

NEBRASKA Agriculture

In The Classroom

Corn

A. Corn Plant

Corn is an annual plant that grows seven to ten feet tall. Strong roots called prop roots help support the cornstalk. A tassel grows at the top of each jointed cornstalk and contains hundreds of small flowers that produce pollen. Long, swordlike leaves grow outward from the stalk and end in a pointed tip.

B. Ear of Corn with Kernels

Ears of corn grow where the leaves join the stalk. A plant normally has one or two ears. Special leaves, called husks, protect each ear. An ear consists of a corncob covered with rows of kernels. An ear may have 8, 10, 12 or more rows of kernels.

C. Single Kernel or Seed

Each corn kernel has what looks like a silk thread that runs from the kernel up the row, and sticks out of the husk at the end of the ear.

This thread is called the corn silk. Each silk needs to be pollinated to produce a kernel of corn.



Corn

Most of the corn grown in the United States is produced in the Corn Belt, which includes Iowa, Illinois, Minnesota, Indiana, Nebraska, Ohio, Missouri and South Dakota. Producers in the United States feed most of the corn crop to cattle, hogs, sheep and poultry. The rest is used for processed food or industrial products such as cornstarch and plastics.

The different types of corn include dent corn, sweet corn, flint corn, popcorn, and flour corn. Dent corn and flint corn are commonly called "field corn" because they are fed to animals. Sweet corn, popcorn and

flour corn are used for human food.

Field of Corn

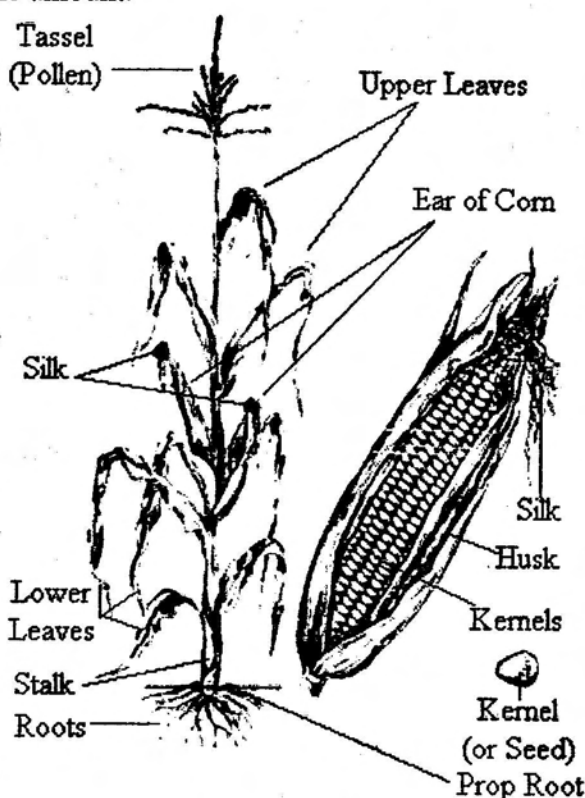
Producers use hybrid seeds to grow crops each year. Hybrid corn is made by crossing two or more corn plants to produce a reliable corn seed. Corn is planted in the early spring using a corn planter. The machine drops the kernels into rows and then presses the soil around each kernel. A producer cultivates the corn when it is still small. This is similar to hoeing a garden. It helps get rid of the weeds that compete with the corn plants for water and nutrients.

The Growing Factor

Today's producer grows a bushel of corn with only six minutes of labor using tractors and special equipment. Native Americans, by hand-planting, hand-hoeing and hand-picking, required 20 hours of labor to produce the same amount.

Before a producer plants the corn seeds, fertilizer is placed in the soil, which helps feed the corn plant. The rest is up to the weather. Rain is extremely important because the corn plant needs a lot of water to grow.

Sometime between late September and November the corn will be dry enough to be picked, or harvested. Corn is harvested by a large machine called a combine. The combine cuts off the plant, removes the ear of corn and separates the kernels from the corn cob. The corn stalks and corncobs are left in the field to protect the soil for the next year.



Food and Product Line

After harvest, the corn kernels will go to a processing plant to be made into food. Corn makes oil, syrup, cereal, starch and more than 1,000 other products you can buy at the grocery store.

Corn kernels are used to make fructose, a liquid sugar used to sweeten soda pop and bakery goods. Cornstarch is also made from corn. It can be used to produce packaging materials which help protect the environment. Ethanol is made from corn and is used as fuel for cars,

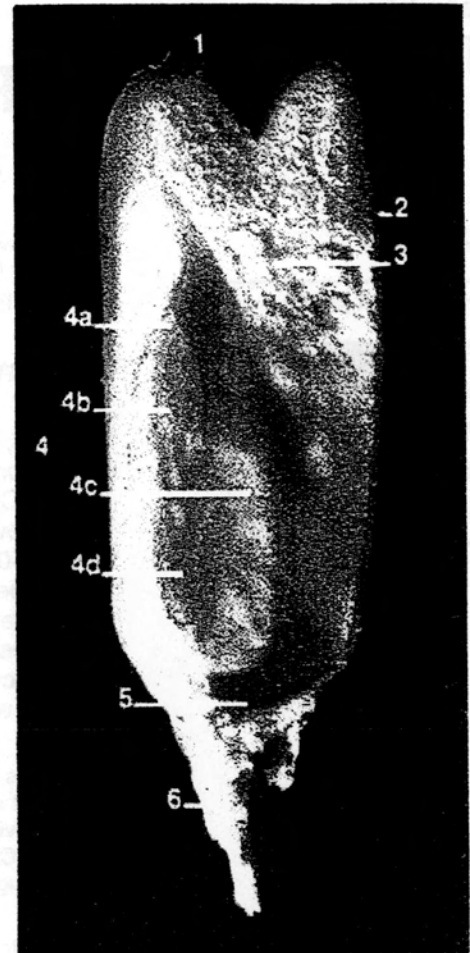
trucks and buses. Corn grown in the United States is also shipped to other countries such as Japan, Russia and Mexico.

Figure 4

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1. Silk scar
2. Seed coat
3. Endosperm
4. Embryo
 - a. coleoptile
 - b. plumule
 - c. scutellum
 - d. radicle
5. Black abscission zone
6. Pedicel

<http://maize.agron.iastate.edu/fig4.html>



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POPCORN

By Lynn Sibley



Did you ever wonder why popcorn pops? Just what is the white stuff? And what was the vapor that escaped from the container? There is a lot of interesting chemistry in a kernel of popcorn. Fill up your bowl and read on.

An American heritage

Popcorn, a New World grain, has been an American favorite for centuries. Fossil corn pollen, 80,000 years old, has been found in excavations under Mexico City. It is very similar to modern corn. Kernels of popcorn 4,000 years old discovered in Bat Cave, NM still pop. Precolumbian pottery poppers date back 1,500 years. According to Paul Mangelsdorf, Harvard popcorn researcher, "All races of wild corn were popcorns, their kernels small and flinty in texture, almost impossible to chew, and difficult to grind. Their real usefulness was discovered when kernels accidentally exposed to the heat of glowing coals exploded to become tender, tasty morsels with the nutritional value of whole grain bread."

Columbus found the natives in the West Indies not only eating popcorn, but also wearing it as jewelry. The English colonists were introduced to popcorn at the first Thanksgiving feast when an Iroquois Indian brought a deerskin bag of popped corn as a gift. Quick to put this unusual food to use, the colonial families ate popcorn with cream, sugar, and fruit for breakfast—the first "puffed" cereal.

Popcorn took to the streets in 1885 when Charles Cretors invented the steam-powered popping machine. In 1893 our first "junk food" was introduced at the Chicago World's Fair—a combination of popcorn, peanuts, and molasses called Cracker Jack. Popcorn became an irresistible attraction at baseball games and circuses. Then, a new fad called "movies" took popcorn inside, and sales exploded.

Steam power

Popcorn, a cereal grain like wheat or oats, is about three-fourths carbohydrate in the form of starch, with smaller amounts of protein, fat, minerals, and water. The water plays a critical role in the popping process. When heated, the moisture inside the kernel turns into steam. As the pressure increases, the starch expands and the kernel explodes. We like popped corn that is large and tender. This requires just the right amount of water in each kernel. Farmers harvest popcorn when the moisture content is 16–19% by mass. To ensure maximum popping expansion, the corn is then carefully cured or dried until the moisture content reaches 13–14% by mass.

Like other cereals, popcorn kernels consist of three main parts: the pericarp (the hull or outer covering), the germ (the part that sprouts), and the endosperm (the starch that expands). Popcorn acts the way it does because of the special construction of the pericarp and the microscopic structure of the endosperm.

Popcorn has an extra strong pericarp. This tough, protective layer acts like a seal, holding in the steam until the pressure builds up high enough and the kernel explodes. If the pericarp has been cut or cracked during processing, the steam will be vented and the kernel will not pop properly.

Corn has two kinds of endosperm, translucent and opaque, which are named according to their appearance. The expansion, or popping, takes place in the tightly packed translucent endosperm. Popcorn contains mostly translucent endosperm, which is better at popping.

Where the action is

Before you start cooking popcorn, The pressure inside and outside the kernel is the same. As the kernel heats, the moisture turns to steam, and the internal pressure of the kernel rises. When the temperature inside the kernel climbs above 100 °C, you might expect that all the water would turn to steam. In fact, only a small amount vaporizes because the tough pericarp acts like a pressure cooker. The high-pressure steam penetrates the starch granules and transforms them into hot, gelatinized globules. Finally at about 175 °C, when the pressure inside the kernel is about 9 atm, the pericarp ruptures.

The steam and superheated water, now surrounded by normal-pressure air, become the driving force that expands the kernel. The gelatinized starch granules do not explode, but expand into thin, jellylike bubbles. Neighboring bubbles fuse together and solidify, forming a three-dimensional network much like a sink full of soapsuds. This is the white fluffy solid we eat. The moisture content of the kernel is now about 1–2% by mass, and the popcorn is transformed into a tender, fluffy morsel.

Pop art

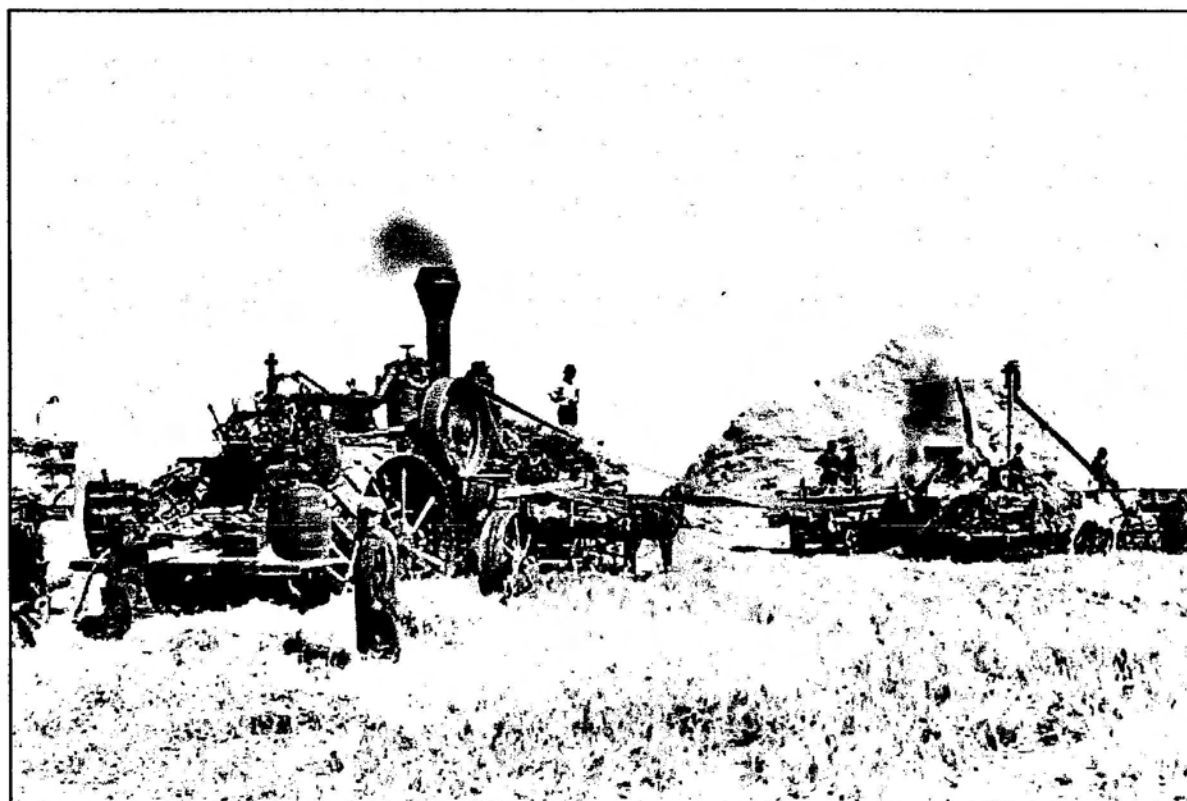
You can pop your corn several ways. One is the dry method. Used first by the New World natives, who popped corn in ceramic pots over open fires, this method has been revived in hot-air poppers. Another is the wet method, using oil. The newest method is popping by microwave oven. The microwave popcorn bag is complete with oil and seasoning. When placed in a microwave oven, the bag expands as the popcorn pops.

To maintain the ideal moisture content of 13–14% by mass, store popcorn in tightly covered containers at a cool temperature. Unpopped corn can lose as much as 3% moisture by mass in five to six days if it is not sealed tightly or if it is too hot. To restore dry popcorn, fill a 1-liter jar 3/4 full of popcorn, add 1 tablespoon of water, cover tightly, and shake thoroughly. In about four days, your popcorn will be ready to give you its best—it will be tender, fluffy and delicious.

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Northern Great Plains, 1880-1920



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Threshing Machine

After the grain had ripened sufficiently in the shocks, it was ready to be threshed so that the farmer could sell it. The threshing process, where grain was removed from the stalks, was accomplished through the use of a threshing machine. Large farmers usually owned their own threshing machines, but many times farmers depended on custom threshermen to do the threshing for them. Regardless of machine ownership, however, the threshing process required a huge amount of labor. Each member of the threshing crew had a specific job to accomplish when the threshing rig arrived.



The steam engineer set it up in a location close to the grain field, or where the farmer wished to have the straw blown. Next, the steam engine was belted up to the threshing machine, and all the pre-threshing maintenance was completed on the threshing machine. Concurrently and after the threshing machine was started, a team of workers called "bundle haulers" went out into the field and loaded shocks onto a horse-drawn wagon. After the wagon was filled, the bundle haulers then brought it up to the spot where the threshing machine was set up.

Soon the threshing machine was started, and men standing on top of the wagon pitched down the grain bundles into the threshing machine's bundle feeder. The conveying chain of the bundle feeder then transported the grain bundles into the threshing machine cylinder where most of the grain was separated from the stalks. The separated grain fell to the bottom of the threshing machine, while chaff and dust was removed by a fan as it descended. An elevator on the threshing machine then transported the loose grain into a grain wagon parked nearby or into individual bags, depending on the method that the farmer preferred. After the straw went through the cylinder, it was continually battered as it progressed along, ensuring that all the grain was removed from the stalks. At the rear of the threshing machine, after the straw had passed over the straw walkers, it was deposited in a fan housing which propelled the straw through the blower and into the straw stack. This series of machine processes was repeated continuously, until all of the farmer's grain was threshed. Overall, while there definitely was an immense amount of labor involved in the use of a threshing machine, it drastically improved the efficiency and capacity of the threshing process over previous methods.

[Photo 01](#) | [Photo 02](#) | [Photo 03](#) | [Photo 04](#) | [Photo 05](#) | [Photo 06](#)


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Single Tine-Separation (STS)



Two new models join the advanced lineup: the 9560STS is a mid-size machine with 265 hp; the 375-9860STS is the largest, most powerful machine John Deere has ever produced.

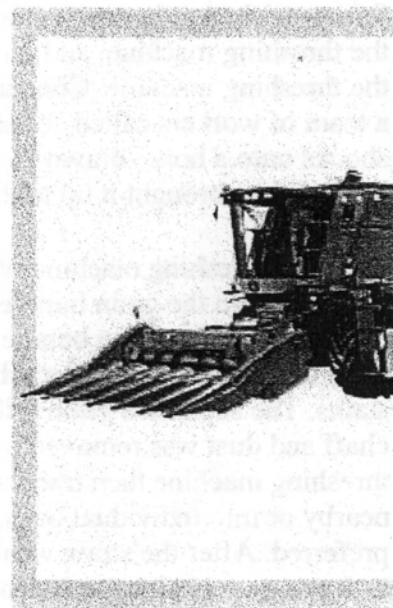
Key new features of 60 Series :

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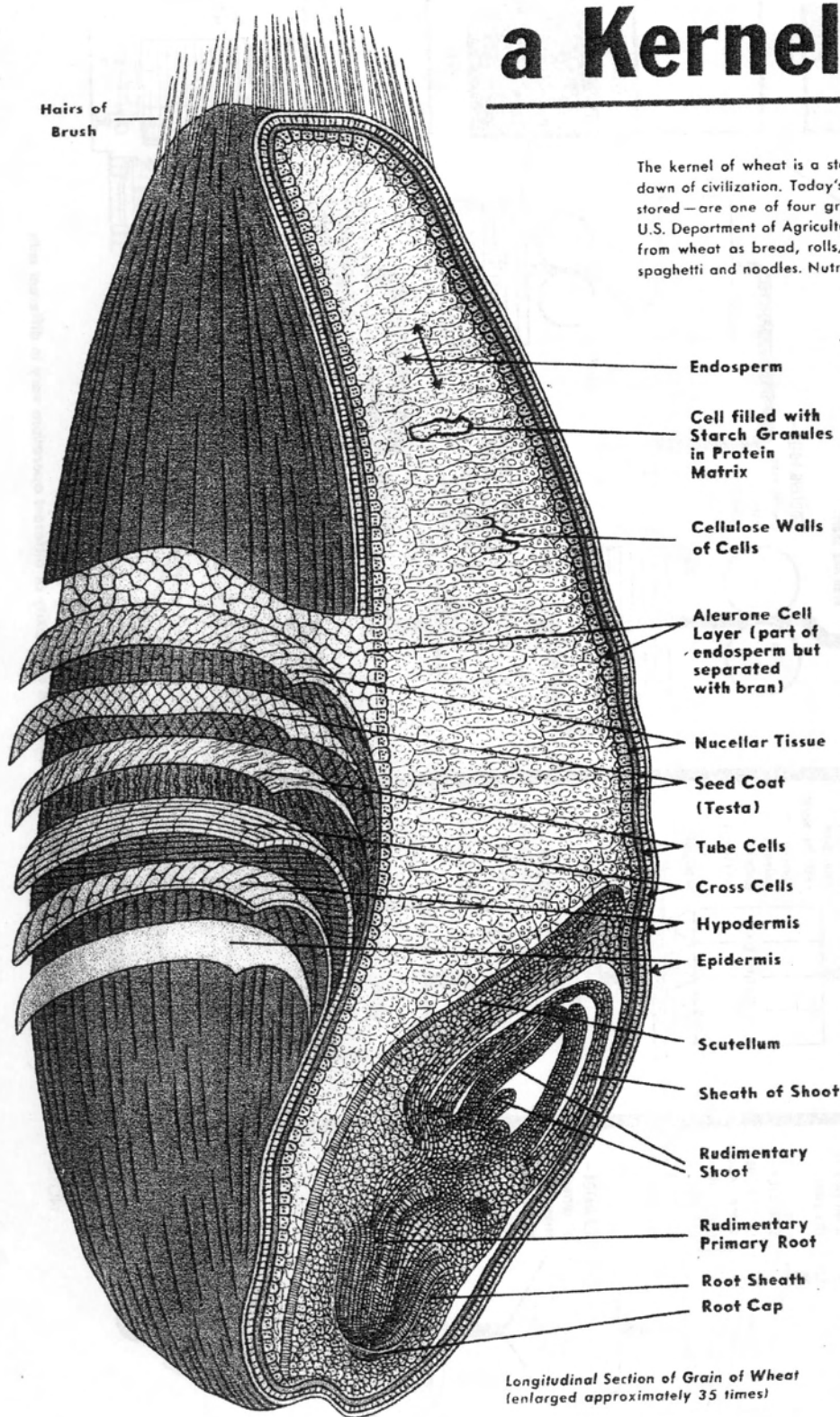
[STS Combine Quick-Specs](#)



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[About Our Site](#)

a Kernel of Wheat



Longitudinal Section of Grain of Wheat
(enlarged approximately 35 times)

The kernel of wheat is a storehouse of nutrients needed and used by man since the dawn of civilization. Today's bread, flour and cereals—enriched, whole grain and restored—are one of four groups of food recommended for optimum nutrition by the U.S. Department of Agriculture. This popular, low-cost group includes such foods made from wheat as bread, rolls, biscuits, muffins, pancakes, breakfast cereals, macaroni, spaghetti and noodles. Nutrients listed below are considered essential in human diet.

ENDOSPERM

... about 83% of the kernel
Source of white flour. Of the nutrients in the whole kernel the endosperm contains about: ⁽¹⁾

70-75% of the protein	} B-complex vitamins
43% of the pantothenic acid	
32% of the riboflavin	
12% of the niacin	
6% of the pyridoxine	
3% of the thiamine	

Enriched flour products contain added quantities of riboflavin, niacin and thiamine, plus iron, in amounts equal to or exceeding whole wheat—according to a formula established on the basis of popular need of those nutrients.

BRAN

... about 14½% of the kernel
Included in whole wheat flour but more often removed and used in animal or poultry feed. Of the nutrients in whole wheat, the bran, in addition to indigestible cellulose material contains about: ⁽¹⁾

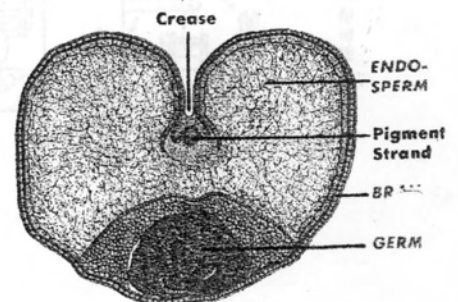
86% of the niacin
73% of the pyridoxine
50% of the pantothenic acid
42% of the riboflavin
33% of the thiamine
19% of the protein

In animal and poultry feeds, these nutrients are available. In human diet, the cellulose material of the bran tends to speed the passage of food through the digestive tract—making the total nutritive contribution less than from enriched white flour products.

GERM

... about 2½% of the kernel
The embryo or sprouting section of the seed, usually separated because it contains fat which limits the keeping quality of flours. Available separately as human food, but usually added to animal or poultry feed. Of the nutrients in whole wheat, the germ contains about: ⁽¹⁾

64% of the thiamine
26% of the riboflavin
21% of the pyridoxine
8% of the protein
7% of the pantothenic acid
2% of the niacin



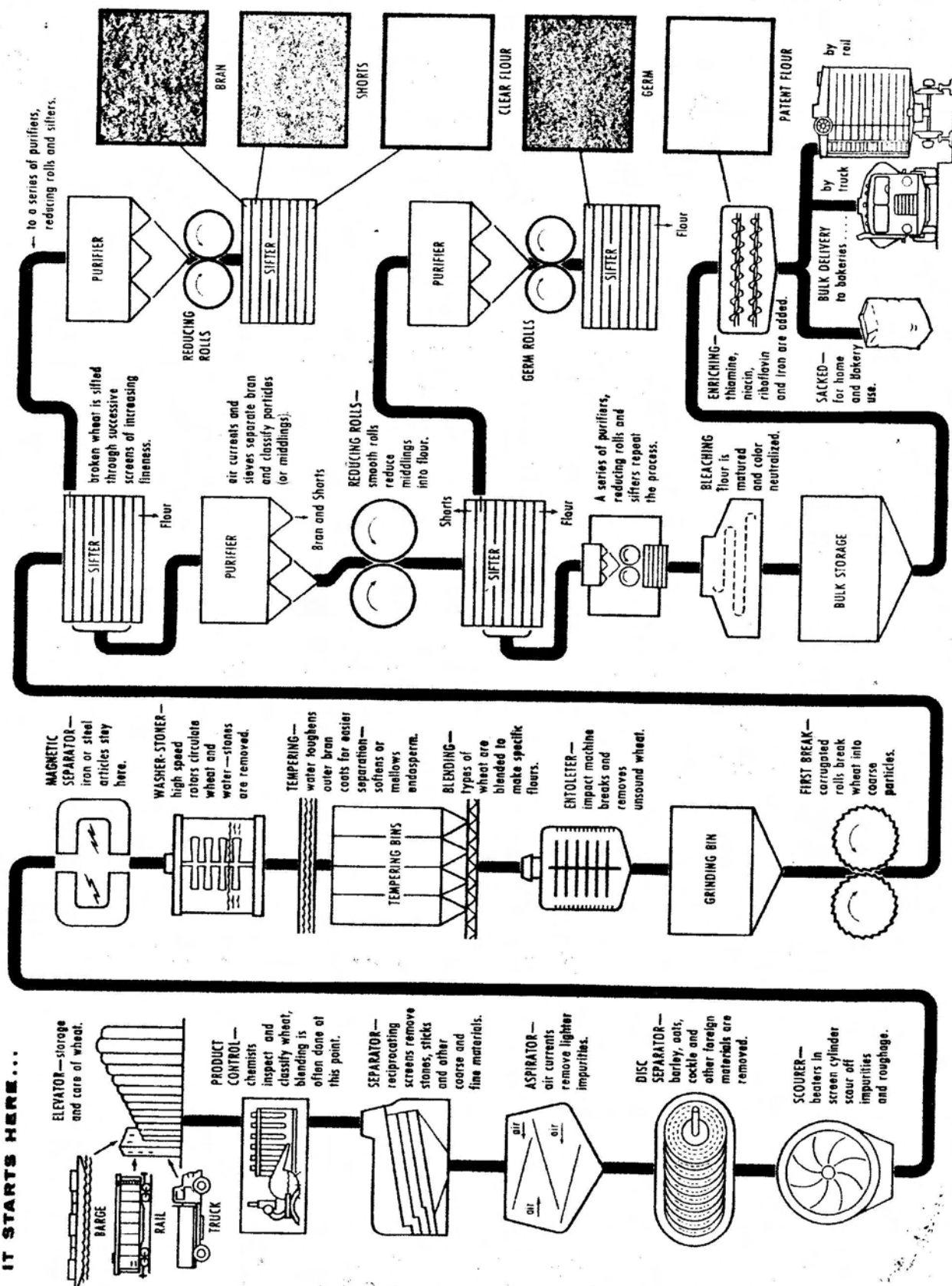
As a product group in the U.S. Department of Agriculture's recommended Daily Food Guide for good nutrition—bread, flour and cereals make a generous contribution to human requirements for the B-vitamins—thiamine, niacin and riboflavin—and the mineral, iron. They also help fill daily needs for protein and calcium. The other three food groups are: milk and milk products; meats, poultry, fish,

eggs and dry lentils; fruits and vegetables. Nutritionists advise eating a variety of foods from each of the four groups every day to obtain all the nutrients necessary for adequate diet. With fresh, frozen, canned and prepared foods readily available, it is easy for everyone to satisfy nutritional requirements by following the Daily Food Guide.

HOW FLOUR IS MILLED

(A SIMPLIFIED DIAGRAM)

IT STARTS HERE...



NOTE: This chart is greatly simplified. The sequence, number and complexity of different operations vary in different mills.