HARVEST OF THE MONTH - DECEMBER / DAIRY

Grades 9-12

KANSAS STATE DEPARTMENT OF EDUCATION

Kansas leads the world in the success of each student.

JULY 17, 2025

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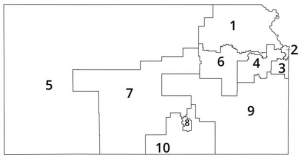

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SUCCESS DEFINED

A successful Kansas high school graduate has the

- Academic preparation,
- Cognitive preparation,
- Technical skills,
- Employability skills and
- Civic engagement

to be successful in postsecondary education, in the attainment of an industry recognized certification or in the workforce, without the need for remediation.

OUTCOMES

- Social-emotional growth
- Kindergarten readiness
- Individual Plan of Study
- Civic engagement
- Academically prepared for postsecondary
- High school graduation
- Postsecondary success

Kansans CAN

MISSION

To prepare Kansas students for lifelong success through rigorous, quality academic instruction, career training and character development according to each student's gifts and talents.

VISION

Kansas leads the world in the success of each student.

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Kansas leads the world in the success of each student.

July 1, 2025

HARVEST OF THE MONTH

INTRODUCTION

Over the next few weeks, we will be learning about a kind of food that we harvest in Kansas. I'm going to give you some clues to see if you can guess what this food is.

- This type of food doesn't grow from the ground. These types of food are made from milk. Usually from cows and goats, but sometimes other animals as well.
- This type of food provides our bodies with calcium which helps to make our bones and teeth strong.
- This type of food can include things like milk, whipped cream, yogurt, cheese, butter, and even ice cream!

Can you guess what food I'm talking about? We will be learning about Dairy!

VOCABULARY

Enzyme: A special protein that speeds up chemical reactions in the body, like breaking down food into smaller parts

Fermentation: A process where cells break down sugars without using oxygen. It can produce things like alcohol, gas, or acids—like how yeast makes bread rise

Galactose: A type of simple sugar found in milk. It's usually linked with another sugar (glucose) to form lactose

Gene Expression: The process where information from a gene is used to make a protein or perform a function in the body. It's how genes "show" their effects

Glucose: A simple sugar that is an important source of energy for cells. It's found in many foods and is used by the body for fuel

Glycolysis: The first step in breaking down glucose to release energy. It happens in cells and doesn't need oxygen

Lactase An enzyme that breaks down lactose (the sugar in milk) into smaller sugars like glucose and galactose

Lactose: A sugar found in milk and dairy products. It's made of two smaller sugars: glucose and galactose

Mutation: A change in the DNA of a gene. It can be helpful, harmful, or have no effect at all

GENERAL RESOURCES

ENGAGE

Dairy foods are highly nutritious. Some human populations have evolved to retain the ability to digest lactose (the sugar found in milk) as adults. Students will watch this short documentary[1] on the evolution of lactose tolerance. Ask students to engage in a notice/wonder routine or complete the companion worksheet developed by HHMI Biointeractive[2] as they watch.

Lead students in a class discussion after they have watched the video. Some suggested discussion questions may include:

- How common is lactose tolerance in adult humans?
- What is an evolutionary benefit of retaining the ability to digest lactose?
- Why can some adult humans digest lactose and others can't?
- What happens when lactose-intolerant people eat dairy products?
- Driving Question: Can we transform dairy into a product that can be digested by people who are lactose-intolerant?

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1 https://www.youtube.com/watch?v=MA9boI1qTuk

2 https://www.biointeractive.org/classroom-resources/activity-got-lactase-coevolution-genes-and-culture

EXPLORE

Background

The production of yogurt from the fermentation of milk dates as far back as 6000 BCE in populations that lived in the Middle East and Central Asia. This process requires a combination of two or more bacterial cultures such as Streptococcus thermophilus and Lactobacillus bulgaricus that are added to milk and heated to an optimal temperature to activate the metabolic processes of the starter cultures. Both bacteria are Gram-positive thermophilic organisms that ferment the sugar lactose (a disaccharide composed of glucose and galactose) to lactic acid via glycolysis. The production of lactic acid lowers the pH of the milk, discouraging the growth of pathogens and preventing spoilage. This change in pH also causes the major milk protein, casein, to form a solid curd, which results in a thicker texture.

Many factors contribute to the final taste and texture of yogurt. These factors can include milk source, amount of milk fat, and the types of bacteria included in starter cultures. In this investigation, students will determine the effect different starter cultures may have on the breakdown of lactose.

Teacher Preparation

Student teams will need access to yogurts with different live, active yogurt cultures. These may include brands like Activia, Chobani, Fage, Noosa, and/or Yoplait (check labels for "live and active cultures").

Other materials include:

- Whole or 2% milk
- Ice water bath
- Thermometer
- Small Mason jars with lids (1 per student team)
- Plastic wrap
- 3-gallon pot with lid, spatula, whisk
- Incubator
- Glucose test strips

General Yogurt-Making Protocol

Note: The teacher or student volunteers can be doing the milk preparation step while student teams are selecting their active cultures and working on their Planning an Investigation Tool[3] from "The Wonder of Science[4]". (Use this rubric[5] for assessing student work.)

3 https://drive.google.com/file/d/1wYMg5ru3-9ZXGBc443aWCTjH67ywjwlw/view

4 https://thewonderofscience.com/graphics

5 https://docs.google.com/document/d/13nbe3cCVMXnU76rNYhv71xVHyAK1am8j8i7_HthnBkk/template/preview

Milk Preparation (Scalding)

1. Pour 2 Quarts (1/2 Gallon) of milk into a 3-Gallon pot. (Optional: For a thicker texture you can add 2 tablespoons of powdered milk before heating. Adding half-and-half results in a creamier product.)
2. Slowly heat the milk over medium heat (not so hot that it burns on the bottom) to a temperature of 180-195o F (82-90o C) while stirring constantly. Caution: Do not allow the milk to boil over!
3. Turn off the heat, place the lid on the pot, and allow the milk to sit for 10 minutes.
   Tip: Whisking the milk occasionally will prevent the formation of a skin during heating and cooling.
4. Carefully transfer the pot with the heated milk to a pan with ice and cool water and allow the milk to cool to 110-115o F (43-46o C).

This scalding step is done to kill the milk bacteria remaining after pasteurization and to ensure a more consistent product. The presence of milk bacteria can result in undesirable flavors and textures. Scalding also helps "condition" or denature the milk protein casein, resulting in a smoother yogurt.

The milk is now ready to be distributed to student teams.

Introduction of Live, Active Cultures

Each team will:

1. Use a glucose test strip to determine the initial concentration of glucose in the milk.
2. Add a spoonful of their chosen live, active culture to their Mason jar.
3. Add enough prepared milk to fill the jar and mix well.
4. Cover the mouths of the jars with plastic wrap. Punch a couple of holes in the plastic wrap to minimize condensation and place the lid ring over the plastic so that it remains in place during the incubation period.
5. Incubate the covered glass jars for 6-12 hours at 110-115o F (43-46o C) and allow to set. (Disturbing the yogurt during early incubation will interfere with proper setting. Yogurt may be incubated for as little as 4-5 hours if more starter culture is added. In general, longer incubation periods will result in a thicker, more tart yogurt with less lactose.)
6. After the incubation period, place the lids on the jars and refrigerate for up to 2 weeks.

Characterization of Yogurt

After yogurt has formed, student teams should characterize the appearance, texture, aroma, and taste of their yogurt. They should retest their yogurt for the presence of glucose with glucose test strips.

Once student investigations are complete, they will analyze and share their findings regarding the effect of different live, active yogurt cultures on lactose breakdown using the Analyzing and Interpreting Data[6] tool from "The Wonder of Science[7]". (Teachers may use this rubric[8] to analyze student work.)

Students may also share their work through mini-poster sessions or a gallery walk.

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6 https://drive.google.com/file/d/1__JPpQ9VtWKbrFTAEHTslQABaQefuBNX/view

7 https://thewonderofscience.com/graphics

8 https://docs.google.com/document/d/11dpWkm1cHw20eqK5c4LzlxqLPzvjqANGZQylALDdaQ/template/preview

ELABORATE

Once students have learned how yogurt is made, they will read about recent scientific work that describes the potential healthful benefits of yogurt consumption. Ask students to read "Eating yogurt regularly may reduce the risk of colon cancer, a new study finds[9]" from NPR.

Ask students to complete the Engaging in Argument from Evidence[10] graphic organizer from "The Wonder of Science[11]" as they read.

Other Sources:

- Background and protocols taken from Yogurt Preparation Lab[12]

9 https://www.npr.org/sections/shots-health-news/2025/02/14/nx-s1-5295042/yogurt-colon-cancer-diet-health

10 https://drive.google.com/file/d/1vn_TCsdAm0dD7UmKKFHlSyOP99P1qPyn/view

11 https://thewonderofscience.com/

12 https://mymission.lamission.edu/userdata/brownst/docs/Yogurt%20Preparation%20Lab.pdf

KANSAS SCIENCE STANDARDS ADDRESSED

HS-LS1-1 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

HS-LS1-1

Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins, which carry out the essential functions of life through systems of specialized cells.

Assessment Boundary:
Assessment does not include identification of specific cell or tissue types, whole body systems, specific protein structures and functions, or the biochemistry of protein synthesis.

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education.

Science and Engineering Practices

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

Disciplinary Core Ideas

LS1.A: Structure and Function

- Systems of specialized cells within organisms help them perform the essential functions of life.
- All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (Note: This Disciplinary Core Idea is also addressed by HS-LS3-1.)

Crosscutting Concepts

Structure and Function

- Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.

HS-LS4-4 Biological Evolution: Unity and Diversity

Construct an explanation based on evidence for how natural selection leads to adaptation of populations.

Clarification Statement:
Emphasis is on using data to provide evidence for how specific biotic and abiotic differences in ecosystems (such as ranges of seasonal temperature, long-term climate change, acidity, light, geographic barriers, or evolution of other organisms) contribute to a change in gene frequency over time, leading to adaptation of populations.

Science and Engineering Practices

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

Disciplinary Core Ideas

LS4.C: Adaptation

- Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not.

Crosscutting Concepts

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future.

Additional Science & Engineering Practices Addressed:

SEP-3: Planning and Carrying Out Investigations
SEP-4: Analyzing and Interpreting Data
SEP-6: Constructing Explanations and Designing Solutions
SEP-7: Engaging in Argument from Evidence

Companion Texts for this study:

- The Evolution of Lactose Tolerance video[13]
- Eating yogurt regularly may reduce the risk of colon cancer, a new study finds article[14]

13 https://www.youtube.com/watch?v=MA9bol1qTuk

14 https://www.npr.org/sections/shots-health-news/2025/02/14/nx-s1-5295042/yogurt-colon-cancer-diet-health

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