydrates. Biotin is present in many foods, including egg yolk, and is synthesized by the body.

Avidin, one of the egg proteins, can combine with biotin and make biotin unavailable. However, a human would have to eat 24 raw egg whites a day for biotin to be inhibited by avidin. Heat inactivates the avidin, so biotin is not inhibited in cooked eggs. – *See Avidin*

Bird Flu

– See Avian Influenza B 7

Blood Spots

Occasionally found on an egg yolk. These tiny spots do not indicate a fertilized egg. Instead, they are caused by the rupture of a blood vessel on the yolk surface during formation of the egg or by a similar accident in the wall of the oviduct.

Mass candling methods reveal most eggs with blood spots and those eggs are removed. However, even with mass scanners, it's impossible to catch them all.

Both chemically and nutritionally, eggs with blood spots are safe to eat. You can remove the spot with the tip of a knife, if you wish.

– See Formation, Grading

Bloom

Also known as the cuticle, bloom is the natural coating or covering on the eggshell that seals the eggshell pores. The bloom helps to prevent bacteria from getting inside the shell and reduces moisture loss from the egg. In nature, the bloom dries and flakes off. Before they are sent to market, eggs are washed and sanitized, removing the bloom. About 10% of egg packers give eggs a light coating of edible mineral oil to restore the bloom.

– *See Cuticle, Oiling, Production*

"Blown Out" Eggshells

Shells from which the edible part of the egg has been emptied. With nothing inside to spoil, you can decorate empty eggshells and keep them indefinitely.

– *See Empty Eggshells*

Boiled Frosting

– *See Italian Meringue*

Bread Pudding

A simple, sweetened custard that is poured over pieces of bread, fruit, nuts or other flavorings and then baked. This classic dessert can be served hot or cold, sometimes with heavy cream or a dessert sauce. A savory version is called a strata.

Breakers

Processors who convert shell eggs into egg products. Breaking plants are under strict U.S. Department of Agriculture inspection by USDA's Food Safety and Inspection Service. Breaking plants use a fascinating array of modern equipment to break eggs and separate the shell, white and yolk.

– *See Egg Products*

Breakout

A quality-control measure to supplement the grading process. The following criteria have been set by the U.S. Department of Agriculture (USDA) to judge egg quality. Sample eggs are selected at random and broken out onto a level surface. The height of the thick albumen (white) is measured with a tripod micrometer and this measurement is correlated with the weight of the egg to give a Haugh unit measurement. A high Haugh value means high egg quality. At the same time, the condition of the yolk is observed. The foodservice industry also uses a breakout test to evaluate the quality of eggs purchased. Simple observations of the condition of albumen (white) and yolk are considered adequate; generally the Haugh unit system is not used.

– *See Grading, Haugh Unit*

Grade AA: Egg content covers a small area. White is firm, has much thick white surrounding the yolk and a small amount of thin white. The yolk is round and upstanding.

Grade A: Egg content covers a moderate area. White is reasonably firm and has a considerable amount of thick white and a medium amount of thin white. The yolk is round and upstanding.

Grade B: Egg content covers a very wide area. White is weak and watery, has no thick white and the large amount of thin white is thinly spread. The yolk is enlarged and flattened.

Brown Eggs

– *See Color Shell*

Buying

Look for shells that are clean and whole. Cracked eggs are always removed from production, but some may be broken in handling. Don't use an egg if it's cracked or leaking.

Proper handling and refrigeration are important factors in maintaining egg quality. Eggs lose quality very rapidly at room temperature, so buy eggs only from refrigerated cases, get them home quickly and refrigerate

immediately. At temperatures of 35° to 45°F (2° to 7°C), you can store eggs with insignificant quality loss for three to five weeks after you bring them home.

Eggs are marketed according to grade and size standards established by the U.S. Department of Agriculture (USDA) or by state departments of agriculture. The USDA shield on the egg carton means that the eggs have been graded by U.S. or state department of agriculture representatives for consistency with USDA's standards for the voluntary grading of shell eggs.

Some egg packers may follow state standards, which must meet or exceed USDA standards. Some states have state seal programs which indicate that the eggs are produced within that state and are subject to continuing state quality checks. All eggs sold at the retail level must meet the standards for Grade B or better.

Size and grade are two entirely different factors and bear no relationship to one another. Grade is determined by the interior and exterior quality of the egg at the time the egg is packed. Size is determined by the average weight per dozen.

Grades (Buying)

Egg grades are labeled AA, A and B. There is no difference in nutritive value between the different grades. All eggs sold at the retail level must meet the standards for Grade B or better. Most eggs sold in supermarkets today are Grade AA or A. Although Grade B eggs are just as wholesome to eat, they rate lower in appearance when broken out. Few Grade B eggs find their way to the retail supermarket. Most go to institutional egg users such as bakeries or foodservice operations.

– See Breakout, Grading

Sizes (Buying)

Eggs are classified as jumbo, extra large, large, medium, small and peewee. The most common sizes available are medium, large and extra large, because hens most often lay eggs of these sizes. Sizes are classified according to minimum net weight expressed in ounces per dozen.

Egg Weight

Egg Size	Oz. Per Dozen
Jumbo	30
Extra Large	27
Large	24
Medium	21
Small	18
Peewe	15

Source: U. S. Department of Agriculture (USDA) http://www.fsis.usda.gov/Fact-sheets/Focus_On_Shell_Eggs/index.asp#17

Which Size to Buy (Buying)

You can use any size egg for most basic egg recipes, including scrambled or fried eggs. However, most recipes for baked goods are formulas in which it's important to maintain the proper proportion of liquid to dry ingredients and to have enough whole egg, white or yolk to perform the needed functions. Most baking recipes are based on large-sized eggs. (To substitute one size egg for another in recipes, see Size Equivalents.) Most of the eggs sold in supermarkets are large-sized, but there are occasionally specials on other sizes. Use the following chart to find which size is the best buy. To compare the price of large eggs to the price of medium eggs, for example, run your fingers down the columns to the figures closest to the prices per dozen for large and medium eggs. Then, go across to the price per pound for each size. The one selling for the lower price per pound is the better buy. Always compare the same grade of eggs for an accurate price comparison. -- See Grading, Size Equivalents

Inexpensive Egg Protein (Buying)

Protein is an essential part of a nutritious diet but, for many people, foods that supply protein are some of the most expensive items on the grocery list.

Fortunately, the protein supplied by eggs is both high in quality and low in cost. It's easy to compare the price of eggs to the price of other protein foods. A dozen large eggs weigh 1 1/2 pounds, so the price per pound of large eggs is two-thirds of the price per dozen. For example, if large eggs cost $1.45 per dozen, they cost 97¢ per pound. At $1.75 per dozen, large eggs are only $1.17 per pound. Another helpful formula is that one egg equals one ounce of lean meat, poultry or fish. This means that you can use two eggs as your main dish at a meal or you can use eggs to "stretch" more expensive protein foods. For instance, you might use one chopped hardboiled egg per serving along with half the usual amount per serving of expensive seafood in a dish.

– See Meat Replacement, Protein

Price Comparison Which size is the best buy?					
Small (18 oz)	Medium (21 oz)	Large (24 oz)	Extra-Large (27 oz)	Jumbo (30 oz)	PRICE/POUND (16 oz)
.68	.79	.90	1.01	1.13	.60
.75	.88	1.00	1.13	1.25	.665
.83	.96	1.10	1.24	1.38	.73
.90	1.05	1.20	1.35	1.50	.80
.98	1.14	1.30	1.46	1.63	.865
1.05	1.23	1.40	1.58	1.75	.93
1.13	1.31	1.50	1.68	1.88	1.00
1.20	1.40	1.60	1.80	2.00	1.065
1.28	1.49	1.70	1.91	2.13	1.13
1.35	1.58	1.80	2.03	2.25	1.20
1.43	1.66	1.90	2.14	2.38	1.265
1.50	1.75	2.00	2.25	2.50	1.335
1.58	1.84	2.10	2.36	2.63	1.40
1.65	1.93	2.20	2.48	2.75	1.465
1.73	2.01	2.30	2.59	2.88	1.53
1.80	2.10	2.40	2.70	3.00	1.60
1.88	2.19	2.50	2.81	3.13	1.665
1.95	2.28	2.60	2.93	3.25	1.73
2.03	2.36	2.70	3.04	3.38	1.80
2.10	2.45	2.80	3.15	3.50	1.865
2.18	2.54	2.90	3.26	3.63	1.93
2.25	2.63	3.00	3.38	3.75	2.00
2.33	2.71	3.10	3.49	3.88	2.065
2.40	2.80	3.20	3.60	4.00	2.13
2.48	2.89	3.30	3.71	4.13	2.20
2.55	2.98	3.40	3.83	4.25	2.265
2.63	3.06	3.50	3.94	4.38	2.33
2.70	3.15	3.60	4.05	4.50	2.40
2.78	3.24	3.70	4.16	4.63	2.465
2.85	3.33	3.80	4.28	4.75	2.53

Source: American Egg Board

Calcium

The major role of the mineral calcium is in building and maintaining bones and teeth. Calcium is also essential for many other body functions related to the blood, nerves and muscles. One large egg provides 28 milligrams (mg) of calcium, 2.6% of the Daily Reference Value (DRV) for calcium, most of which is in the yolk. An eggshell is composed largely of calcium carbonate (about 94%) along with small percentages of magnesium carbonate and calcium phosphate and, in total, contains about 2 grams of calcium.

– See Daily Value, Daily Reference Values (DRVs), Nutrient, Shell

Calories

The calorie count for eggs varies with size.

– *See Nutrient, Reference Daily Intakes (RDIs)*

Egg Calories

Egg Sizes	Calories Per Egg
Small	54
Medium	63
Large	72
Extra large	80
Jumbo	90

Source: U.S. Department of Agriculture, Agricultural Research Service. 2004. USDA National Nutrient Database for Standard Reference, Release 17. Nutrient Data Laboratory Home Page, http://www.ars.usda.gov/nutrientdata

Candling

The step in grading during which the egg grader looks inside the egg (without breaking it) to judge quality. Long ago, this quality check was done by holding a candle behind an egg. Some hand-candling, using electric equipment, is still used for spotchecking or for training egg graders, but today most eggs pass on rollers over high-intensity lights, which make the interior of the egg visible. The eggs are rotated so all parts are visible. The candler checks the size of the air cell and the distinctness of the yolk outline. Imperfections such as blood spots show up in candling. Very large packing plants may also use electronic blood and/or check detectors to sort and remove eggs exhibiting these defects.

– *See Air Cell, Blood Spots, Grading*

Carotenoids

Antioxidants

– *See Xanthophylls, Lutein and Zeaxanthin*

Carton Dates

Egg cartons from plants producing USDA-graded eggs must display a Julian date – the date the eggs were packed. Although not required, egg cartons may also carry an expiration (sell-by) date and/or a best-by (use-by) date. On USDA grade-shielded egg cartons, if an expiration date appears, it can be no more than 30 days after the pack date. It may be less through the choice of the packer or quantity purchaser, such as your local supermarket chain. On USDA grade-shielded egg cartons, if a best-by (use-by) date appears, it can be no more than 45 days after the pack date. Eggs that are not packed under USDA's grading program must be labeled and coded in accordance with egg laws in the state where they are packed and/or sold. Most states require the use of a Julian date.

– *See Julian Dates, Expiration Date*

Cephalin

A phospholipid found in nerve tissues, including the white matter of the brain and spinal cord. One large egg contains 0.23 gram of cephalin.

– *See Nutrient*

Chalazae (kuh-LAY-zah)

Ropey strands of egg white which anchor the yolk in place in the center of the thick white. Chalazae are neither imperfections nor beginning embryos. The more prominent the chalazae, the fresher the egg. Chalazae don't interfere with the cooking or beating of the white and you don't need to remove them, although some cooks like to strain them from stirred custard.

– *See Composition*

Chantilly Meringue

– *See Italian Meringue*

Chinese Eggs

– *See Preservation*

Cholesterol

A fat-like substance found in every living cell in your body. Cholesterol is made in necessary amounts by your body and is stored in your body. Cholesterol is especially concentrated in your liver, kidney, adrenal glands and brain. Cholesterol insulates nerve fibers and must be available for your body to produce vitamin D.

Cholesterol is also required for the structure of cell walls, is essential to the production of digestive juices and is the basic building block for many hormones. Cholesterol is essential for life.

While your body produces cholesterol, dietary sources also can contribute to blood cholesterol levels. Research shows that a diet high in saturated fat, trans-fatty acids and excess calories contributes to increased levels of cholesterol in your blood.

Dietary cholesterol, found in all foods from animals, does not automatically raise your blood cholesterol levels. Your body usually compensates for dietary cholesterol by synthesizing smaller amounts in the liver, by excreting more or by absorbing less.

Elevated blood cholesterol levels do increase the risk of heart disease. You should know your blood cholesterol levels and, if they are elevated, follow your doctor's advice. In a blood cholesterol-lowering diet, research shows that the most important change you can make is to limit saturated fats and trans-fatty acids. Including fats – such as monounsaturated and polyunsaturated fats and omega-3 fatty acids – also may help improve blood cholesterol levels. A wealth of research has shown that eggs do not have a significant impact on blood cholesterol levels, so it's not necessary to avoid egg yolks, as part of an overall healthful diet. You can use egg whites freely.

One large egg contains 186 milligrams (mg) of cholesterol. Regardless of the color of the eggs, the hen's housing system, or whether the eggs are fertilized, the cholesterol content is the same unless the feed was altered, in which case a claim will appear on the carton. Cooking does not affect the cholesterol content of eggs.

– *See Fat*

Choline

Choline is essential for the normal functioning of all cells in your body and assures the structural development and signaling functions of cell membranes. Choline is made by your body but needed in larger amounts during pregnancy and lactation. When consumed during pregnancy, choline may be a key factor in the development of infants' memory functions and, later in life, choline may improve memory capacity. Animal studies have shown that a mother's insufficient choline production and intake during pregnancy can cause either defective memory or lower memory capabilities that last throughout life. Research shows that choline supplementation during fetal development enhances memory function. Egg yolks are an important source of choline (126 mg per large egg yolk) and provide 28% of a pregnant woman's daily needs (450 mg).

Choux Pastry

– *See Cream Puff*

Cleaning

Washing eggs to remove any dirt or stains. In modern laying houses, eggs are gathered shortly after they're laid and moved to automated washing equipment. Strict federal regulations specify the procedures and cleaning compounds that may be used. Today most eggs are cleaned in mechanical egg washers employing sprayers, brushes, detergent-sanitizers, rinses and driers. Only clean eggs go to the market.

In washing, the bloom is removed. About 10% of egg packers apply an edible mineral oil to replace it.

– *See Bloom, Oiling, Production*

Coddled Egg

1. An egg cooked in a coddler.

– *See Cooking Equipment, Coddler*

2. A less frequently used term for eggs cooked-in-the-shell for a very brief time.

Cold Storage

The practice of holding eggs in refrigerated warehouses. Commercial cold storage of eggs began in the U.S. in 1890. Because egg production was seasonal then, spring and summer eggs could be held in cold storage for release during periods of relative scarcity in autumn and winter. This practice helped avoid drastic price fluctuations.

Modern breeding and flock management have virtually eliminated seasonal differences in egg production so that cold storage is neither necessary nor practical. Thanks to rapid handling methods and efficient transportation, most eggs reach the supermarket warehouse within a few days of being laid.

– *See Preservation, Storing*

Color

Egg shell and yolk color may vary. Color has no relationship to egg quality, flavor, nutritive value, cooking characteristics or shell thickness.

Shell (Color)

Shell color comes from pigments in the outer layer of the shell and, in eggs from various commercial breeds, may range from white to deep brown. The breed of hen determines the color of the shell. Among commercial breeds, hens with white feathers and ear lobes lay white-shelled eggs; hens with red feathers and ear lobes lay brown eggs.

White eggs are most in demand among American buyers. In some parts of the country, however, particularly in New England, brown shells are preferred. Commercial brown-egg layers are hens derived from the Rhode Island Red, New Hampshire and Plymouth Rock breeds. Since brown-egg layers are slightly larger birds and require more food, brown eggs are usually more expensive than white.

White (Albumen)

Egg albumen in raw eggs is opalescent and doesn't appear white until you beat or cook it.

Yolk

Yolk color depends on the hen's diet. If a hen consumes plenty of yellow-orange plant pigments called xanthophylls, the xanthophylls will be deposited in the egg yolk. Hens fed mashes containing yellow corn or alfalfa meal lay eggs with medium-yellow yolks, while those eating wheat or barley yield lightercolored yolks. A colorless diet, such as white cornmeal, produces almost colorless yolks. Natural yellow-orange substances, such as marigold petals, may be added to light-colored feeds to enhance yolk color. Artificial color additives are not permitted. Gold or lemon-colored yolks are the most common. Yolk pigments are relatively stable and are not lost or changed in cooking. A **green** ring around hard-boiled egg yolks is the result of sulfur and iron compounds in the egg reacting at the surface of the yolk. The greenish color may occur when you cook eggs for too long or at too high a temperature or when there is a high amount of iron in the cooking water. Although the color may be unappealing, eggs with green rings are still wholesome and nutritious and have a normal flavor. The best ways to avoid greenish yolks are to use the proper cooking time and temperature and to rapidly cool the cooked eggs.

– *See Cooking Methods, Hard-Boiled*

Sometimes a large batch of scrambled eggs turns green. Although not pretty, the color change is harmless. Just as in hardboiled eggs, the green color is the result of heat causing a chemical reaction between the eggs' iron and sulfur. The green color occurs when you cook eggs at too high a temperature, hold them for too long, or both. To prevent the coloring, use stainless steel equipment and a low cooking temperature, cook the eggs in small batches and serve them as soon as possible after cooking. If it's necessary to hold scrambled eggs for a short time before serving, it helps to avoid direct heat. Place a pan of hot water between the pan of eggs and the heat source.

Occasionally several concentric green rings appear in hard-boiled egg yolks. A yolk develops within the hen in rings. As the rings are formed, iron in the hen's feed or water may cause the green coloring.

Complete Protein

- *See Protein*

Composition

Shell

- Outer covering of egg, composed largely of calcium carbonate
- May be white, brown or even blue-green depending on breed of chicken
- Color does not affect egg quality, flavor, cooking characteristics, nutritive value or shell thickness

Yolk

- Yellow portion of egg
- Color varies with feed of the hen, but doesn't indicate nutritive content
- Major source of egg vitamins, minerals and fat and about half of the protein
- Germinal Disc

Vitelline (Yolk) Membrane
- Clear seal which holds yolk

Chalazae
- Twisted, cord-like strands of egg white
- Anchor yolk in center of egg
- Prominent chalazae indicate freshness

Air Cell
- Pocket of air formed at large end of egg
- Caused by contraction of the contents during cooling after laying
- Increases in size as egg ages

Shell Membranes
- Two membranes - inner and outer shell membranes - surround the albumen
- Provide protective barrier against bacterial penetration
- Air cell forms between these two membranes

Thin Albumen (White)
- Nearest to the shell
- Spreads around thick white of high-quality egg

Thick Albumen (White)
- Major source of egg riboflavin and protein
- Stands higher and spreads less than thin white in higher-grade eggs
- Thins and becomes indistinguishable from thin white in lower-grade eggs

Cooking Equipment

It's easy to cook eggs with no special kitchen equipment. For example, you don't need to have a double boiler to cook egg sauces and custards. Simply use a heavy-gauge saucepan over low heat. However, there are some pieces of kitchen equipment designed especially for preparing eggs. Some of these items – such as an electric egg cooker – are limited to egg use only, while others – such as custard cups – come in handy for a variety of foods.

As a rule, on top of the range, cooking is more even in heavy-gauge pots and pans. Baking dishes and pans of the proper size are particularly important for items that rise, such as breads, cakes and soufflés.

Beaters

Cooks once had to rely on muscle power to whip eggs. They used an assortment of large and small, flat and balloon-shaped whisks, many of which are still available. Today, most cooks use an electric stand or hand mixer. Blenders and some food processors can whip up a whole egg, an egg yolk or a mixture but do not produce stiffly beaten egg whites.

Bowls

There has long been a great controversy about the merits, if any, of using a copper bowl to produce volume in beaten egg whites. The copper in the bowl reacts with the conalbumin of egg whites much like cream of tartar to stabilize egg-white foam. With the addition of cream of tartar, a stainless steel or glass bowl works just as well, is much less expensive and avoids the possibility of copper leaching into food.

Because they tend to absorb fat, plastic and wooden bowls aren't suitable for beating egg whites. Any film or residue of fat will keep the whites from forming a stable foam.

The size and shape of a bowl is important. When you use an electric stand mixer, use the bowl that comes with the mixer. A deep bowl with enough room for expansion is best for an electric hand mixer. For hand-whipping with a balloon whisk, use a bowl that's rounded at the bottom, at least 10 inches across the top and 5 to 6 inches deep.

Cooking Equipment Especially For Eggs

Coddler

A small cup made of porcelain, heatproof glass or pottery with a screw-on top. To use a coddler, break an egg or two into the cup, screw on the top and submerge the cup in simmering water until the egg is cooked. Eat the eggs directly from the coddler. You can also coddle eggs in a small jelly-size canning jar.

Cooker

An electric appliance which steamcooks eggs in the shell. Most egg cookers also have inserts or cups for steam-poached eggs and some have a flat insert for cooking fried or scrambled eggs and omelets.

Crepe Pan

A shallow, slope-sided skillet, 6 to 8 inches in diameter. Crepe pans range from inexpensive, lightweight pans to sophisticated electric models, some of which cook the crepes on what appears to be the outside of the pan. You can make crepes in almost any small shallow pan with sloping sides, such as a small omelet pan.

Custard Cups

Small, deep, individual bowlshaped dishes, with a capacity of 6 or 10 ounces, designed for oven use and perfect for baking eggs, individual custards or quiches.

Omelet Pan

A shallow, slope-sided nonstick skillet, usually 7 to 10 inches in diameter. A double omelet pan consists of 2 shallow rectangular or semicircular pans attached by hinges. Each pan has a handle.

Piercer

A sharp-pointed tool for gently pricking a very small hole in the large end of an eggshell before hard-boiling. Piercing may allow some air to escape and some water to seep into the egg during cooking, which may make peeling easier. However, piercing often produces hairline cracks in the shell, making the egg more vulnerable to bacteria. For this reason, piercing is not recommended. To make peeling hard-boiled eggs easier, use eggs that are 7 to 10 days old.

Poacher

A rack that holds cups, sized to fit one egg each, over simmering water, or a small colander-like form that holds an egg as it poaches in simmering water.

Quiche dish

A round, shallow, straight-sided ceramic dish, usually with scalloped edges, for oven use. Sometimes also called a flan or tart dish, a quiche dish is available in several sizes. You can also use a pie plate of the same size to bake a quiche.

Ring

A round band, with or without a handle, to hold a fried egg during cooking.

Separator

A small cup centered in a round frame made of plastic, metal or ceramic. The cup catches the yolk while slots around the frame let the white slip through to a container beneath the separator. You can also use a kitchen funnel to separate eggs.

Slicer

A device which cuts a hard-boiled egg into neat slices with one swift stroke. An egg slicer has an indented tray in which the egg rests and a cutting mechanism of parallel wires. To chop an egg, carefully rotate the sliced egg 90 degrees in the tray and cut through again. You can also chop eggs using a pastry blender in a bowl or with a sharp knife on a cutting board.

Soufflé dish

A deep, straight-sided dish designed for oven use. Soufflé dishes are available in various sizes and can serve as casserole dishes, too. You can also bake a soufflé in a straightsided casserole or baking dish or an uncoated saucepan of the same size.

Wedger

A device which cuts a hard-boiled egg into 6 equal wedge-shaped parts. The wedger holds the egg upright as you pull wires over it to cut the wedges. When you draw down the wires only partway, you can open the egg to hold a stuffing or to resemble a flower.

Cooking Functions

Although eggs are widely known as breakfast entrees, they also serve in many other ways. In fact, the cooking properties of eggs are so varied that eggs have been called "the cement that holds together the castle of cuisine".

Eggs **bind** ingredients in dishes such as meatloaves or crab cakes, **leaven** such baked high-rises as soufflés and sponge cakes and **thicken** custards and sauces.

Eggs **emulsify** mayonnaise, salad dressings and Hollandaise sauce and are frequently used to **coat or glaze** breads and cookies.

Eggs **clarify** soups and coffee and **retard crystallization** in boiled candies and frostings.

Eggs **add color, flavor, moisture and nutrients** to baked goods such as cakes. As a finishing touch, hard-boiled eggs often serve as a garnish. For more in-depth information visit www.IncredibleEgg.org

Cooking Methods

The basic principle of egg cooking is to use a medium to low temperature and time carefully. When you cook eggs at too high a temperature or for too long at a low temperature, the whites shrink and become tough and rubbery and the yolks become tough and their surface may turn gray-green.

To kill bacteria and other microorganisms, the recommended guidance is to cook eggs until the whites are firm and the yolks thickened. Cook egg dishes to an internal temperature of 160°F (71°C). Pasteurized shell eggs are available on the market for those who prefer eggs not cooked to this level of doneness. There are five basic methods for cooking eggs.

Baked

Eggs baked in a dish in the oven, also known as shirred. Break and slip 2 eggs into a greased 10-ounce custard cup, shallow baking dish or ramekin. Spoon 1 tablespoon milk or half and half over the eggs. Bake in a preheated 325°F (163°C) oven until the whites are completely set and the yolks begin to thicken but are not hard, about 10 to 12 minutes, depending on the number of servings you're baking.

Hard-boiled/Hard-cooked

Place eggs in a saucepan large enough to hold them in a single layer. Add enough cold water to come at least 1 inch above the eggs. Heat over high heat to boiling. Turn off heat. If necessary, remove the pan from the burner to prevent further boiling. Cover pan. Let the eggs stand in the hot water about 12 minutes for large eggs (about 9 minutes for medium, about 15 for extra-large). Immediately run cold water over the eggs or place them in ice water until they're completely cooled. Never microwave eggs in the shell and unfortunately, it's almost impossible to hard-boil eggs at altitudes above 10,000 feet.

– *See Peeling*

Fried

For Sunny-Side-Up Eggs: Heat a small amount of butter in nonstick skillet over medium-high heat until hot. Break eggs and slip into pan, one at a time. Immediately reduce heat to low. Cover pan and cook slowly until whites are completely set and yolks begin to thicken but are not hard, 5 to 6 minutes. Sprinkle with salt and pepper.

For Over-Easy or Over-Hard Eggs: Cook as for Sunny-Side-Up, but do not cover pan. When whites are completely set and yolks begin to thicken but are not hard, 5 to 6 minutes. Slide turner under each egg and carefully flip it over in pan. Cook second side to desired doneness, 30 seconds to 1 minute.

For Basted Eggs: Cook as for Sunny-Side-Up, but use 2 tablespoons butter and do not cover pan. Cook until edges turn white, about 1 minute. Begin basting eggs with butter from pan. Cover pan between bastings and continue cooking until whites are completely set and yolks begin to thicken but are not hard, 4 to 5 minutes.

For Steam-Basted Eggs: cook as for Sunny-Side-Up, but use 1 teaspoon butter or a light coating of cooking spray. Cook until edges turn white, about 1 minute. Add 1 teaspoon water to pan. Cover pan tightly. Continue cooking until whites are completely set and yolks begin to thicken but are not hard, 4 to 5 minutes.

Poached

Heat 2 to 3 inches of water, milk, broth, tomato juice, wine or other liquid in a large saucepan or deep skillet to boiling. Adjust heat to keep liquid simmering gently. Break cold eggs, one at a time, into a custard cup or saucer. Holding the dish close to the liquid's surface, slip the eggs, one by one, into the water. Cook until the whites are completely set and the yolks begin to thicken but are not hard, about 3 to 5 minutes. Do not stir. With a slotted spoon, lift out the eggs. Drain the eggs in the slotted spoon or on paper towels. Trim any rough edges, if you like. Adding vinegar or salt to the water to enhance coagulation is not necessary and can flavor the eggs. Use very fresh eggs for poaching. They hold their shape better and form fewer wispy threads or "angel wings" in the water.

Scrambled

Beat together 2 eggs, 2 tablespoons milk or water, salt and pepper, if you like, until blended. Heat a small amount of butter or cooking spray in a 7 to 8 inch nonstick omelet pan or skillet over medium heat until hot. Pour in the egg mixture. As the eggs begin to set, gently pull the eggs across the pan with an inverted turner, forming large soft curds. Continue cooking – pulling, lifting and folding eggs until thickened and no visible liquid egg remains. Do not stir constantly.

Cooking Terms

The following terms or phrases regularly occur in egg recipes.

Cook until knife inserted near center comes out clean. Baked custard mixtures are done when a metal knife inserted off center comes out clean. The very center still may not be quite done, but the heat retained in the mixture will continue to cook it after you remove it from the oven. Cooking longer may result in a curdled and/or weeping custard. Cooking less time may result in a thickened but not set custard.

Cook until just coats a metal spoon. For stirred custard mixtures, the eggs are cooked to the proper doneness when a thin film adheres to a metal spoon dipped into the custard. The point of coating a metal spoon is 20° to 30°F below boiling. Stirred custards should not boil. The finished product should be soft and thickened but not set. Stirred custards will thicken slightly after refrigeration.

Slightly beaten. Beat eggs with a fork or whisk just until the yolks and whites are blended.

Well beaten. Beat eggs with a mixer, blender, beater or whisk until they are light, frothy and evenly colored.

Thick and lemon-colored. Beat yolks with an electric mixer at high speed until they become a pastel yellow and form ribbons when you lift the beater or drop the yolks from a spoon, about 3 to 5 minutes. Although yolks can't incorporate as much air as whites, this beating does create a foam and is important to airy concoctions such as sponge cakes.

Add a small amount of hot mixture to eggs/egg yolks. When you add eggs or egg yolks to a hot mixture all at once, they may begin to coagulate too rapidly and form lumps. So, stir a small amount of the hot mixture into the eggs to warm them and then stir the warmed eggs into the remaining hot mixture. This is called **tempering**.

Room temperature. Some recipes call for eggs to be at room temperature before you combine the eggs with a fat and sugar. Cold eggs could harden the fat in this type of recipe and the batter might become curdled. This could affect the texture of the finished product. To prevent the curdling, remove eggs from the refrigerator about 30 minutes before you use them or put them in a bowl of warm water for 10 to 15 minutes while you assemble other ingredients. For all other recipes, use eggs straight from the refrigerator.

The following cooking terms apply specifically to egg whites.

Separated. Fat inhibits the foaming of egg whites. Since egg yolks contain fat, recipes sometimes call for the yolks to be separated from the whites. Beating the whites separately allows them to reach their fullest possible volume. It's easiest to separate the yolks and whites when the eggs are cold, but whites reach their fullest volume if you allow them to stand at room temperature for about 30 minutes before beating.

Many inexpensive egg separators are available. To separate eggs, tap the midpoint of the egg sharply with a table knife. Hold the egg over the bowl in which you want the whites and gently pull apart the shell halves. Let the yolk nestle into the cuplike center of the separator and the white will drop through the slots into the bowl beneath. You can use the same process with a funnel.

Drop one egg white at a time into a cup or small bowl and then transfer it to the mixing bowl before separating another egg. This avoids the possibility of yolk from the last egg you separated getting into several whites. Drop the yolk into another mixing bowl if you need it in the recipe, otherwise into a storage container.
– See Storing

Add cream of tartar. Egg whites beat to greater volume than most other foods, including whipping cream, but the air beaten into them can be lost quite easily. To make the foam more stable, add a stabilizing agent such as cream of tartar to the whites. Lemon juice works much the same way.

– *See Cream of Tartar*

Add sugar, 1 to 2 tablespoons at a time. When you make meringues and some cakes, you add sugar to beaten egg whites. Sugar serves to increase the stability of the foam. However, sugar can also retard the foaming of the whites and you must add it slowly so you don't decrease the volume. Beat the whites until they just begin to get foamy, then slowly beat in the sugar.

– *See Meringue*

Stiff but not dry. Beat whites with a mixer, beater or whisk just until they no longer slip when the bowl is tilted. (A blender or food processor will not aerate them properly.) If you underbeat egg whites, the finished product may be heavier and less puffy than desired. If you overbeat egg whites, they may form clumps which are difficult to blend into other foods in the mixture and the finished product may lack volume.

Stiff peaks form. Stiff but not dry.

Soft peaks or piles softly. Whites that have been beaten until high in volume but have not reached the stiff peak stage. When you lift the beater, peaks will form and curl over slightly.

Gently folded. When you combine beaten egg whites with other heavier mixtures, handle carefully so you don't lose the air you've beaten into the whites. It's best to pour the beaten egg whites onto the heavier mixture. Then, using a spoon or rubber spatula, gradually combine the ingredients with a downward stroke into the bowl, followed by an across-up-andover- the-mixture motion. Come up through the center of the mixture about every three strokes and rotate the bowl as you are folding. Fold just until there are no streaks remaining in the mixture. Don't stir because this will force air out of the egg whites.

Copper Bowl

– *See Cooking Equipment, Bowls*

Cream of Tartar

An acid ingredient which stabilizes beaten egg whites. As a rule of thumb, use 1/8 teaspoon cream of tartar per egg white or 1 teaspoon per cup of egg whites. For meringues, use 1/8 teaspoon cream of tartar for each 2 egg whites.

– *See Cooking Terms, Add Cream of Tartar*

Cream Puff

A light, but rich, hollow pastry puff which you can fill with a sweet filling for dessert or with a savory one, such as egg or chicken salad, for a main dish. Called choux pastry (Pâte or choux) after the French word for cabbage, cream puffs come out of the oven looking like little cabbages. A high proportion of egg is necessary to form the cream puff structure. Egg yolk helps to emulsify the fat and egg whites are drying agents for crisp, dry puffs. Visit www.IncredibleEgg.org for a cream puff recipe.

Crème Anglaise

– *See Custard, Stirred*

Crème Caramel

– *See Custard, Baked*

Crepe

A light, thin, egg-rich pancake. The word is French, but the crepe is so versatile that it exists in many other languages, too. It's a Russian blini, a Jewish blintz, a Chinese egg roll, a Greek krep or a Hungarian palacsinta. Depending on the filling, a crepe can be an appetizer, main dish or dessert. Crepe batter should be the consistency of heavy cream. Letting the batter rest for an hour or so after mixing allows the flour to absorb moisture and gives the air bubbles time to dissipate so that the crepes you make don't have tiny holes. You can make crepes in advance. Stack, wrap and refrigerate them for a few days and reheat to serve. For longer storage, double wrap and freeze. Visit www.IncredibleEgg.org for a crepe recipe.

Curdling

Also known as syneresis or weeping. When you cook an egg mixture such as a custard sauce too rapidly or for too long, the protein becomes overcoagulated and separates from the liquid, leaving a mixture resembling fine curds and whey. If the curdling in a custard sauce hasn't progressed too far, you may be able to reverse it if you remove the mixture from the heat and stir or beat vigorously.

To prevent syneresis or curdling in a custard sauce, use a low temperature, stir (if appropriate for the recipe), cook just until the custard tests done, and cool quickly by setting the pan in a bowl of ice or cold water and stirring for a few minutes.

The term curdling is usually used in connection with a stirred mixture such as custard sauce, while weeping or syneresis are more often used with reference to pie meringues or baked custards.

– See Meringue, Soft Meringue

Custard

A cooked mixture of eggs and milk with sugar and flavoring sometimes added. There are two basic kinds of custard – stirred and baked.

Stirred custard is also known as soft custard, custard sauce or erroneously, boiled custard. This custard is cooked on top of the range to a creamy, but pourable, consistency. You can cook the mixture in a double boiler over hot water or in a heavy saucepan over low heat. Serve stirred custard as a pudding or over cake or fruit. Visit www.IncredibleEgg.org for a vanilla custard sauce recipe.

Baked custard is cooked in a water bath in the oven and has a firm, but delicate, gel-like consistency. Serve a sweetened baked custard as a dessert in itself or as a base for toppings and sauces. A quiche or timbale is an unsweetened baked custard.

The usual proportions for a sweet custard are one egg and two tablespoons of sugar for each cup of milk. This is the minimum ratio of eggs to milk which will produce properly thickened custard. You may, though, use as many as four eggs and increase the sugar to four tablespoons. Increasing the sugar will make the custard less firm and lengthen the cooking time. Increasing the egg will make the custard firmer and shorten the cooking time. You can also substitute two egg yolks for one whole egg. Two egg whites will also thicken the custard as much as one whole egg, but the characteristic custard color and flavor will be missing.

Visit www.IncredibleEgg.org for baked custard and quiche recipes.

Cuticle

– See Bloom

Daily Reference Values (DRVs)

There are two sets of reference values for reporting nutrients in nutrition labeling: 1) Daily Reference Values (DRVs) and 2) Reference Daily Intakes (RDIs). These values assist consumers in interpreting information about the amount of a nutrient that is present in a food and in comparing nutritional values of food products. DRVs are established for adults and children four or more years of age, as are RDIs, with the exception of protein. DRVs are provided for total fat, saturated fat, cholesterol, total carbohydrate, dietary fiber, sodium, potassium, and protein. RDIs are provided for vitamins and minerals and for protein for children less than four years of age and for pregnant and lactating women. In order to limit consumer confusion, however, the label includes a single term (i.e., Daily Value (DV)), to designate both the DRVs and RDIs. Specifically, the label includes the % DV, except that the % DV for protein is not required unless a protein claim is made for the product or if the product is to be used by infants or children under four years of age.

– See Daily Values (DVs), Reference Daily Intakes (RDIs), Recommended Dietary Allowances (RDAs), U.S. Recommended Daily Allowances (U.S. RDAs)

Daily Values (DVs)

A term on food labels that represents the amount of protein, fat, cholesterol, carbohydrate (including dietary fiber and sugars), vitamins and minerals, expressed in percentage of a specific nutrient that a person should consume per day. To avoid consumer confusion, the term DV represents both Daily Reference Values (DRVs) and Reference Daily Intakes (RDIs). DVs serve as a yardstick for food comparisons and not as a strict dietary prescription.

– See Daily Reference Values, Reference Daily Intakes (RDIs), Recommended Dietary Allowances (RDAs), U.S. Recommended Daily Allowances (U.S. RDAs)

Daily Values (DVs)	
DVs based on a caloric intake of 2,000calories, for adults and children four or more years of age.	
Food Component	**DV**
Total Fat	65 grams (g)
Saturated Fat	20 g
Cholesterol	300 milligrams (mg)
Sodium	2,400 mg
Potassium	3,500 mg
Total Carbohydrate	300 g
Dietary Fiber	25 g
Protein	50 g
Vitamin A	5,000 International Units (IU)
Vitamin C	60 mg
Calcium	1,000 mg
Iron	18 mg
Vitamin D	400 IU
Vitamin E	30 IU
Vitamin K	80 micrograms mcg
Thiamin	1.5 mg
Riboflavin	1.7 mg
Niacin	20 mg
Vitamin B6	2 mg
Folate	400 mcg
Vitamin B12	6 mcg
Biotin	300 mcg
Pantothenic acid	10 mg
Phosphorus	1,000 mg
Iodine	150 mcg
Magnesium	400 mg
Zinc	15 mg
Selenium	70 mcg
Copper	2 mg
Manganese	2 mg
Chromium	120 mcg
Molybdenum	75 mcg
Chloride	3,400 mg

The nutrients in the table are listed in the order in which they are required to appear on a label in accordance with 21 CFR 101.9(c). This list includes only those nutrients for which a DRV has been established in 21 CFR 101.9(c)(9) ora RDI in 21 CFR 101.9(c)(8)(iv). Source: Dietary Reference Intakes: The Essential Guide to Nutrient Requirements, Jennifer J. Otten, Jennifer Pitzi Hellwig, Linda D. Meyers, Editors, The National Academies Press, 2006

Decorating Eggs

The egg shape has often inspired artists and the egg has been the palette for some of the most intriguing of folk arts in many cultures.

There is literally no end to the creative possibilities for individual expression on an eggshell. You can paint eggs or color them with crayons or felt-tipped pens, turn them into funny faces, top them with fantastic hats, trim them with feathers or sequins or simply dye them in an endless variety of hues. However you decide to do it, decorating eggs is fun for grown-ups as well as kids.

You can decorate either hard-boiled eggs or empty eggshells. The hardboiled variety is a bit sturdier for children to use, while empty shells are best if you're making an egg tree or want to keep the eggs on display for a considerable time.

Commercial egg dyes are sold especially at the Easter season and food coloring is available year round. Any time of year, you might prefer to craft your eggs by experimenting with colors from nature.

To make naturally-dyed eggs: Toss your choice of a handful – or two or three – of one of the materials below into a saucepan. (Use your own judgment about quantity. This is an art – not a science!) Add about a cup of water for each handful, so the water comes at least an inch above the dyestuff. Bring to boiling, reduce the heat and simmer from 15 minutes up to an hour, until the color is the shade you want. Keep in mind that

Naturally-Dyed Eggs

Pinkish Red
Fresh beets, cranberries, radishes 3 or frozen raspberries

Orange/Yellow
Yellow onion skins, ground turmeric, orange or lemon peels, carrot tops, celery seed or ground cumin

Pale Green
Spinach leaves

Green-gold
Yellow Delicious apple peels

Blue
Canned blueberries or red cabbage leaves

Beige to brown
Strong brewed coffee, dill seeds, chili powder

Gray
Purple or red grape juice or beet juice

Source: American Egg Board

the eggs will dye a lighter shade. Remove the pan from the heat.

Through cheesecloth or a fine sieve, strain the dye mixture into a small bowl that's deep enough to completely cover the eggs you want to dye. Add 2 to 3 teaspoons of white vinegar for each cup of dye liquid. With a spoon or wire egg holder from a dyeing kit, lower the eggs into the hot liquid. Let the eggs stand until they reach the desired color. For emptied eggshells, stir or rotate for even coloring. With a slotted spoon or wire egg holder, remove the eggs to a rack or drainer. Allow the eggs to dry thoroughly. Within two hours (or within one hour if the weather is warm), refrigerate hardboiled eggs that you intend to eat.

However you decide to color your hard-boiled eggs, follow these tips if you'd like to eat them later: Wash your hands thoroughly before handling the eggs at every step, including cooking, cooling, dyeing and hiding. If you won't be coloring your eggs right after cooking them, store them in their cartons in the refrigerator. Don't color cracked eggs.

When coloring the eggs, use water warmer than the eggs. Refrigerate the eggs in their cartons right after coloring and refrigerate them again after they've been hidden and found. Don't eat cracked eggs or eggs that have been out of refrigeration for more than two hours. If you plan to use hard-boiled eggs for an Easter egg hunt or as a centerpiece or other decoration and they will be out of refrigeration for many hours or several days, cook extra eggs to refrigerate for eating. Discard the eggs that have been left out for more then two hours. For more decorating ideas, visit www.IncredibleEgg.org

– See Cooking Methods, Hard-Boiled; Empty Eggshells; Easter Eggs

Deviled Eggs

Also known as stuffed eggs, hardboiled eggs, peeled, cut in half and stuffed with a seasoned, mashed yolk mixture. The yolks are removed from the whites, mixed with a moistener, such as mayonnaise, flavoring foods and/or seasonings and then piled back into the whites. The word "devil" originally referred to the combination of spices, including dry mustard, with which the eggs were highly seasoned. D

Doneness Guidelines

To prevent food-born illness, U.S. Department of Agriculture (USDA) recommends cooking eggs until the whites are firm and yolks are thickened. Cook egg-containing dishes to an internal temperature for 160°F (71°C). For egg preparations not cooked to these guidelines, pasteurized shell eggs are available on the market. Eggs should be served promptly after cooking.

• Cook **scrambled eggs, omelets and frittatas** until the eggs are thickened and no visible liquid egg remains.

• To cook both sides of **fried eggs** and increase the temperature the eggs reach, cook slowly and baste the eggs, turn the eggs or cover the pan with a lid. Cook until the whites are completely set and the yolks begin to thicken but are not hard.

• For classic **poached eggs** cooked gently in simmering water, cook until the whites are completely set and the yolks begin to thicken but are not hard, about 3 to 5 minutes. For steamed eggs cooked in "poaching" inserts set above simmering water, cook until the whites are completely set and the yolks begin to thicken but are not hard, about 6 to 9 minutes. Avoid precooking and reheating poached eggs.

• Cook or bake **French toast, Monte Cristo sandwiches, crab or other fish cakes, quiches, baked custards and most casseroles** until a thermometer inserted at the center shows 160°F (71°C) or a knife inserted near the center comes out clean. You may find it difficult to tell if a knife shows uncooked egg or melted cheese in some casseroles and other combination dishes that are thick or heavy and contain cheese – lasagna, for example. To be sure these dishes are done, make sure that a thermometer at the center of the dish shows 160°F (71°C).

• Cook a **soft (stirred) custard – including cream pie, eggnog and ice cream bases** – until it's thick enough to coat a metal spoon with a thin film and a thermometer shows 160°F (71°C) or higher but no higher than 180°F (83°C). A custard sauce thickens at 160°F (71°C) and curdles at 180°F (83°C). An exception to the rule is when cream pie fillings and puddings that contain a starch, the addition of starch prevents curdling even when the mixture is brought to a boil. After cooking, cool the custard quickly by setting the pan in ice or cold water and stirring for a few minutes. Cover and refrigerate the cooled custard to chill thoroughly, at least 1 hour.

• Bake a 3-egg-white **soft (pie) meringue** spread on a hot, fully cooked pie filling in a preheated 350°F (177°C) oven until the meringue reaches 160°F (71°C), about 15 minutes. For meringues using more whites, bake at 325°F (163°C) or a lower temperature until a thermometer registers 160°F (71°C), about 25 to 30 minutes (or more). The more egg whites, the lower the temperature and longer the time you need to cook the meringue through without excessive browning. Refrigerate meringue-topped pies until serving. Return leftovers to the refrigerator.

• **Baked goods and hard-boiled eggs** will easily reach internal temperatures of more than 160°F (71°C) when they are done. Note, though, that while Salmonella are destroyed when hard-boiled eggs are properly prepared, hard-boiled eggs can spoil more quickly than raw eggs. After cooking, cool hardboiled eggs quickly under running cold water or in ice water. Avoid allowing eggs to stand in stagnant water. Refrigerate hard-boiled eggs in their shells promptly after cooling and use them within one week.

• For **microwaved egg dishes**, encourage more even cooking by covering the dish, stirring the ingredients, if possible, and if your microwave does not have a turntable, rotate the dish once or twice during the cooking time.

Recipes calling for raw or lightly cooked eggs. Although the overall risk of egg contamination is very small, the risk of foodborne illness from eggs is highest in raw and lightly cooked dishes. To eliminate risk and ensure food safety, replace all your recipes calling for raw or lightly cooked eggs with cooked egg recipes or use pasteurized shell eggs or egg products when you prepare them. To cook eggs for these recipes, use the following methods to adapt your recipes:

Cooking whole eggs for use in recipes. Fully cook whole eggs for assured safety in recipes that call for raw or lightly cooked eggs. You can use the following method for a variety of recipes, with any number of eggs.

In a heavy saucepan, stir together the eggs and either sugar, water or another liquid from the recipe (at least 1/4 cup sugar, liquid or a combination per egg). Cook over low heat, stirring constantly, until the egg mixture coats a metal spoon with a thin film or reaches 160°F (71°C). Immediately place the saucepan in ice water and stir until the egg mixture is cool. Proceed with the recipe.

Cooking egg yolks for use in recipes. Cook egg yolks for use in mayonnaise, Hollandaise sauce, Caesar salad dressing, cold soufflés, chiffons and mousses and other recipes calling for raw egg yolks. You can use the following method with any number of yolks.

In a heavy saucepan, stir together the egg yolks and the liquid from the recipe (at least 2 tablespoons liquid per yolk). Cook over very low heat, stirring constantly, until the yolk mixture coats a metal spoon with a thin film, bubbles at the edges or reaches 160°F (71°C). Immediately place the saucepan in ice water and stir until the yolk mixture is cool. Proceed with the recipe.

Cooking egg whites for use in recipes. For full safety in all recipes, cook egg whites before you use them. You can use the following method with any number of whites, including chilled desserts and Seven-Minute Frosting, Royal Icing and other frosting recipes calling for raw egg whites.

In a heavy saucepan, the top of a double boiler or a metal bowl placed over water in a saucepan, stir together the egg whites and the sugar from the recipe (at least 2 tablespoons sugar per white), water (1 teaspoon per white) and cream of tartar (1/8 teaspoon per each 2 whites). Cook over low heat or simmering water, beating constantly with a portable mixer at low speed, until the whites reach 160°F (71°C). Pour into a large bowl. Beat on high speed until the whites stand in soft peaks. Proceed with the recipe.

Note that you must use sugar to keep the whites from coagulating too rapidly. Test with a thermometer as there is no visual clue to doneness. If you use an unlined aluminum saucepan, eliminate the cream of tartar or the two will react and create an unattractive gray meringue.

The egg whites in an Italian meringue (made by adding hot sugar syrup to egg whites while beating them) do not reach much above 125°F (52°C), so this method is only safe in dishes that are further cooked. However, if you bring the sugar syrup all the way to the hard ball stage (250° to 266°F/121° to 130°C), the whites will reach a high enough temperature. You can use a sugar syrup at hard ball stage for Divinity and similar recipes.

– See Cooking Methods, Egg Safety, Fight BAC!, Partnership for Food Safety Education, Raw Eggs, Salmonella

Double-yolked Eggs

– See Yolk, Formation, Ovary

Dried Eggs

– See Egg Products

Easter Eggs

Eggs were colored, blessed, exchanged and eaten as part of the rites of spring long before Christian times. Even the earliest civilizations held springtime festivals to welcome the sun's rising from its long winter sleep. Ancient peoples thought of the sun's return from darkness as an annual miracle and they regarded the egg as a natural wonder and a proof of the renewal of life. As Christianity spread, the egg was adopted as a symbol of Christ's Resurrection from the tomb.

For centuries, eggs were among the foods forbidden by the church during Lent, so it was a special treat to have them again at Easter. In Slavic countries, baskets of food including eggs are traditionally taken to church to be blessed on Holy Saturday or before the Easter midnight Mass, then taken home for a part of Easter breakfast.

People in Eastern European countries have a long tradition of elaborately decorating Easter eggs. Polish, Slavic and Ukrainian people create amazingly intricate designs on the eggs. They draw lines with a wax pencil or stylus, dip the egg in color and repeat the process many times to make true works of art. Every dot and line in the pattern has a meaning. Yugoslavian Easter eggs bear the initials "XV" for "Christ is Risen", a traditional Easter greeting.

The Russians, during the reign of the Tsars, celebrated Easter much more elaborately than Christmas, with Easter breads and other special foods and quantities of decorated eggs given as gifts. The Russian royal family carried the custom to great lengths, giving exquisitely detailed jeweled eggs made by goldsmith Peter Carl Fabergé from the 1880s until 1917.

In Germany and other countries of central Europe, eggs that go into Easter foods are not broken, but emptied out. The empty shells are painted and decorated with bits of lace, cloth or ribbon, then hung with ribbons on an evergreen or small leafless tree. On the third Sunday before Easter, Moravian village girls used to carry a tree decorated with eggshells and flowers from house to house for good luck. The eggshell tree is one of several Easter traditions carried to America by German (Deutsch) settlers, especially those who became known as Pennsylvania Dutch. German immigrants also brought the fable that the Easter bunny delivers colored eggs for good children.

Easter is an especially happy time for children and many Easter customs are for their enjoyment. Hunting Easter eggs hidden around the house or yard is a widespread activity and so are egg-rolling contests.

– See Decorating Eggs, Empty Eggshells, Games

Eclairs

– See Cream Puffs

Eggnog

A beverage of eggs, milk, sugar and sometimes flavoring. Rich cream may take the place of part or all of the milk and spirits are often added at holiday time. Eggnog may be served hot or cold, but it should be prepared as a cooked stirred custard. The name may come from the noggin or small cup in which it was served in earlier days. Visit www.IncredibleEgg.org for an Eggnog recipe.

-See Custard, Doneness Guidelines, Cooking Whole Egg for Use in Recipes, Egg Safety, Raw Eggs

Egg Nutrition Center

The nutrition organization for the egg industry. American Egg Board began to fund ENC in 1984 to provide scientifically correct information on egg nutrition and accompanying health issues. Located in Park Ridge, IL, the Egg Nutrition Center communicates regularly with industry, the media, and health and nutrition communities.

A panel of independent scientists advises the Egg Nutrition Center on the interpretation of research studies. The Center is dedicated to providing scientifically accurate, up-to-date information on egg nutrition and health issues. The Egg Nutrition Center's website can be accessed at: www.eggnutritioncenter.org

– See American Egg Board

Egg Products

Processed and convenience forms of eggs for commercial, foodservice and home use, including refrigeratedliquid, frozen, dried and specialty products. Egg products are comparable to shell eggs in flavor, nutritional value and most functional properties. Convenience foods – such as cake and pudding mixes, pasta, ice cream, mayonnaise, candies and bakery goods – utilize egg products. Egg products are frequently preferred to shell eggs by commercial bakers, food manufacturers and the foodservice industry because they have many advantages, including convenience, labor savings, minimal storage requirements, ease of portion control, and product quality, safety, stability and uniformity.

Surplus shell eggs, as well as those produced particularly for the purpose, are used in making egg products. About 30% of total U.S. egg production goes into egg products. About three billion pounds of all types of egg products are produced each year in the U.S.

Since passage of the Egg Product Inspection Act (EPIA) in 1970, all plants that make egg products operate under continuous USDA inspection. The Act mandates specific inspection requirements for shell eggs and egg products to ensure wholesomeness, including pasteurization of all egg products.

Processing egg products. Immediately on delivery to the breaking plant, shell eggs are held in refrigerated holding rooms. Before breaking, the eggs are washed in water that is at least 90°F (32°C). The wash water must also be at least 20°F (-7°C) warmer than the internal temperature of the eggs. The eggs must be sprayrinsed with a sanitizing agent.

Refrigerated liquid products. Machines break eggs and, if necessary, separate the whites and yolks. After the liquid egg is pasteurized and put into covered containers, it may be shipped to bakeries or other outlets for immediate use or to other plants for further processing. When shipped by truckload, sanitary tank trucks maintain temperatures low enough to assure that the liquid egg arrives at its destination at 40°F (4°C) or less.

In addition to tanker truckloads, wholesale and foodservice refrigerated-product containers range in size from bags containing a few ounces to 20-, 30- and 45-pound bags, 4- to 10-pound cartons, 30-pound cans and bulk totes holding up to 3,000 pounds. Retail refrigerated products for home use are generally available in one- or two-pack cartons containing 8 to 16 ounces each.

Keep liquid egg products under refrigeration and use immediately after opening. Shelf life can vary, so check the product label.

Frozen egg products. These products include separated whites and yolks, whole eggs, blends of whole eggs and yolks or whole eggs and milk and these same blends with salt, sugar or corn syrup added. Salt or carbohydrates are sometimes added to yolks and whole eggs to prevent yolk gelation during freezing. Frozen egg products are generally packed in 30- and 40-pound plastic pails, 30-pound cans, and in 4-, 5-, 8- and 10-pound pouches (some of which are cook-in-bag pouches) or waxed or plastic cartons. Some retail consumer products are available frozen in one-or two-pack cartons containing 8 to 16 ounces each.

Keep frozen egg products frozen or refrigerated until use. Thaw frozen egg products under refrigeration or under cold running water in unopened containers. After defrosting, refrigerate thawed egg products and use within 3 days.

Dried or dehydrated egg products. Known also as egg solids, dried egg products have been produced in the United States since 1930. Demand was minimal until World War II when production reached peak levels to meet military and lend-lease requirements. Presentday technology – such as glucose removal and improved multi-stage dryers – has greatly improved the quality of dried eggs. Dried egg products are used in a wide number of convenience foods and in the foodservice industry.

Dried eggs for foodservice are sold in 6-ounce pouches, and 3- and 25-pound poly-packs. For commercial use, 5-, 25- and 50- pound boxes and 150-, 175- and 200-pound drums are available. For home use, dried egg products include dried egg whites in 3- to 8-ounce fiberboard and metal canisters sold in supermarkets, meringue powders often available at gourmet outlets and freezedried egg products found in camping goods stores.

Unopened dried egg products may be stored at room temperature as long as they are kept cool and dry. Tightly seal and refrigerate opened containers. Reconstituted egg products should be used immediately or refrigerated and used that day.

Specialty egg products. Egg specialties processed for the foodservice industry include wet- and dry-pack, pre-peeled, hard-boiled eggs – either whole, wedged, sliced, chopped or pickled; long rolls of hard-boiled eggs; and freeze-dried scrambled eggs. Among other convenience menu items, also available are a host of frozen products, including precooked fried and scrambled eggs and scrambled egg mix in boilable pouch, omelets, egg patties, French toast, quiche and quiche mix. Ultra-pasteurized liquid eggs with extended shelf-life are also available.

Many specialty egg items are also available at retail, including refrigerated peeled, hard-boiled eggs; shelf-stable pickled eggs; and frozen scrambled eggs, omelets and mixes, French toast and quiche.

– See Breakers, Egg Products Inspection Act, Restricted Eggs

Egg Products Inspection Act

The Egg Products Inspection Act assures that eggs and egg products distributed and consumed by the public are wholesome, not adulterated, and properly labeled and packaged. Passed by Congress in 1970, the Egg Products Inspection Act is administered by the U.S. Department of Agriculture (USDA) and imposes specific inspection requirements for two categories of eggs – shell eggs and egg products. Under the Egg Products Inspection Act, plants that break, dry and process shell eggs into liquid, frozen or dried egg products must operate under the continuous inspection program of the USDA. The law does not apply to foodmanufacturing plants which prepare cooked eggs or other food products made with eggs or egg products, such as those which make mayonnaise, egg noodles and ice cream, for example. An official inspector must be present at all times when eggs are being processed.

– See Egg Products, Grading, Restricted Eggs

Egg Roll

1. An elongated, hard-boiled egg processed for the foodservice industry. When the roll is sliced, every piece is a center cut for attractive service. – See Egg Products
2. An Asian specialty consisting of a savory filling wrapped in an egg-rich dough, then deep-fat fried. In the U.S., egg rolls are usually served as appetizers.
3. An annual Easter event held in many venues, including the White House lawn.

– See Egg Games

Egg Safety

Clean hands and equipment, sanitary food-handling practices, proper cooking and adequate refrigeration are essential in preparing all foods, including eggs, prior to eating. The contents of raw shell eggs may contain the bacteria Salmonella Enteritidis, but common food-safety practices can reduce the risk of illness. Use only refrigerated, clean, uncracked, fresh Grade AA or A eggs and follow these important food-handling practices:

Clean. Clean all cooking equipment and food-contact surfaces you use in food preparation. Always wash your hands before and after cracking open raw eggs and wash frequently during food preparation. Use soap and warm water and rub your hands together for 20 seconds, then dry thoroughly.

Separate. As the kitchen can also be a source of bacteria, to avoid crosscontamination, clean all cooking equipment and food-contact surfaces. Also avoid mixing egg yolks and whites with the shell.

Cook. Proper heating destroys the bacteria of concern in eggs. Cook eggs until the whites and yolks are firm and cook egg-containing dishes to an internal temperature of 160°F (71°C)

Chill. Always refrigerate eggs in their original carton in the main section of the refrigerator. Use a refrigerator thermometer to make sure the refrigerator temperature is between 33° to 40°F (1° to 4°C). If you accidentally leave eggs, egg mixtures or cooked egg dishes at room temperature, discard them after two hours or one hour (when the temperature outside is 90°F (32°C) or warmer. For summer outings, use ice or coolant in an insulated bag or cooler to keep cold foods cold (40°F/4°C or lower) and thermal containers to keep hot foods hot (140°F/60°C or higher). When you tote raw eggs on outings, leave them in their shells. E 41

– See Cooking Methods, Doneness Guidelines, Fight BAC!, Partnership for Food Safety Education, Raw Eggs, Salmonella, Egg Safety Center

Egg Safety Center

Under the administration of United Egg Producers, the Egg Safety Center (ESC) provides scientifically accurate information on egg safety issues to both consumers and egg producers. ESC also answers any questions that consumers, producers, or media may have on eggs and egg safety as well as provides real-time updates on recalls that include eggs or egg products.

– See Egg Safety

Egg Salad

A popular combination of chopped hard-boiled eggs, a dressing – such as mayonnaise – and seasonings. Egg salad is often served as a sandwich filling or in tomato or lettuce cups.

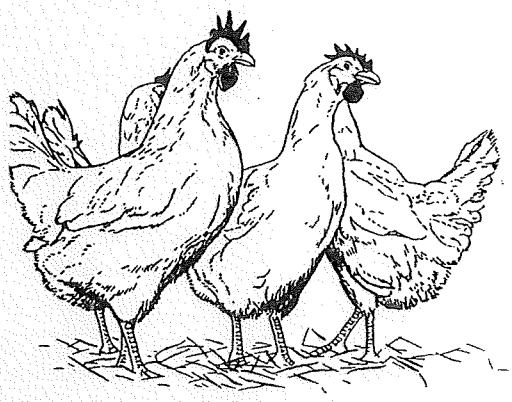
Eggs Benedict

Poached eggs with Canadian bacon served on English muffins with Hollandaise Sauce.

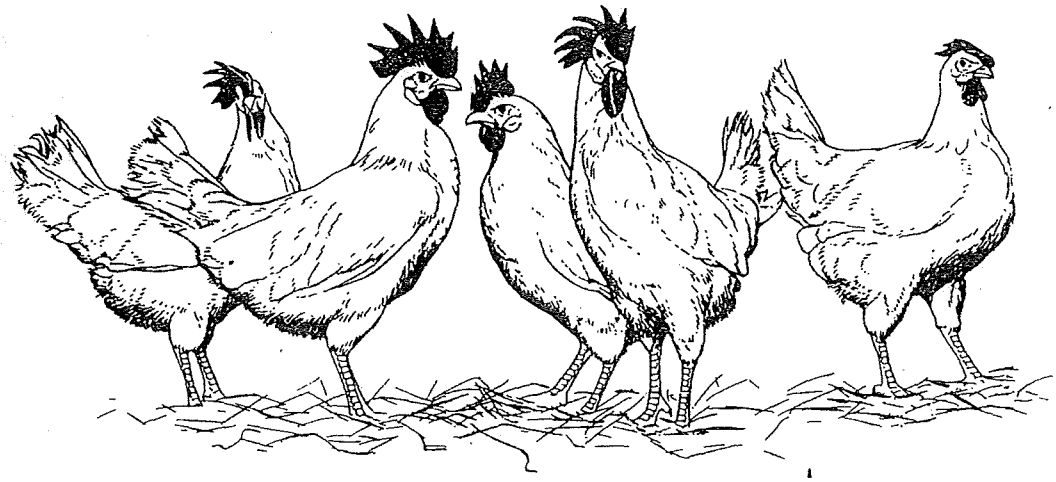
Egg Substitutes

Liquid egg products that typically contain only egg white with the yolk replaced by other ingredients, such as non-fat milk, tofu, vegetable oil, emulsifiers, stabilizers, antioxidants, gum, artificial color, minerals and vitamins. Egg substitutes contain the high-quality protein of egg white as well as the white's vitamins and minerals. However, each formula for replacing the yolk differs, so check labels for total nutrient content.

Due to varying formulas, each brand of egg substitute performs differently in cooking. You may have to experiment to learn how to cook an individual brand. For instance, those brands without fat will cook more quickly than those containing fat. Common to all brands is that the yolk's cooking properties, including emulsification, are lost. All brands which contain fat retard egg-white foaming which is needed to leaven certain dishes. Since both emulsification and leavening are important in many baked goods, egg substitutes may not yield the same results as shell eggs in home baking.



Small Turkey Flock Management



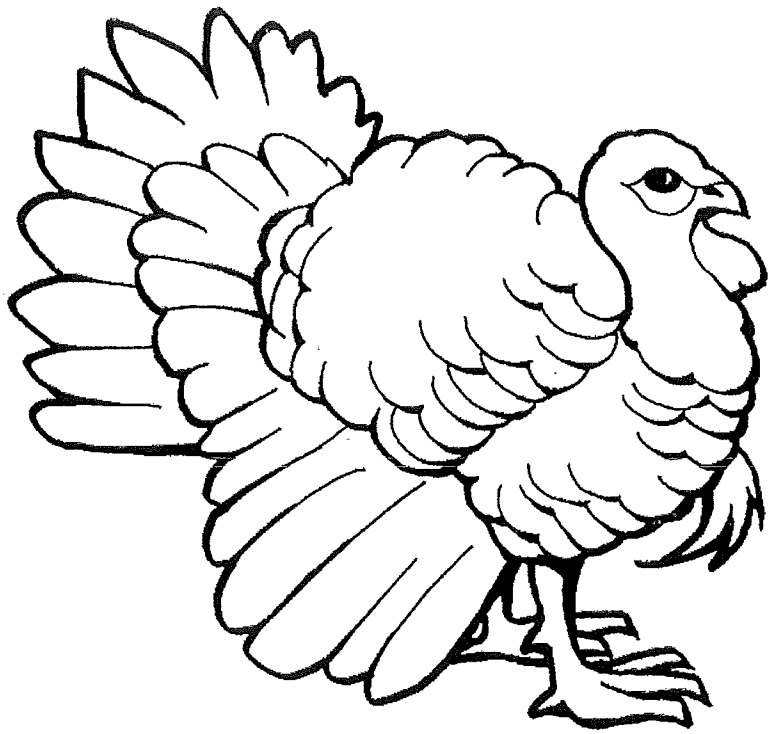
SMALL TURKEY FLOCK MANAGEMENT

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.



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

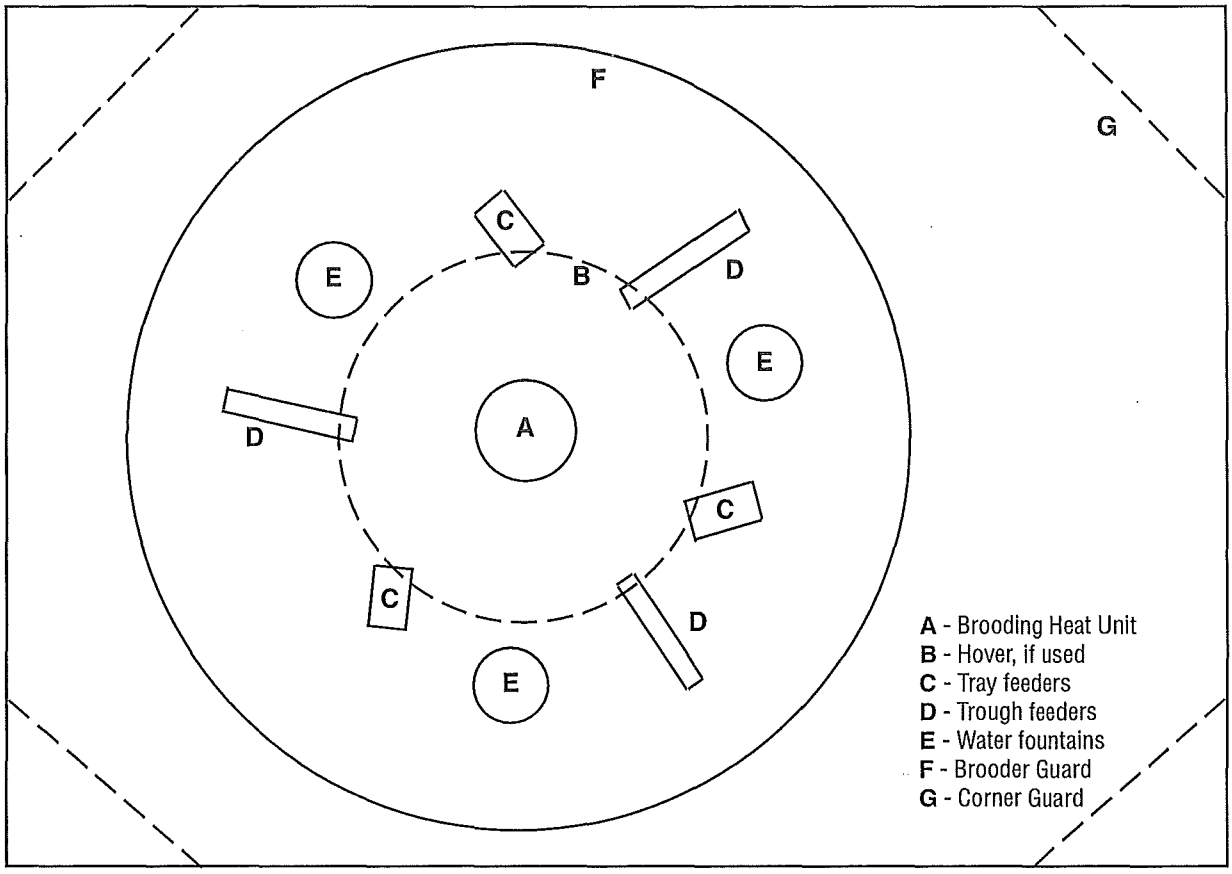


Figure 9. Brooding Arrangement

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.

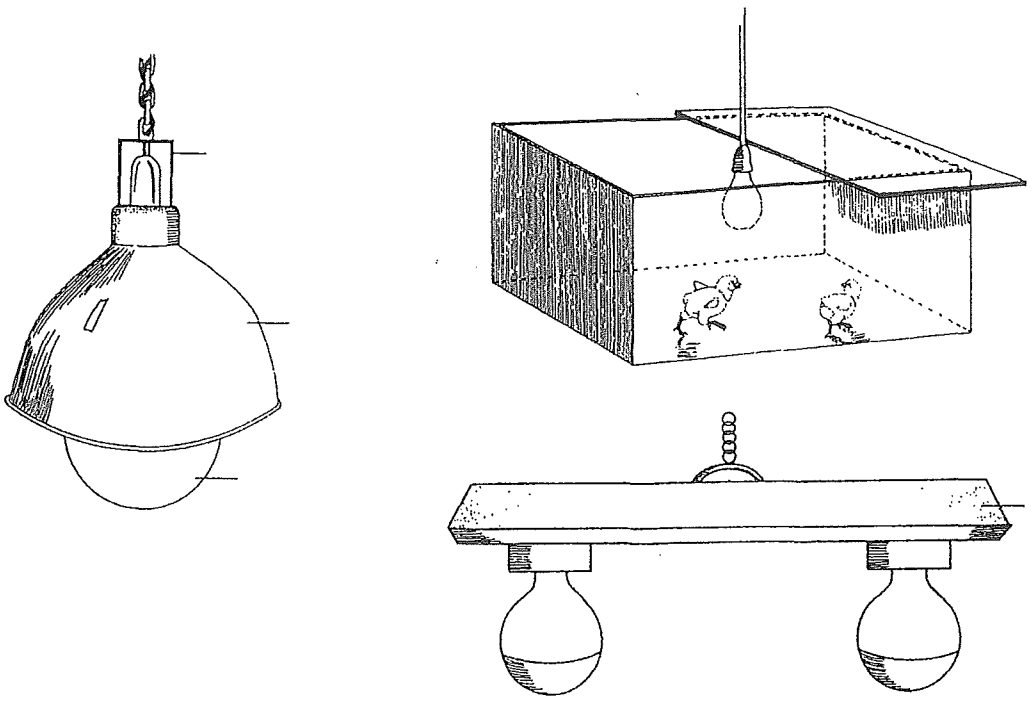


Figure 10. Brooders Commonly Used for Small Flocks.

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 mid-day 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 6-8 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 box-tops 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 9. 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 box-tops 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 1½ 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.

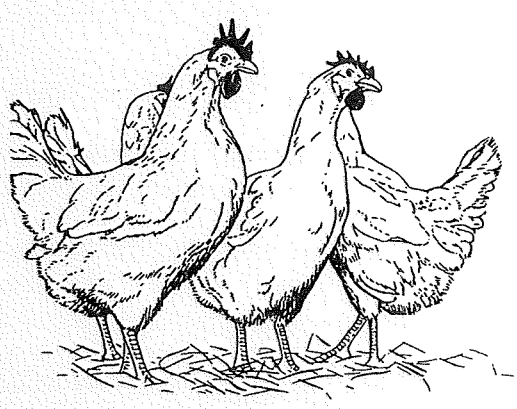
Some death loss is normal and should be expected, especially during the first 2 weeks. However, it is important to get an early diagnosis of disease problems in order to stop the spread of disease throughout the flock. A good feed or hatchery serviceperson can give you helpful advice on many day-to-day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

Marketing and Processing

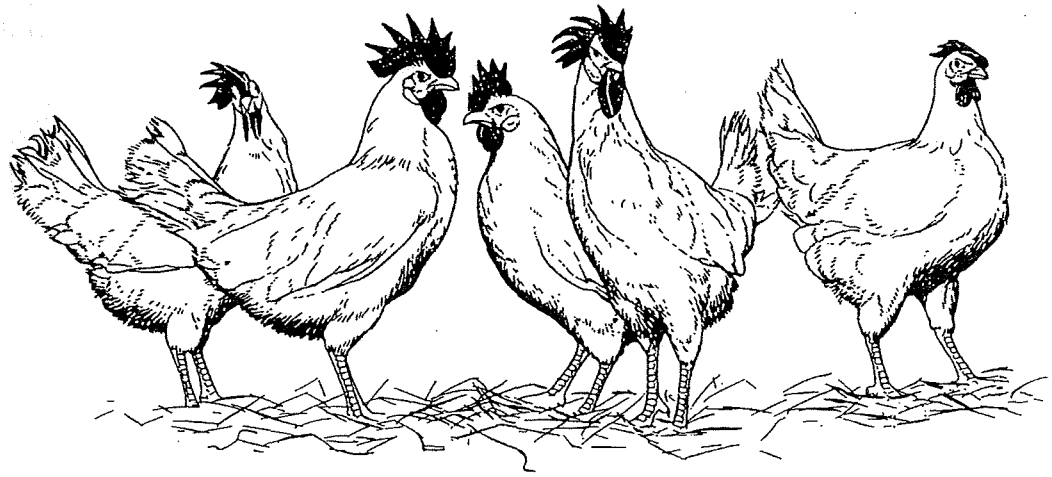
If you have more turkeys than you will need, you may be able to sell some, either alive or dressed. State and federal laws regulate the sale of processed birds but limited processing for direct sale to consumers is exempt in some cases. For details on regulations, contact your Extension Service or State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



Fact Sheets



The Changing World of Poultry and Egg Markets

DEFINITIONS

Demand - the quantity (amount at a price the consumer will pay) of a product that consumers/buyers desire.

Embargo - governmental order that has the effect of completely limiting trade between one country and another.

Inflation - sustained increased in price levels in an economy. This leads to a decline in the value of money and the consumer's money will not buy as much today and yesterday.

Sanction - governmental trade prohibition on specific products and/or services to another country. Sanctions can be thought of as partial embargoes and are often enacted due to nuclear proliferation violations or human rights violations.

Supply - the quantity (in this case, the amount of product the producer will sell at a given price) of product that the market can offer.

Tariff - the tax on goods either being imported or exported from a country.

Trade - the buying or selling of goods and/or service

A fundamental of business is the law of supply and demand. Simply, this refers to the observed relationship that as the demand for a product increases, prices go up. Then with rising prices, new suppliers join the market and increase the supply. This will bring the price back to normal.

Ex. 4-Her, Mark, is the first to offer eggs for sale in the neighborhood. Only the Green family buys the eggs. The Greens pay $3.00 per dozen. The Greens tell their neighbors how much they are enjoy these fresh eggs. Mark starts receiving orders from other neighbors. Soon he has more orders than eggs, so he raises his price to $5.00 per dozen and he still sells out. Some of his poultry club members hear how much he is making and start their own egg projects. With these 4-Hers also producing eggs, there are more eggs than buyers in the neighborhood. At this point, all the 4-Hers drop their prices so they can sell all their eggs.

You might think that producers could predict the demand for eggs or poultry meat, based on historical date and the predictions of economists. Then the producers could plan their flock sizes to meat demands in a way that eggs or meat would be profitable. This does work in countries that have a quota system, such as Canada. However, this means no one can just start an egg operation. You must obtain the "quota permission" from the government. In the United States we have a "free market" economy.

Unforeseen circumstances may disrupt egg production and prices.

Ex. When a disease wipes out portions of the American egg layer population (such as Highly

Pathogenic Avian Influenza), supplies decrease and prices increases. The unaffected egg producers with the financial ability may then increase their flock sizes to take advantage of the high prices. However, when the producers whose flocks were lost to disease, are able to stock new birds, the number of eggs being produced could be greater than demand, and the egg prices fall.

Ex. Political unrest, including international conflict and outright war, can complicate food animal production. Starting in 2021, the United States and the European Union imposed sanctions on Belarus. A relatively small European country, Belarus is the world's third largest producer of potash. Potash supplies potassium which is a crucial crop fertilizer. Sanctions on Belarus have increased the price of potash from non-sanctioned countries. In turn, this means high production costs for grain producers and consequently increased feed costs for poultry producers.

With the start of the Ukraine War in 2022, many became aware of the natural reserves and agricultural productivity in that part of the world. With farmers leaving their land to fight and with ports damaged, there was less grain from the traditionally #2 exporter of all grain crops. While the United States has enough grain to export surplus, the reduction of Ukranian grain going into the worldwide market drove up prices.

Ex. Legislation on farm animal management can also impact the cost of production. As more and more states pass legislation forcing producers to abandon traditional cage laying facilities and transition to cage-free, the price of production has increased. California economists calculated that it costs 24 cents more per dozen to produce cage-free eggs.

Domestic economic conditions and climate can result in price increases.

Ex. Inflation in the United States began rising in December of 2020 and by May 2022 reached the highest level in 40 years. A large part of the increase was due to surging oil and gas prices. The COVID pandemic forced many to stay close to home, work from home, and/or not travel. So demand for gas decreased and the industry pumped and refined less gas. A new administration in the government in 2021 pledged to move the national economy away from gas and oil. While demand increased with citizens returning to work and travel, supplies remained low. Understandably, the oil industry was wary of making large investments to meet current demand, if the government planned to greatly restrict the use of oil and gasoline. You can quickly think of many parts of egg and poultry meat production that require oil and gas. So it is no wonder that the prices for these products rose.

Severe droughts in many parts of the United State have serious impacts on food animal production. For grain producers relying on rainfall to directly water their crops, the drought effect is obvious. Other grain producers and animal production facilities my rely on water from reservoirs and rivers. With reduced rainfall, shortages result. Farmers may also plant fewer fields of grain due to water shortages. This in turn reduces grain supply and increases prices.

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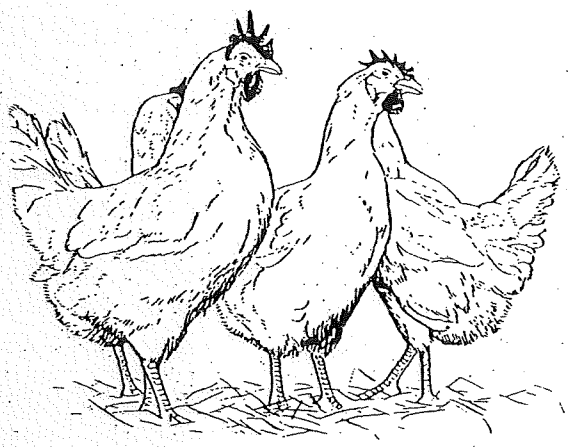
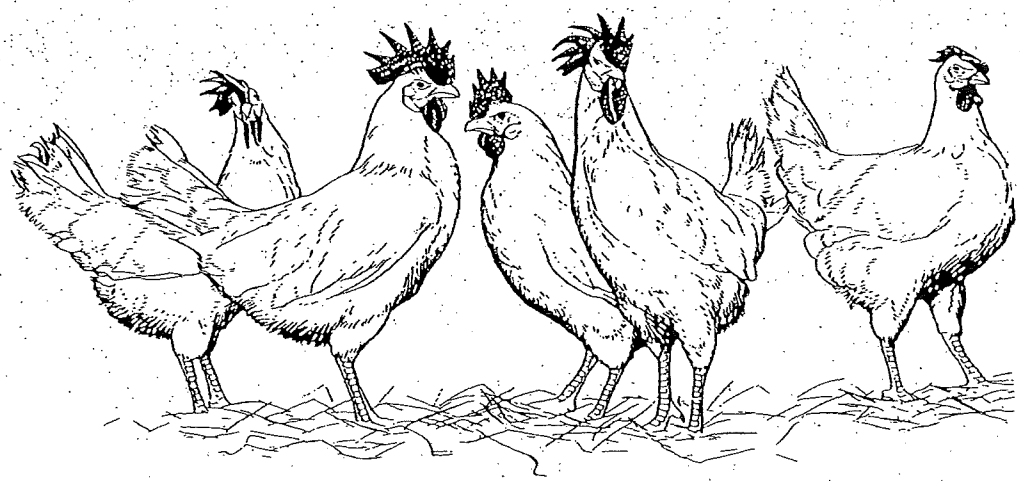


Embryology



DAILY EMBRYONIC DEVELOPMENT

Before Egg Laying

1. Fertilization
2. Division and growth of living cells
3. Segregation of cells into groups of special functions

Between Laying and Incubation

1. Virtually no growth. Stage of inactive embryonic life.

During Incubation

Day One:

1. Development of blastoderm.
2. Major developments visible under microscope:
   - 18 hours: Appearance of alimentary tract
   - 19 hours: Beginning of brain crease
   - 20 hours: Appearance of vertebral column
   - 21 hours: Beginning of formation of brain and nervous system
   - 22 hours: Beginning of formation of head
   - 23 hours: Appearance of blood island
   - 24 hours: Beginning of formation of eyes.

Day Two:

1. Embryo begins to turn on left side.
2. Blood vessels appear in the yolk sac.
3. Major developments visible under microscope:
   - 25 hours: Beginning of formation of veins and heart
   - 30 hours: Second, third, and fourth vesicles of brain clearly defined, as is heart, which now starts to beat
   - 35 hours: Beginning of formation of ear pits
   - 36 hours: First sign of amnion
   - 46 hours: Formation of throat

Day Three:

1. Beginning of formation of nares, wings, legs and allantois
2. Amnion completely surrounds embryo

Day Four:

1. Beginning of formation of tongue.
2. Embryo completely separate from yolk sac and turned on left side
3. Allantois breaks through amnion

Day Five:

1. Proventriculus and gizzard formed.
2. Formulation of reproductive organs - sex division

Day Six:

1. Beginning of formation of beak and egg-tooth
2. Main division of legs and wings
3. Voluntary movement begins

Day Seven:

1. Indications of digits in legs and wings.
2. Abdomen more prominent due to development of viscera.

Day Eight:

1. Beginning of formation of feathers

Day Nine:
1. Embryo begins to look bird-like
2. Mouth opening appears

Day Ten:
1. Beak starts to harden
2. Skin pores visible to naked eye
3. Digits completely separated

Day Eleven:
1. Days ten to twelve tend to run together. No different changes visible on this day.

Day Twelve:
1. Toes fully formed
2. First few visible feathers

Day Thirteen:
1. Appearance of scales and claws
2. Body fairly well covered with feathers

Day Fourteen:
1. Embryo turns its head toward blunt end of egg

Day Fifteen:
1. Small intestines taken into body

Day Sixteen:
1. Scales, claws and beak becoming firm and horny
2. Embryo fully covered with feathers
3. Albumen nearly gone and yolk increasingly important as nutrient

Day Seventeen:
1. Beak turns toward air cell, amniotic fluid decreases and embryo begins preparation for hatching

Day Eighteen:
1. Growth of embryo nearly complete

Day Nineteen:
1. Yolk sac draws into body cavity through umbilicus
2. Embryo occupies most of space within egg except air cell

Day Twenty:
1. Yolk sac completely draws into body cavity
2. Embryo becomes chick, breaks amnion, starts breathing air in air cell
3. Allantois ceases to function and starts to dry up

Day Twenty-one:
1. CHICK HATCHES

OBSERVING THE DEVELOPING EMBRYO

Candling

The development of the embryo can be observed by candling. Candling is done by holding a bright light on the large end of the egg in a darkened room and looking at the inside. "Candling" got its name from using a candle to look at the inside of the egg.

Candling serves three important functions. First, candling the egg before it is set will eliminate any cracked eggs from being set. Cracked eggs will not hatch. Second, candling helps determine which eggs are fertile. Third, by candling the eggs every few days you can observe the growth and development of the embryo without breaking the egg open.

ONCE THE CHICKS HATCH

Brooding

Whether there is one chick or 1,000 chicks in the brooding unit, the principles are the same. The chicks must be kept warm, well fed, watered, protected from predators and dampness and provided with plenty of fresh air without being exposed to drafts.

Newly hatched chicks can live on the unabsorbed yolk in their bodies for about 2 days if necessary. However, chicks with access to feed and water will begin to eat and drink when less than one day of age.

It is extremely important that you build and/or setup all necessary equipment at least two days prior to the chicks hatching.

Brooders should maintain a temperature of 95 °F (taken at one inch above the floor level, the height of the chick's back) during the first week, then decrease the temperature 5 °F per week until room temperature is reached.

The brooder should have a textured, absorbent litter on the floor. If the floor is slippery, the chicks can damage their legs.

Feed 18 to 22 percent protein chicken starter food. The feed can be placed in jar lids, egg cartons, small cans or a commercial chick feeder, any item which can hold enough feed to keep feed available at all times.

Water should be available at all times. Use watering equipment which prevents the chick from getting into it and drowning. Commercially made water fountains can be bought and added to a quart jar.

Clean the waterer and brooder daily. This will prevent odors and keep the brooder dry. Dampness provides favorable conditions for the development of molds and bacteria. Providing at least 1 square foot for every five chicks will also help keep the conditions more desirable.

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 - 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 - male reproductive cell.

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.

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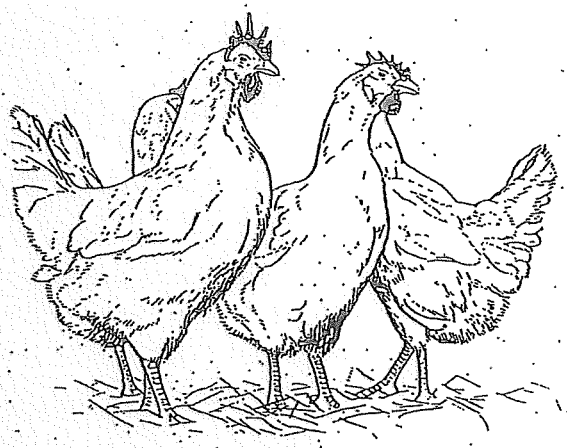
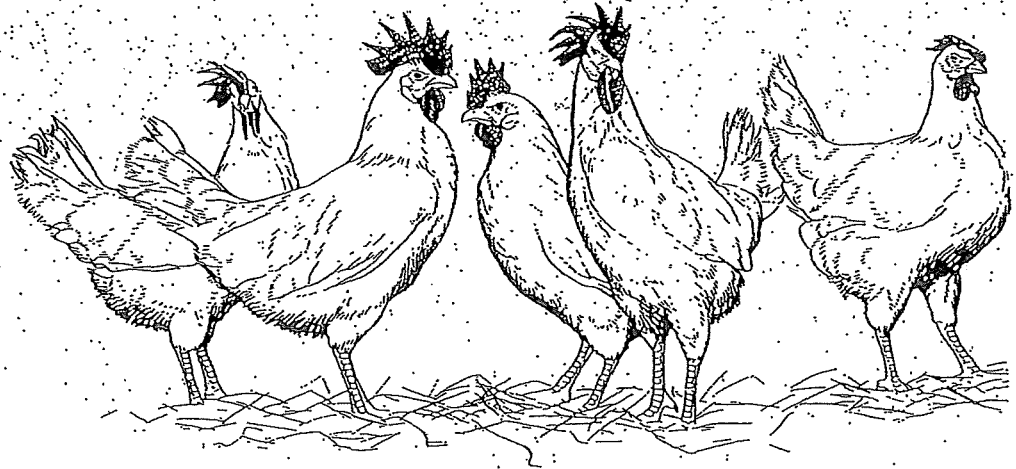


Non-Food Uses Of Eggs



Non-Food Uses of Poultry & Egg Products

Not every chicken and egg produced by the poultry industry is destined to end up on our plates. There are many uses for what is currently thrown away or has been thrown away in the past. Why pay to dispose of a product when there may be a way to put it to good use? The selection of products that follows will hopefully teach you about many of the non-food uses of poultry and egg products.

Eggs and Egg products

Glue – One of the first glues, egg whites can be used alone or in a mixture to glue objects together. Albeit not one the strongest glues alone, the adhesive properties of egg whites can be improved by adding flour, sugar, water, and alum in different amounts.

Hair Conditioner – An early non-food use of whole eggs, or just the fattier egg yolks, is as a hair conditioner. Adding an oil, such as olive oil, and the scent of your choice, can create a lovely hair conditioner. When mixing the ingredients, beat until frothy and leave in the hair for 20 minutes, then rinse with warm water. This hair treatment will help hair be less prone to breakage and shedding.

Face Mask – A long-time do-it-yourself facemask includes eggs as an ingredient. The yolk contains Vitamin A which has moisturizing properties. The protein in the egg white is also considered to have positive effects on reducing the size of pores or in reducing puffiness. There are many different recipes available depending on the needs of an individual's skin type.

Seed Starters – if cracked cleanly halfway around the egg, the shell itself can be used for starting seeds. Poke a hole in the bottom and fill the eggshell half with soil. Place the shell halves in an egg carton to keep them upright and plant the seeds inside. When ready to transfer to another container or be placed outside, then the shell and seedling can be planted together.

Abrasive Pan Cleaner – Eggshells can be washed, dried, and then crushed into a fine powder in order to create a natural abrasive pan cleaner. Mixing a cup of ground eggshells with 3 cups of baking soda, and then drying the mix is an acceptable blend for use in the home. It takes quite a large number of broken eggshells to make enough for a natural cleaner.

Toothpaste – Some toothpastes use an abrasive substance in the blend to aid in whitening teeth. This calcium carbonate ingredient comes from eggshells. It helps to remove stains from the surfaces of teeth.

Fertilizer – Eggshells can be washed, dried and ground up to create a soil amendment. It increases the calcium content of the soil which may be low due to the presence of excess nitrogen and low soil pH. When these soil conditions occur, then calcium uptake by plants that benefit from calcium such as tomatoes, peppers, eggplant, broccoli, cauliflower, swiss chard, and spinach. Extra calcium in the soil can also help prevent certain plant diseases such as blossom end rot.

Folk Art Decoration - Decorated eggs can take different forms. From Ukranian Pysanky to Romanian eggs, decoration using beeswax and colored pigments is commonly done using a tool called a kitsky. Artists can start with eggshells of different colors and sizes. Designs are made using dyes and symbols with different meanings, some of which are traditional.

Paint – Egg tempera paint is a mixture of pigment and egg yolk along with an extender such as vinegar, water or wine. Most mixtures will last only a day unless an extender is added to allow the paint to be used for up to a week or so. Tempera been used on Egyptian sarcophagi and in paintings because of its ability to last for long periods of time.

Vaccines – Fertilized whole eggs have been used for decades in the development and production of vaccines. Partially incubated eggs are given a dose of the organism for which a vaccine is needed. The inside of an egg is sterile so the chick will then provide the right atmosphere to reproduce the organism. After a few days of incubation, the virus is harvested from the eggs and either killed to make a killed vaccine or weakened in some manner to make an attenuated vaccine. An example of a common vaccine that uses this process is the Influenza vaccine or flu shot. People who are allergic to eggs can have an anaphylactic response if given a vaccine that was produced using eggs.

Plant Water – After you hard-boil eggs, the water can be cooled and used to water plants. Solanaceous plants, including peppers, tomatoes and eggplants, grow well with the slightly higher calcium content of the water.

Oxidizing Jewelry – Hard-boiled egg yolks, mashed and placed in a sealed plastic container with jewelry can be used as an oxidizing agent. Some jewelry appears better with more contrast as it brings out details in the design. Place the jewelry on a rack above the yolks for 1-2 days to create the effect.

Leather Cleaner – Egg whites are thick and sticky. Using egg whites on leather that needs cleaning will require a little gentle scrubbing to lift off the dirt and grime. Wipe with a damp cloth and dirt is removed with the whites. What remains is a little bit of protective cover and shiny leather.

Feathers

Down – Down feathers are collected from both ducks and geese. Down feathers have long been valued for their ability to insulate. These feathers have been used in bedding and clothing with good effect.

Art & Clothing – Collecting feathers that have been molted naturally or harvested from processed birds can be sorted and packaged. Feathers have been used to make masks and costumes for stage and gallery. Feathers can also be cut and painted as a canvas for artwork. Traditional Native American clothing, regalia, and headdresses have also included different types of feathers.

Fly-tying – Chickens bred for extra-long hackle and saddle feathers are prized by fly fisherman to be used in fly tying. Flies are tied in different configurations to mimic different types of insects preferred by fish. The hackle and saddle feathers can also be dyed to help sell the fish on the type of insect that the fly is designed to imitate.

Feather Fiber – This is made by removing the lighter feather material from the quill. Millions of tons of feathers are discarded as waste in the poultry industry annually. The poultry industry pays to have feathers removed from processing facilities. Some is re-routed into feather meal which is an ingredient in poultry feed. The success in routing more feathers into alternate products, such as those listed below, will be in creating feather fiber products who have more value than what is currently in use.

- Air Filter – Chicken feather composite paper is made of 51% feather fiber and 49% wood pulp. Feather fiber is finer than wood pulp fiber. Wood pulp fiber is 10-20 microns while feather fiber is 5 microns in diameter. This finer diameter removes more spores, dust and dander from the air, which is preferrable for those who have asthma.
- Sound Reduction – Chicken feather fiber can be used to make sound deadening composite material. This product has been used in locations such as cubicles, cars, and sleeping compartments.
- Fabric – Feathers are being processed into fiber components that resemble cotton, wool and linen. This method takes an agricultural waste product and turns it into an alternative to the petroleum based synthetic fibers currently in use.
- Miscellaneous – Feather fiber has been used on a limited basis in non-woven textile, bioplastic, energy storage, paper additive, cosmetics, and carbon nanotube production.

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