

The Science and Art of Cheese Educator Guide

A resource for using QUEST video in the classroom

Watch it online <http://science.kqed.org/quest/video/the-science-art-of-cheese/> | 10:26 minutes

QUEST SUBJECTS

Life Science **Biology**
Health
Environment

Earth Science Geology
Climate
Weather
Astronomy

Physical Science Physics
Chemistry
Engineering

CONNECTIONS TO THE SCIENCE CLASSROOM

The resources in this guide provide information on

- the importance of microbes.
- the chemistry of cooking.
- using the scientific method in industry.

PROGRAM NOTES

Cheese comes in more than 2,000 varieties. This nutritious food has been made for thousands of years. Take a journey to Cowgirl Creamery in Marin to learn how artisan cheeses are made. See how scientists can put cheese under the microscope to gain new insights about this incredible food.



In this segment you'll find...

- the chemical functions of various ingredients utilized during the science and art of cheese making.
- how cheesemakers study and vary the process to alter the final texture and taste.

TOPIC BACKGROUND

Cheese has been valued for thousands of years because of its portability, long life, and rich nutrient content. It's possible that cheese was discovered accidentally when milk stored in the stomach of an animal was separated into curds and whey by the stomach's rennet enzyme. Today cheese is typically made from the milk of cows, goats or sheep. The process of making cheese first involves adding acid (such as vinegar or lemon juice) to the milk. Adding rennet then facilitates the coagulation of the milk protein. The solid curds are separated and pressed into a moist gel. Some soft cheeses are then drained, flavored and packaged. Hard cheeses are usually heated to remove more whey from the curd. Adjusting the salt content affects the firmness and flavor of the cheese while preventing the cheese from spoiling. The final shape of most cheeses comes from the curds being pressed into a mold. More pressure on the cheese makes a harder cheese. Finally, the cheese is aged. This process can last from a few days to several years. As cheeses age, bacteria and mold change the texture and transform the flavor.

Thousands of cheeses are produced every year. Their tastes and textures depend on several factors, including the origin of the milk, the bacteria and mold utilized, and the degree of pasteurization, processing and aging. The many different varieties of cheeses are classified according to these criteria, as well as by fat content, country of origin and moisture content. Today scientists purposefully tinker with these variables to produce artisan cheeses with new flavors -- and new followers.

Additional resources:

Cowgirl Creamery <http://www.cowgirlcreamery.com/>

Robert Mondavi Institute for Wine and Food Science <http://rmi.ucdavis.edu/>

The Cheeseboard Collective <http://cheeseboardcollective.coop/>

VOCABULARY

Brine

water saturated with salt

Fermentation

the conversion of carbohydrates to alcohols and carbon dioxide using microbes such as yeast or bacteria under anaerobic conditions

Lactic acid

a liquid found in sour milk products like yogurt and cottage cheese, often used to curdle fermented milk

Lactose

the disaccharide sugar found in milk; lactose-intolerant individuals can't metabolize and break it down properly

Pasteurization

the process of heating liquid such as milk to a specific temperature in order to slow microbial growth

MRI

magnetic resonance imaging; a technique that allows researchers to visualize molecular structures in great detail

PRE-VIEWING

- What is your favorite cheese?
- What do you know about cheesemaking?

VIEWING FOCUS

- What are the ingredients of cheese? What is the function of each ingredient?
- How was cheese discovered?
- Why is cheese a “super food”?
- Compare and contrast the role of yeast and mold in the process of making cheese.
- Why is the Bay Area an ideal setting for artisan cheesemaking?
- What role does pasteurization serve in cheesemaking?
- What are curds and whey? How can you modify these two components to affect the final texture of the cheese?
- What role does brining have in cheesemaking? How does changing the salt content affect the final product?
- Why do scientists use an MRI to study cheese?
- How are certain cheeses “regional” by definition?
- In what way is cheesemaking a science?

For all media see:

- Segment Summary Student Sheet
http://science.kqed.org/quest/files/imp/QUEST_SegSum_StudentSheet.pdf
- Personal Response Student Sheet
http://science.kqed.org/quest/files/imp/QUEST_PersResp_StudentSheet.pdf

LESSON PLANS and RESOURCES from QUEST, PBS and NPR

Cheese: Not the Same Mold Story PBS LearningMedia

<http://www.pbslearningmedia.org/content/sf10.sci.ps.psci.chmchnng.cheese/>

Science Friday investigates the secret life of cheese. Trent Hendricks, from Hendricks Farms and Dairy, walks through how he makes a hybrid cheese he calls cheddar blue.

Cheesy Chemistry PBS LearningMedia

<http://www.pbslearningmedia.org/content/sf10.sci.ps.psci.chmchnng.lpcheese/>

In this activity, students use kitchen utensils and household ingredients to discover the chemical reaction that occurs when vinegar is mixed with milk protein to make curds and whey.

Cheesemakers Taste a Change in the Weather PBS LearningMedia

<http://www.pbslearningmedia.org/content/24a79bdd-aba1-4678-9bd5-6f4741fbc5d4/>

Learn how warmer weather affects what cows eat, which in turn influences the subtle flavors of alpine cheese in this **Morning Edition** audio broadcast.

Cheese by the Numbers: 7 PBS LearningMedia

<http://www.pbslearningmedia.org/content/8bed312d-8251-4064-86da-5e88123f404a/>

Learn why there are seven grams of protein in a one-ounce slice of cheese and explore why cheeses made from cow, goat and sheep milk taste different from each other.

Discuss the Science and Art of Cheese story on the QUEST Blog

<http://science.kqed.org/quest/2011/05/17/producers-notes-the-science-of-cheese/>

VISIT OUR PARTNERS

The Bay Institute
www.bay.org

California Academy of Sciences
www.calacademy.org

Chabot Space and Science Center
www.chabotspace.org

East Bay Regional Park District
www.ebparks.org

Exploratorium
www.exploratorium.edu

Girl Scouts of Northern California
www.girlscoutsnorcal.org

Golden Gate National Parks Conservancy
www.parksconservancy.org

The J. David Gladstone Institutes
www.gladstone.ucsf.edu

Lawrence Berkeley National Laboratory
www.lbl.gov

Lawrence Hall of Science
www.lawrencehallofscience.org

Monterey Bay Aquarium
www.mbayaq.org

Monterey Bay Aquarium Research Institute
www.mbari.org

Oakland Zoo
www.oaklandzoo.org

Stanford University's Woods Institute for the Environment
<http://woods.stanford.edu>

The Tech Museum of Innovation
www.thetech.org

UC Berkeley Natural History Museums
<http://bnhm.berkeley.edu/>

MORE EDUCATIONAL RESOURCES FOR USING QUEST MULTIMEDIA TO ENHANCE 21st CENTURY SKILLS IN TEACHING AND LEARNING

Why Use Multimedia in Science Education?

<http://science.kqed.org/quest/files/downloads/2011/06/QUESTWhyMedia.pdf>

- Read about the importance of using multimedia in the 21st century science classroom.

How to Use Science Media for Teaching and Learning

<http://science.kqed.org/quest/files/downloads/2011/06/QUESTMediaTips.pdf>

- A collection of tips, activities and handouts to actively engage students with multimedia.

Science Multimedia Analysis

<http://science.kqed.org/quest/files/downloads/2011/06/QUESTMediaAnalysis.pdf>

- Give your students the tools to recognize the purposes and messages of science multimedia.

Create Online Science Hikes with Google Maps

http://science.kqed.org/quest/files/downloads/2011/06/QUEST_ExplorationCreation.pdf

- Do you like the science hike Explorations on the QUEST site? Use this place-based educational guide to create similar science-based maps with youth.

Media-Making Toolkit for Science Education

<http://science.kqed.org/quest/education/media-making-toolkit/>

- Are you interested in integrating media making into your classroom or science education program? Find instructions, worksheets and rubrics for implementing simple media-making projects with students.

OTHER WAYS TO PARTICIPATE IN QUEST

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www.kqed.org/quest

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89.3 FM Sacramento**

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KQED Channel 9

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