



From Milk to Cheese & Seed to Shelf

Career and Technical Education Introduction Agricultural Science in Your Shopping Cart

Purpose

To use cheese making as an introduction to a detailed exploration of career possibilities and opportunities in science-based agriculture and biotechnology.

Time: Two or three 45-minute sessions

Level: Elementary

Materials

Activity 1

- Computer lab or computer and projector for presentation
- Computer speakers or headphones
- Computer internet access or Agricultural Technologies and Education software (available from Utah ATC)
- Biotech Cheese Kit
- 2 crockpots
- Rennet
- Thermometer
- Large spoon
- Large kettle
- Colander
- 8-cups powdered milk
- 2-quart buttermilk
- Salt
- 2 small bowls
- Crackers
- Herbs (optional)
- "Understanding Biotechnology," CD, optional, available from Utah ATC
- "What is Biotechnology," bulletin board, lesson plan, and worksheet, optional, available from Utah ATC
- "Bringing Biotechnology to Life," optional, available from Utah ATC

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Utah Agriculture in the Classroom

Background

Food production, processing, and preservation techniques have changed drastically in the United States over the last 200 years. This lesson looks at three major agricultural changes—the science of biotechnology, the science of food preservation, and the business of processing and distribution—through these classroom activities.

Activity Procedures

Activity 1: Making Cheese, Old and New

Biotechnology is a relatively new term that is defined as "techniques that use living organisms or parts of organisms to produce a variety of products (from medicines to industrial enzymes) to improve plants or animals or to develop microorganisms to remove toxins from bodies of water, or act as pesticides." With this definition, humans have been practicing "biotechnology" since the dawn of civilization. Over time, humans have wanted access to more high quality food and have sought out methods or techniques to improve agricultural production and food preservation. Today, we still want quantity and quality, but we also want food to be inexpensive.

As science has advanced, the ability to modify organisms through the tool of biotechnology has resulted in "genetically modified organisms" or GMOs. Some of these GMOs are controversial, especially if the GMO has caused or has the potential to cause a change in the environment.

A positive example of biotechnology and the resulting GMO can be found in cheese making. According to legend, cheese was "discovered" thousands of years ago by a traveler who placed milk into a pouch made from a sheep stomach. During the journey, the sun's heat and the enzymes in the lining of the stomach pouch changed the milk into curds and cheese whey.

Scientists later discovered that the enzyme rennin (produced in calf stomach lining cells) would coagulate the protein (casein) in milk, forming curds and whey. Because the enzyme reacts with a protein, the enzyme is called a protease. Commercial rennin products, available in most grocery stores sold as "Rennet" or "Flanest," are made from the enzymes found in the fourth stomach of calves. Through biotechnology, the gene from the calf stomach cell which makes the cell produce the enzyme, rennin, is removed and inserted into a bacteria or yeast cell. This causes the organism (bacteria or yeast) to produce the enzyme. Yeast replicate and grow rapidly, so yeast is often used to duplicate the enzyme. In the past, a large number of milk fed calves have been slaughtered for the rennin in their stomachs to supply cheese manufacturers. Through biotechnology, the enzyme-producing gene can be extracted, purified and concentrated – no calves necessary. This creates an endless supply of the human-made enzyme with the commercial name of "Chymosin." Today in the United States, about 80 percent of cottage cheese and 50 percent of all other cheeses are made with the enzyme Chymosin which has been isolated from a microorganism which has been genetically engineered through biotechnology.

Cheese making is really the removal of water from milk (milk is 87% water and 13% solids). This is done by coagulating the protein in the milk. Coagulation changes the chemistry of protein so it is no longer water-soluble.