The science of milk
How do cows produce milk?

All mammals produce milk to feed their young. Animal milk is a healthy source of the nutrients that ensure proper growth and development. Cows are a common source of milk for human use. But how do cows produce milk?

Before a cow can begin producing milk, she must have a calf. After giving birth, the cow uses nutrients from the feed she eats to stay healthy and produce milk. These nutrients include water, vitamins, protein, carbohydrates, fats and minerals.

After the cow eats the feed, the feed moves into her “stomach.” The cow’s stomach is made up of four different chambers: the rumen, reticulum, omasum, and abomasum! The rumen has good bacteria that help break down the feed. The reticulum softens the feed and removes bad objects, like nails, that were eaten accidentally. The omasum continues to break down the feed. The abomasum digests feed with special stomach juices. The abomasum then passes the feed to the cow’s intestines.

To help break down the feed, the cow also regurgitates her feed. This means the cow brings up feed from her rumen and chews it again. Once back in the mouth, the partially digested feed is called cud. Because cows do not have any front teeth on their top jaw, chewing their feed again allows for better digestion.

Digested feed moves to the small intestine where some of the nutrients are absorbed into the bloodstream. Nutrients that are not absorbed...
are then excreted as manure or urine.

Nutrients that were absorbed are carried in the bloodstream to the udder. The udder is made up of four **mammary glands**. A mammary gland is an organ that produces milk. A mammary gland is made up of billions of **alveoli** (pronounced al-vee-oh-lie). Alveoli are special hollow places where milk is produced. The alveoli remove nutrients from the blood and transform these nutrients into milk. The alveoli move the milk into the milk ducts. The milk then flows into larger collection ducts just above the teat. The teat serves as the exit point for milk.

Milking time is signaled by the hormone **oxytocin** (pronounced oxy-toe-sin). In the United States, most cows are milked by a **milking machine**. The milk is then collected in a big container called a tank. Then the milk is cooled and later picked up for processing into different dairy products.

Did you know that there is an easy way to find real dairy products in the store? Look for the **REAL® Seal**! The REAL® Seal is a label placed on all food products in the United States that contain real dairy products made from milk.
Fun facts about milk!

In one day, a cow can make enough milk to supply Mozzarella cheese for 40 pizzas.

One hundred pounds of milk makes five pounds of butter, ten pounds of cheddar cheese, or eight gallons of ice cream.

Female sheep and goats have two mammary glands and two teats. Female pigs have 12 to 14 teats and two mammary glands per teat. Female horses have four mammary glands and only two teats.

On average, cows make about eight gallons (30.3 liters) of milk every day.

When many people think of dairy cows, they think of cows with black and white spots. These cows are called Holsteins.

All mammals produce milk for their young. Even female dolphins can make milk.

Try it!

Be a dairy scientist: Make your own butter

What you need: 1 half pint of whipping cream, 1 small glass or plastic jar

1. Pour half of the half pint of whipping cream into the glass jar or plastic container. Put lid on tightly.

2. Hold the jar with your thumb on the bottom and fingers on the top.

3. You can take turns shaking the jar with friends until the cream has passed from liquid to whipped cream and finally to butter and buttermilk.

4. Squeeze out most of the buttermilk with a spoon. Spread the butter on crackers or bread and enjoy!
Find the bold words!

**Alveoli**: Specialized hollow places in the udder where milk is made.

**Bovid**: Any of various hoofed, horned mammals of the family Bovidae, which includes cattle, sheep, goats and buffaloes.

**Carbohydrate**: A compound found in many foods. Carbohydrates are produced in green plants by photosynthesis and serve as a major energy source in animal diets.

**Cow**: A fully grown female bovid.

**Cud**: Feed that has been partly digested and brought up from the rumen to the mouth for further chewing by animals like cattle and sheep.

**Feed**: Animal foodstuffs. For example: corn can be an important ingredient in cattle feed.

**Genetics**: The scientific study of how traits are passed on from organisms to their offspring.

**Nutrient**: A substance that provides nourishment for growth or metabolism. Plants absorb nutrients mainly from the soil in the form of minerals and other compounds.

**Rumen**: The first and largest division of the stomach in ruminant animals, in which the food is fermented by microorganisms.

**Silage**: A crop that has been preserved in a moist, succulent condition by partial fermentation in a tight container (silo) above or below ground. The main crops stored in this way are corn, sorghum, and various legumes and grasses.

**Udder**: The organ where milk is produced. Cows, sheep and goats all have udders.

**Warm-blooded**: Having a relatively warm body temperature that stays about the same regardless of changes in the surroundings. Birds and mammals are warm-blooded.

Bonus word: Animal poop (called manure) can be added to fields and gardens to help plants grow. Plants like all the nutrients in manure!
Jeff Ettling is a scientist who works hard to preserve amphibians and reptiles.

Ettling works at the Saint Louis Zoo, where he is the curator of **Herpetology** and Aquatics. Herpetology (pronounced her-pe-tall-o-gee) is the study of **amphibians** (frogs, toads and salamanders) and **reptiles** (snakes, lizards and turtles).

Ettling’s favorite animals are snakes. He currently studies **Armenian vipers** and their habitat. Armenian vipers are venomous snakes that grow around three feet long. They live near mountains in Turkey, Iran and Armenia.

The viper has been threatened recently due to land development and over-collection of the viper for the pet trade. Ettling works with farmers, landowners and conservationists to develop ways to protect the viper.

He also studies the **Ozark hellbender**. The Ozark hellbender is an endangered salamander that lives in streams in Missouri and Arkansas. The Saint Louis Zoo and Missouri Department of Conservation recently developed a recovery program for the Ozark hellbender. This year was especially exciting for the program. The zoo became the first to hatch baby Ozark hellbenders in captivity!

“It has taken a lot of brainstorming to develop a habitat that the salamander would use to reproduce. It was great to see what science can do,” said Ettling.

Ettling’s favorite classes in school were biology
and life sciences. Ettling majored in biology during college. He also earned a masters degree in biology. Ettling then began working at the Saint Louis Zoo with reptiles and amphibians.

“I have a lifelong love of reptiles and amphibians. From the time I was in junior high, I knew that I wanted to be a herpetologist,” said Ettling.

Growing up, Ettling had pet snakes, lizards and turtles. Ettling said having pets helped him develop responsibility and learn more about animals.

Ettling offered advice for anyone interested in animal science or working in a zoo:

“It is important to get practical experience. This could be at a zoo, vet clinic or wildlife conservancy. If you have the opportunity to volunteer, do an internship, or externship. It will help give you the edge over others. Make sure you love what you do,” said Ettling.
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