Nearly as long as humans have been drinking milk, they have been making cheese products from that milk. Cheese continues to be a healthy and popular aspect of our daily diets. From salads and pizza to hamburgers and snacks, cheese has definitely made an impact on the type of food we eat.

Objective:
Examine cheese making and explain how microorganisms play a role in this process.

Key Terms:
- curd
- hydrolyze
- proteolytic enzymes
- rennet
- ripening
- whey

How Cheese Is Made
For cheese to be created, milk must curdle and begin to ferment. Milk contains about 3.5 percent protein. About 80 percent of that is casein. Casein is a phosphoprotein that is a major component of milk and the basis for all cheeses. Cheese is a food product made by separating the curd, or soft, semisolid substance composed mostly of casein, from the whey, or watery liquid separated from the curd after coagulation. Curds are formed as casein is affected by the acid buildup created by fermenting bacteria. At this point, neither the curd nor the whey is very appetizing.
Proteolytic enzymes, or proteins produced by living cells to speed up the transformation of milk casein into curd, will cause the coagulation of the curds. These enzymes hydrolyze, or break down, the milk proteins into an unstable state in which curds will begin to form. This curd formation usually begins when the pH level of the liquid milk has fallen to near 4.6. Fermentation of lactose, which causes the accumulation of lactic acid, will lower the pH of the liquid milk.

Several factors can affect the coagulation and curdling process. High temperatures and strong acidity will both increase the coagulation of the milk proteins. On the other hand, higher milk fat content of liquid milk will produce lower amounts of coagulation during the same conditions. Sometimes, cheese makers use the enzyme rennet to aid in the fermentation process. Rennet helps milk proteins to link together and will encourage the formation of curds.

ON THE JOB...

CAREER CONNECTION: Cheese Maker

Cheese making is such an ancient and worldwide practice that many consider it almost an art form. Cheese making is a very physical process, the cheese maker being required to lift, skim, mold, and package large amounts of dairy products and cheese.

A cheese maker first uses machines to separate the curd from the whey of processed milk. Curds are then collected, cut, and formed into measured slabs. The slabs are fed into a mill that cuts the curds into smaller pieces, which are, in turn, salted and placed into hoops (cheese forms) that press the curds to remove excess whey. Cheeses are then placed in brine tanks or rolled in salt before the aging process begins. Some cheeses are treated with cultured washes to promote mold growth that will affect their flavors and smells. Finally, the cheeses are processed, packaged, and shipped to stores for sale to consumers.

A career in cheese making requires a basic knowledge of chemistry, food physics, and dairy products. Apprenticeships are a common route for new employees to enter the cheese-making industry. Salaries for cheese producers vary based on the location of the industry, the size of the production plant, and the type of cheeses being produced.
Milk

Pasteurized [161°F (71.7°C) — 16 sec.] or heat treated whole milk [145.4°F (63°C) — 16 sec.]

Setting

Cool milk to 87.8°F (31°C). Add 1–2% lactic starter and hold 30 min. Introduce 200 ml rennet extract per 1,000 kg warm milk. Add color if required.

Curd Formation

10–15 min.

Cutting Curd

Use 1/4–5/8" knives.

Cooking

Cook cut curds slowly with stirring by direct jacket steam to 100.4°F (38°C) in 30 min. Hold at 100.4°F (38°C) for 30 min. Stir intermittently.

Draining Whey

Cheddaring

After 15 min., cut curd bed into blocks. Turn every 15 min. and pile two high. Continue for about 2 hr. until pH 5.3.

Milling

Reduce blocks to domino size by inserting into slicing machine—for better salt absorption.

Salting

1.5–1.75%

Hooping and Pressing

Application of Cheese Bonding Materials

Use Wax, Plastic, or Wrapper Coating Materials

Ripening — 3–9 Months at 39.2°F (4°C) – 50°F (10°C)

Storage — 39.2°F (4°C)

FIGURE 2. The cheddar cheese manufacturing process.
Once cheese has been made, it must be allowed to age and ripen. **Ripening** is the process of cheese enzymes breaking down fats, carbohydrates, and proteins over time. The ripening process is critical to produce the flavors and textures of the various kinds of cheeses. The environmental conditions experienced during ripening, along with the amounts of salt and flavor enhancers used, will create the numerous cheeses that consumers desire. Each type of cheese has a specific ripening time and definite conditions necessary to create that cheese. Some cheeses must be ripened for a year or more to produce their specific flavors. Various molds can be added during the ripening process to create specialty cheeses, such as Swiss or blue cheese.

**FIGURE 3.** Colors and flavors of cheeses are dependent on factors experienced during ripening.

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**UNDER INVESTIGATION...**

**LAB CONNECTION: Making Cheese**

Milk is one of nature’s most perfect foods. Alone it has the nutrients to sustain life and satisfy most of our dietary requirements. Over the years, milk has been developed into a vast number of dairy products. One of the most popular and widely eaten forms is cheese. Thirty percent of all the milk produced in the United States is used for making cheese.

More than 400 different types of cheese are manufactured in the United States, with about 12 million tons of cheese produced each year. Cheeses are constantly being researched and developed with such techniques as the use of microencapsulated enzymes to decrease the time needed for aging. Approximately 10 pounds of whole milk are needed to make 1 pound of hard cheese, and about 6 pounds of fat-free milk are needed to make 1 pound of cottage cheese. The large ratio of milk to cheese and the high demand for cheese help keep the dairy industry strong in our country.

You can easily produce cheese in your own classroom by using a cheese-making kit from a science catalog or supplies bought locally. A brief description of the procedure follows. Nonfat dry milk is mixed with water. *Lactobacillus* bacteria are added. The milk is heated and allowed to ferment. After incubation, salt is added, along with the enzyme rennet. After 15 minutes, the cheese is strained through cheesecloth. It can then be allowed to age for several weeks. The aging process of some cheeses can be lengthy, taking up to a year or more.
Summary:

An ancient and nutritious product from milk is cheese. Cheese is created by a churning process that separates the curd from the whey when liquid milk curdles. The whey is removed, and the curd is processed. Additives, such as salt, are used to create various flavors and smells associated with different cheeses. Some cheeses must go through an aging period, known as ripening, to fully enhance their color, smell, and flavor.

Checking Your Knowledge:

1. Define *curd* and *whey*.
2. How does pH play a role in the production of cheese?
3. Why is the ripening process important in cheese making?

Expanding Your Knowledge:

Using the Internet and/or print-media materials, research the making of your favorite kind of cheese. Prepare a report on your findings.

Web Links:

- National Dairy Council
  

- Vermont Dairy—How Cheese Is Made
  
  [http://www.vermontdairy.com/farm_to_you/cheese](http://www.vermontdairy.com/farm_to_you/cheese)

- Agricultural Career Profiles
  
  [http://www.mycaert.com/career-profiles](http://www.mycaert.com/career-profiles)