

Fermentation in Food Products

CTE Lesson Aligned with TN State Standards for Literacy in Science and Technology

This resource is best for:

Teachers of:	Food Science and Safety	Career Cluster:	Agriculture, Food & Natural Resources
Addressing Standard(s):	Standard 9	Grade-Band:	11-12
In alignment with CTSO:	FFA: www.tnffa.org Click here for specific guidelines.	CTSO Event: (if applicable)	Agriscience Fair, Milk Quality and Products, Meat Evaluation, and Agricultural Issues

Learning Objective: The goal of this activity is to develop a student’s understanding of the chemical process of fermentation in food products and food processing. The skills reflect proficiency in literacy standards. Teachers can use this activity to develop an understanding of the basic fermentation process used in food preservation. Discussions in class help students learn the various benefits of fermentations within the food industry.

CTSO Competition Overview: Participants in several FFA competitive events may expect a connection to fermentation techniques and describe the basic chemical principles of fermentation and the factors that affect the fermentation process. Performance indicators may include the following:

- Explain benefits of fermented foods.
- Evaluate meat animal products in order to optimize economic returns to producers and industry as well as to meet the needs of the consumer.
- Utilize knowledge of milk quality, regulations, grades and classes of milk, factors necessary to produce quality milk.
- Identify cheese varieties and characterize properties
- Compare and contrast best management practices associated with food processing procedures.

Visit the Tennessee FFA websites for event guidelines.

<https://www.tnffa.org/page.aspx?ID=72>

Tennessee State Standards for Literacy in Technical Subjects addressed by task	
Strand	Grades 11-12
TN Reading for Technical Subjects: Key Ideas and Details	2. Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
TN Writing for Technical Subjects: Text Types and Purposes	2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. <ol style="list-style-type: none"> a. Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. b. Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts. d. Use precise language, domain-specific vocabulary, and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers. e. Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).
TN Writing for Technical Subjects: Production and Distribution of Writing	4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
Tennessee CTE Standards addressed by task	
Food Science and Safety	9) Research common microorganisms that cause fermentation, discuss the benefits or dangers of fermentation in food products and processing. Develop an annotated chart that illustrates fermentation techniques and the foods they are used to create, describing the basic chemical principles of fermentation and the factors that affect the fermentation process. (TN Reading 2; TN Writing 2, 4)

Texts	Text Complexity Analysis
<p>Text 1 Title: “Microorganisms in food production”</p> <p>Author: The European Food & Feed Cultures Association</p> <p>Citation/Publication Information: European Food and Feed Cultures Association. <i>Microorganisms in Food Production</i>. European Food and Feed Cultures Association. 123-136. Retrieved April 19, 2014.</p> <p>Link: http://www.efca.org/content/microorganisms-food-production</p>	<p>Quantitative: Lexile: 1360</p> <p>Qualitative: This article demonstrates a multiple level purpose with simple structure. The article is conversational with domain-specific language. The knowledge demands should be manageable for students with strong science or biology foundation skills.</p> <p>Reader and Task: Scaffolding will be necessary for students who do not have a background in, or who struggle with scientific concepts.</p>
<p>Text 2 Title: “FUNDAMENTAL FOOD MICROBIOLOGY Third Edition”</p> <p>Author: Dr. Bibek Ray.,</p> <p>Citation/Publication Information: Ray, B. 2005. New York: <i>Fundamental Food Microbiology</i>, 3rd ed. New York: CRC Press, 125-136.</p> <p>Link: http://www.scribd.com/doc/52999892/49/Microorganisms-Used-in-Food-Fermentation</p>	<p>Quantitative: Lexile: 1490</p> <p>Qualitative: This text is at a higher level due to the technical and scientific content. Scaffolding will be necessary for students who do not have a background in or who struggle with scientific concepts. Graphics and illustrations will help students manage the content.</p> <p>Reader and Task: Comprehension strategies should be employed for students who need assistance managing the large amount of diverse information in the text. Scaffolding will be necessary for students who do not have a background in or who struggle with scientific concepts.</p>

What key insights should students take from these resources?

1. Differentiate between the concept of pasteurization and fermentation.
2. Identify the main microorganism used in the fermentation process.
3. Describe the advantages and hazards associated with the fermentation process to preserve foods.
4. Describe the basic chemical principles of fermentation and the factors which affect the fermentation process.
5. Identify the types and kinds of fermented foods.

Text-Dependent Questions

Text 1

1. What criteria did the author indicate was used to select a microorganism for beneficial purposes in foods?
2. How did the author divide the species in genus *Lactobacillus* (the basis) into groups? Identify two species from each group.
3. Explain and then compare the three bacterial species currently used as probiotic bacteria.
4. According to the text, how were molds used in food? Name two species and list their uses. What precautions are needed while using a mold strain in food fermentation?

Text 2

1. Identify two species of yeasts and briefly discuss the use of each in the production of fermented foods and food additives.
2. What three mold species did the author outline in the text? Indicate their specific uses in food bioprocessing.
3. Investigate patterns in starter-culture bacteria metabolization.
4. What comparisons did the author make about lactic acid bacteria in the transportation of lactose?
5. Why did the author feel the need to explain items transported inside the lactic acid bacterial cells?
6. What examples of lactic acid bacteria are in each fermentation group?
7. Which enzymes play crucial roles in homolactic and heterolactic fermentation?
8. Analyze the food proteins and food lipids transported and metabolized by starter-culture bacteria.

Potential Lesson Plan Design:

Day 1:

- Have the students individually write an explanation of the term fermentation. Have a student turn to their shoulder partner to build on their explanation.
- Show the video clip “Bacterial Culture” located at <https://www.youtube.com/watch?v=wDun3LLOKL4>.
- Read the definition of fermentation from the following link: <http://www.effca.org/content/fermentation> and have the students revise their explanation of fermentation using evidence from the video clip and web article.
- Have students read the information from text one, “Microorganisms in food production,” including the three links within the article.
- Have students complete notes, a graphic organizer, or some other form of note-taking to capture take-always during their reading.
- Have students submit an exit-slip at the conclusion of class to gauge student understanding. For example, have each student list how two foods are developed by fermentation.

Day 2:

- Open class by reviewing the key points from the day before and connecting to prior knowledge.

Read the text two, “FUNDAMENTAL FOOD MICROBIOLOGY Third Edition,” Chapter 10 pages 125 – 136. Scaffolding will be necessary for students who do not have a background in, or who struggle with scientific concepts. Have students take notes using a graphic organizer to chart the fermentation techniques, foods created, and factors which affect the fermentation process.

- Have students complete a one minute essay at the conclusion of class to gauge student understanding. For example, have each student explain how bacteria, yeast, or mold can be used in food processing.

Text Under Discussion	Sample Teacher Dialogue & Guiding Questions
<p>Read the text one, “Microorganisms in food production” in its entirety including the information from the three links within the body of the text.</p>	<ol style="list-style-type: none"> 1. How and why did the author recommend preparing yeast for making bread products? 2. Using the information from the author, describe, in your own words, the chemical products of fermentation. 3. How does the fermentation process preserve or enhance breads, cucumber pickles and sauerkraut? <p><i>Examples of text dependent questions the teacher can ask of students:</i></p> <p>“Let me see if we can find that part and read it again.”</p> <p>“How do you know?”</p> <p>“Where do you see evidence of that?”</p> <p>“What words in the text make you think that?”</p>

Day 3:

- Open class with answers to questions students may have from the previous lesson.
- Divide the class into groups of four.
- Within their groups, have each student select a food for each one of the microorganisms (bacteria, yeast, and mold).
- Each group sketches an outline the fermentation process for their microorganism. Students can draw information from the previous class notes.
- Citing evidence from the text, develop an annotated chart which illustrates fermentation techniques and the foods they are used to create, describing the basic chemical principles of fermentation and the factors affecting the fermentation process.

Day 4:

- Open class with a class discussion highlighting the “ah-ha’s” and “challenges” in development of the annotated chart. Allow students to build on solutions to overcome the challenges.
- Using recommendations from the class discussion, students will complete their individual annotated chart.
- Each group will need to combine information from their individual annotated chart to present to the class.

Day 5:

- Open class with a 3-2-1 activity by having the students list three important facts about fermentation, two interesting facts, one question they still have.
- Review
- Have each group present their annotated chart to the class. Have students build on informational gaps for each group.
- Using information gained from this lesson, have students develop an informative essay using the writing prompt below. Allow 20 minutes for this writing activity.

Writing Mode	Writing Prompt
Informative	Fermentation is used to preserve and enhance the quality of a variety of foods. Your local Master Gardener is developing a fall harvest fair to educate the general public in methods of preserving food. Write an informative article outlining the benefits and dangers of fermentation in food products, fermentation techniques and the foods they are used to create. The Master Gardener will be using your information as an informational handout during the fall harvest fair.

Discussion: These texts could be explored orally and used to form the basic foundation of a series of lessons. Lexile scores are slightly above grade-band recommendations because of advanced vocabulary; however, the scaffolding and discussion of these texts in classroom discussion should allow access for students. Close-reading questions or a graphic-organizer or notes-sheet could be developed in advance in order to drive student understanding of the material while also practicing reading skills. For information on how to develop questions for this type of discussion, visit http://www.tncore.org/literacy_in_science_and_technology/curricular_resources/text_dependent_questions.aspx.

Writing and/or Assessment: The writing prompt can be either a constructed-response assessment or a longer-term writing assignment for students to develop and refine over time to gauge student understanding of technical content as well as reading and writing skills as outlined in the literacy standards. An appropriate writing rubric – such as those found at http://www.tncore.org/literacy_in_science_and_technology/assessment/scoring_resources.aspx – should be used to assess student work.

- **Task:** If using this material as a writing task, you may scaffold the texts with close readings and text-based questions to guide student exploration of the texts. A culminating task of this lesson or sequence of lessons could be the writing prompt – either assigned in class, as homework, or as a report which is drafted and refined over time to build writing skills.
- **In-class work:** The exit slips, lab sheets, or other formative assessments at the conclusion of a lesson or series of lessons to determine student understanding of the concept.

Scaffolding and support for students with special needs, English language learners, and struggling readers: Consider pre-teaching synonyms of difficult vocabulary words. Lower-level readers and ELL students can still be challenged without being overloaded with difficulty. This strategy can also be used to differentiate for stronger readers by introducing new, and more challenging, vocabulary. Struggling readers would also benefit from visual aids to illustrate many of the ideas presented. Pictures, diagrams, and charts alongside the text will go far to aid students as they dissect the articles.

Note: Social, ethnic, racial, religious, and gender bias is best determined at the local level where educators have in-depth knowledge of the culture and values of the community in which students live. TDOE asks local districts to review these materials for social, ethnic, racial, religious, and gender bias before use in local schools.

Additional Resources**Check these sites for additional supplemental resources materials:**

- [Parker, R. 2003. *Introduction to Food Science*. New York: Thompson Learning.](#) *
- [Food Science and Safety Standards Cross-Reference, iCEV Multimedia*](#)
- <http://www.biology-online.org/dictionary/Fermentation>
- <http://www.usda.gov>
- <https://ag.tennessee.edu/foodscience/Pages/Food-Science-Extension.aspx>

Additional Website References from websites can be located using one of several search engines for more information by searching these words or phrases: fermentation, food preservation, lactic acid bacteria, acetic acid bacteria, bread making, and making cheese.

Notes:

*= Requires either online subscription or purchase of textbook to use reference.