

## Overview

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**Lesson Title:** Meat Safety and Preservation

**Lesson Overview:** Students can analyze and interpret data to provide evidence that using curing agents (e.i., nitrites/nitrates/sodium chloride) effects the resource availability (e.i., water and environment) for microorganisms to grow on meat thus preserving them.

**Lesson Objectives:**

Students will understand the scientific basis for preserving meat using modern preservation methods such as salting and drying.

Students will identify traditional meat preservation methods and science.

Students will understand the role of ingredient and drying as preservation methods.

Students will evaluate jerky samples with different levels of salt and formulas.

**NSF Subject Classification:** 40.0501 Chemistry, General

**National Next Gen Standards:**

MS-PS1-2 Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

**North Dakota Standards:**

MS-PS1-2 Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

3.12.1 Evaluate the validity of health information, products, and services.

**Grade or Grade Band:** 6 - 12

**Time Needed (estimate):** 4 hours (including prep)

**Lesson Author:** Allie Kollman

**Author Bio:**

Allie Kollman is a high school physical science and biology teacher at Davies High School in Fargo, ND. Kollman is currently a course captain for Physical Science in Fargo Public Schools. Her focus area this past year has been on developing Evidence-Based curriculum and Evidence-Based Grading.

**Scientist/K12 Collaborator & University:** Deland Myers Sr. and Clifford Hall of North Dakota State University

**Scientist Bio/Summary of Research:** Hello. My name is Clifford Hall and I am a Professor in the Dairy and Food

Science Department at South Dakota State University. I received my Bachelor of Science and doctoral degrees in food science and technology. Food science is not new. It has been practiced by prehistoric man who first used food science to preserve meat by smoking meat over open fire. American Indians used the drying potential of the sun to dry bison or “tatanka”. Nicolas Appert was awarded 12,000 francs by the French government in the 18th century for developing a method to preserve foods for Napoleon’s armies. This process later became known as canning. In 1857, Louis Pasteur showed that microorganisms were responsible for making milk sour. This discovery led to the development of the pasteurization process in 1880 by German scientists. Clarence Birdseye introduced frozen foods to the U.S. marketplace in 1917. These are just a few of the many discoveries that have shaped the world’s food supply and were introduced to me in the first food science course that I took as an undergraduate. I discovered that I had a passion for the science of food. As a graduate student, I discovered that I enjoyed teaching and interacting with students. As a professor, I became interested in the cultural basis for food and specifically how food was preserved by different cultures. I oversee research on pulse quality and utilization of pulses in food systems and the annual U.S. Pulse Quality Survey. Other primary research areas include the utilization of non-traditional crops in food products. Examples include omega-3 fortification, from flaxseed in extruded bean snacks (similar to Cheetos), use of chickpea proteins as egg replacers, effects of extrusion on pulse components and sensory and stability characteristics of pulses, pulse flours and pulse fortified products. In addition, methods to remove flavor of pea flours has also been an area of research. I currently teach the Food Safety Management and the Food Product Development courses at South Dakota State University.

Deland Myers Sr. is now at Prairie View A & M University in Texas. His research interests are in utilization of proteins in food, feed and nonfood applications; Product Development, Farm to Table Food Security.

## Preparation/Materials

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### Background knowledge students must have to be successful:

Students should have a background in cell function and structure and homeostasis (e.g. osmosis). Salt inhibits microbial growth by plasmolysis in which water is drawn out of the microbial cell by osmosis due to the higher concentration of salt outside the cell. A cell loses water until it reaches a state of first where it cannot grow and cannot survive any longer. The concentration of salt outside of a microorganism needed to inhibit growth by plasmolysis depends on the genus and species of microorganisms. Fortunately, the growth of many undesirable organisms normally found in cured meat products is inhibited at relatively low concentrations of salt (“Curing and Smoking Meats for Home Food Preservation Literature Review and Critical Preservation Points”).

### Essential Terminology:

Preservation- any unit operation or step that reduces or prevents the deterioration of a food.

Food safety- elimination of any hazard that can cause an illness if a food is conserved

Food deterioration- a process that renders a product unacceptable or undesirable for consumption.

Microorganism- a microscopic organism (e.i., bacterium, virus, or fungus).

### Resources:

Science and Tradition of Meat Safety and Preservation PowerPoint

Meat Safety and Preservation Worksheet

Website for Lesson 1 <http://www.fao.org/3/x6932e/X6932E02.htm>

Article for Lesson 2 [https://nchfp.uga.edu/publications/nchfp/lit\\_rev/cure\\_smoke\\_cure.html](https://nchfp.uga.edu/publications/nchfp/lit_rev/cure_smoke_cure.html)

### Websites:

Website for Lesson 1 <http://www.fao.org/3/x6932e/X6932E02.htm>

Article for Lesson 2 [https://nchfp.uga.edu/publications/nchfp/lit\\_rev/cure\\_smoke\\_cure.html](https://nchfp.uga.edu/publications/nchfp/lit_rev/cure_smoke_cure.html)

### Materials needed:

#### Lesson 1:

- Ground beef (90% lean)
- Spice mix
- Sodium Nitrite (cure mix) or pre-bought cure mix
- Bowls and utensils for mixing ground meat with dry ingredients
- Dehydrators
- Balances
- Jerky Cannon/Gun
- Gloves
- Sharpie
- Tape
- Meat Preservation and Safety Handout

**Lesson 2:**

- Empty petri dishes
- Nutrient Agar
- Cotton Swabs
- Premade homemade jerky samples
  - Sample A no nitrites (cure) added
  - Sample B nitrite (cure) added
- Meat Preservation and Safety Handout
- Whiteboard (optional)

PowerPoint – found as separate attachment

### **Lesson 1: Preparation of Jerkies (1 hr 50 min)**

#### **Part 1- Cultural Connection and Background (50 min)**

1. Introduce the lesson with cultural overview (PPT Slides 3-10).
2. Hand out the Meat Preservation and Safety Handout.
3. Ask students to discuss with their partners the following two questions: (1) In what ways that you know of, cause food to deteriorate?, (2) What methods that you know of can be used by you or food manufactures to preserve food?
4. Talk and go through Modern Meat Preservation (PPT Slides 11-15). On the Meat Preservation and Safety handout, have students write down the definitions for preservation and food safety.
5. On the Meat Preservation and Safety handout, direct students to write down different ways food can deteriorate (e.g., biological vs. chemical) and different methods to preserve food (PPT Slides 12-13).

#### **Part 2- Preparation of Jerkies (50 – 60 min)**

6. Ask students the question, “What kinds of jerky meats do you usually eat?” Write answers down on the board to see what the most popular answer is.
7. The instructor will tell students that they will be making jerky and comparing the two different types they are making today.
8. The instructor will assign meat and nitrite addition to specific student groups (half groups will make jerky with no sodium nitrite (cure) addition and the other half will make jerky with the sodium nitrite (cure) addition).
9. Instructor assigns the appropriate procedure for each student group to follow on the Meat Preservation and Safety handout.
10. Students make and prepare assigned jerky following procedure on the Meat Preservation and Safety handout. Instructor walks around room and helps where needed.
11. When students have put their jerkies into the dehydrator and have cleaned up their lab station, instructor instructs them to answer the follow up question on the Meat Preservation and Safety handout.
12. Explain that food deterioration is caused by several factors ranging from microbial, biological, biochemical, chemical, and physical. Typically, spoilage microorganisms are hardier than the pathogens; thus, treatments that inhibit spoilage microorganisms will preserve food. Slowing the deteriorative processes will enhance the shelf life of a product or simply put, preserve the food (Myers Sr. & Hall).

### **Lesson 2: Evaluate the Impact of Salt on Meat Preservation (50 – 60 min)**

1. On each lab table set out the four labeled petri dishes with jerky. Two petri dishes are for Jerky A (no nitrite addition) and Jerky B (nitrite addition). The other two petri dishes are agar growth of bacteria from Jerky A and Jerky B. (Instructor will need to prepare petri dishes at the appropriate times. Jerky A should have noticeable microorganism growth like bacteria or mold on it. Jerky A agar petri dish should have more bacteria growth due to lack of nitrites).
2. Using the Meat Preservation and Safety Handout, Instructor tells students to review their answers from Lesson 1 follow up question.

3. When students are finished, student groups go around the room sharing their predictions and the reasonings.
4. Explain that students will collect qualitative and quantitative data on the two jerky samples for students to analyze and interpret the data collected.
5. Direct students to lesson 2 lab procedure and activity on the Meat Preservation and Safety handout.
6. Instructor will walk around the room as students collect data, helping where necessary.
7. After students are done collecting their data, ask students the question, "Which jerky had nitrites in it? Why do you think that?" Have students talk with their partners and write their answers down under the follow-up questions on the Meat Preservation and Safety Handout.
8. As a large group, go around and have students discuss their answers and reasonings to the previous steps question.
9. Direct students to part 2 of lesson 1 on the Meat Preservation and Safety Handout. Tell students to read the articles and answer the article follow-up questions.
10. After students have answered the questions, instructor explains using salt or other curing additions like nitrites help preserve foods like jerky. Salt inhibits microbial growth by plasmolysis in which water is drawn out of the microbial cell by osmosis due to the higher concentration of salt outside the cell. A cell loses water until it reaches a state first where it cannot grow, reproduce to make more cells, and ultimately cannot survive. Some bacteria cannot grow or survive with higher salt concentrations like Salmonella. Fortunately, the growth of many undesirable organisms normally found in cured meat products is inhibited at relatively low concentrations of salt. ("Curing and Smoking Meats for Home Food Preservation Literature Review and Critical Preservation Points")
11. Direct students to answer the lab follow-up questions in their Meat Preservation and Safety Handout.
12. Instructor walks around the room helping students with their CER if necessary (Claim, Evidence, Reasoning).
13. (Optional) When students are finished with writing their CERs, instructor divides the board into two halves. One side for evidence and the other for reasoning. One student from each group comes up to write one piece of evidence and one piece of reasoning. Instructor then leads large group highlighting key evidence and reasoning. Students then can underline key evidence and reasoning OR add in missing pieces of key evidence and reasoning.

#### **Extensions for above average students:**

##### **Discuss:**

1. How are different chemicals like sodium nitrite/nitrate and potassium nitrite/nitrate used in preservation.
2. How does eating nitrite/nitrates affect human health.

##### **Watch the following videos for further ideas:**

1. <https://www.youtube.com/watch?v=WX9SzvVCMvM> (Lesson 1 or 2)
2. <https://www.youtube.com/watch?v=ZJU34yTJL4M> (Lesson 2)
3. <https://www.youtube.com/watch?v=XQm0clyfmSA> (Lesson 2)

##### **Websites to explore and research topics:**

<http://www.fao.org/3/x6932e/X6932E02.htm> (Lesson 1)

- In this lesson we use a food dehydrator to make jerky, explore and explain at least two different methods for drying or preserving meat.

[https://nchfp.uga.edu/publications/nchfp/lit\\_rev/cure\\_smoke\\_cure.html](https://nchfp.uga.edu/publications/nchfp/lit_rev/cure_smoke_cure.html)

- What is corning and how was it significant in Anglo-Saxon culture?

**Mediation/Support for students that need it:**

- List the vocab words with definitions on the front board or hand out them listed on a piece of paper for students to reference.
- Print off article for Lesson 2 and highlight key paragraphs and vocabulary.

## Standards Alignment

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### **ND Science Standard(s):**

MS-PS1-2 Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

### **ND Health Standard(s):**

3.12.1 Evaluate the validity of health information, products, and services.

### **Disciplinary Core Idea:** Physical Science

LS2.A: Interdependent Relationships in Ecosystems

- Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and nonliving factors. In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. Growth of organisms and population increases are limited by access to resources.

### **North Dakota DPI Standards:**

MS-PS1-2 Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

### **Next Gen Standards:**

MS-PS1-2 Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

### **Science and Engineering Practices**

SEP4: Analyzing and Interpreting Data

### **Cross Cutting Concepts**

Cause and Effect

- Cause and effect relationships may be used to predict phenomena in natural or designed systems.

### **Unit Objectives**

- Students can analyze and interpret data to provide evidence that using curing agents (e.i., nitrites/nitrates/sodium chloride) effects the resource availability (e.i., water and environment) for microorganisms to grow on meat thus preserving them.

### **Assessment**

- Students can analyze and interpret data to write a CER (claim, evidence, reasoning) that provides evidence for the effect nitrites have on meat preservation.



## Daily Plans and Assessments

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### Learning Target for each day/activity

- Students will understand the scientific basis for preserving meat using modern preservation methods such as salting and drying (Lesson 1).
- Students will identify traditional meat preservation methods and science (Lesson 1).
- Students will understand the role of ingredient and drying as preservation methods (Lesson 2).
- Students will evaluate data evidence of jerky samples with different levels of salt and formulas (Lesson 2).

### Criteria for Success/Assessment for each activity

- Students can predict meat preservation samples based on different levels of salt/nitrites (Lesson 1).
- Students can analyze and interpret data for evidence of the effect salt/nitrites have on meat preservation (Lesson 2).

## Additional Lesson Resources / Materials

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### References:

- “Curing and Smoking Meats for Home Food Preservation Literature Review and Critical Preservation Points.” *Curing and Smoking Meats for Home Food Preservation*, [nchfp.uga.edu/publications/nchfp/lit\\_rev/cure\\_smoke\\_cure.html](http://nchfp.uga.edu/publications/nchfp/lit_rev/cure_smoke_cure.html).
- Myers Sr., Deland and Clifford Hall. “Science and Tradition of Meat Safety and Preservation”. 2012. North Dakota State University. Microsoft PowerPoint presentation.
- Myers Sr., Deland and Clifford Hall. “Science and Tradition of Meat Safety and Preservation.” 2012. PDF File.
- “Simple Techniques for Production of Dried Meat.” *Food and Agriculture Organization of the United Nations*, <http://www.fao.org/3/x6932e/X6932E02.htm>

### Websites for purchasing materials

- Spice Mix
  - [https://www.amazon.com/s?k=jerky+spice+mix&ref=nb\\_sb\\_noss\\_2](https://www.amazon.com/s?k=jerky+spice+mix&ref=nb_sb_noss_2)
- Sodium Nitrite (cure mix) or pre-bought cure mix
  - [https://www.amazon.com/Hoosier-Hill-Farm-Prague-Powder/dp/B00C2PIC92/ref=sr\\_1\\_4?crid=F5U6B5AKQECQ&dchild=1&keywords=prague+powder&qid=1595279787&srefix=pragu%2Caps%2C215&sr=8-4](https://www.amazon.com/Hoosier-Hill-Farm-Prague-Powder/dp/B00C2PIC92/ref=sr_1_4?crid=F5U6B5AKQECQ&dchild=1&keywords=prague+powder&qid=1595279787&srefix=pragu%2Caps%2C215&sr=8-4)
- Bowls and utensils for mixing ground meat with dry ingredients
  - Bowls: [https://www.amazon.com/Plastic-Salad-Bowls-Count-Disposable/dp/B07T9NTHRS/ref=sxin\\_9\\_sk-bs-v2-na\\_f09d07d04a7028beb928f26b5886f7a7bdf581fc?crid=2COP03NLLGUXD&cv\\_ct\\_cx=disposable+bowls&dchild=1&keywords=disposable+bowls&pd\\_rd\\_i=B07T9NTHRS&pd\\_rd\\_r=dbeb080e-bcd2-4363-a03a-2f9e8af6ebe2&pd\\_rd\\_w=mabPa&pd\\_rd\\_wg=lmD4T&pf\\_rd\\_p=8cc1969c-360f-4bcd-ba2f-2e49c19a8fad&pf\\_rd\\_r=HE3CDJNF3CGGNSTZVA4J&qid=1595279866&srefix=dispensable+bowls%2Caps%2C189&sr=1-3-db39674d-a3a5-4ccf-88e3-f4fdf0022c7a](https://www.amazon.com/Plastic-Salad-Bowls-Count-Disposable/dp/B07T9NTHRS/ref=sxin_9_sk-bs-v2-na_f09d07d04a7028beb928f26b5886f7a7bdf581fc?crid=2COP03NLLGUXD&cv_ct_cx=disposable+bowls&dchild=1&keywords=disposable+bowls&pd_rd_i=B07T9NTHRS&pd_rd_r=dbeb080e-bcd2-4363-a03a-2f9e8af6ebe2&pd_rd_w=mabPa&pd_rd_wg=lmD4T&pf_rd_p=8cc1969c-360f-4bcd-ba2f-2e49c19a8fad&pf_rd_r=HE3CDJNF3CGGNSTZVA4J&qid=1595279866&srefix=dispensable+bowls%2Caps%2C189&sr=1-3-db39674d-a3a5-4ccf-88e3-f4fdf0022c7a)
  - Utensils: [https://www.amazon.com/Disposable-Plastic-Serving-Spoons-Utensils/dp/B07CZNBWXX/ref=sr\\_1\\_5?crid=3BPA06LB535W3&dchild=1&keywords=disposable+large+spoons&qid=1595279913&s=home-garden&srefix=disposable+large+%2Cgarden%2C194&sr=1-5](https://www.amazon.com/Disposable-Plastic-Serving-Spoons-Utensils/dp/B07CZNBWXX/ref=sr_1_5?crid=3BPA06LB535W3&dchild=1&keywords=disposable+large+spoons&qid=1595279913&s=home-garden&srefix=disposable+large+%2Cgarden%2C194&sr=1-5)
- Dehydrators
  - [https://www.amazon.com/NESCO-FD-75A-Snackmaster-Food-Dehydrator/dp/B0090WOCN0/ref=sr\\_1\\_5?crid=Z3NQPRG7PNZD&dchild=1&keywords=dehydrators+for+food+and+jerky&qid=1595279944&srefix=dehy%2Caps%2C208&sr=8-5](https://www.amazon.com/NESCO-FD-75A-Snackmaster-Food-Dehydrator/dp/B0090WOCN0/ref=sr_1_5?crid=Z3NQPRG7PNZD&dchild=1&keywords=dehydrators+for+food+and+jerky&qid=1595279944&srefix=dehy%2Caps%2C208&sr=8-5)
- Balances
  - [https://www.amazon.com/s?k=gram+balance&ref=nb\\_sb\\_noss\\_2](https://www.amazon.com/s?k=gram+balance&ref=nb_sb_noss_2)
- Jerky Cannon/Gun
  - <https://www.amazon.com/Nesco-BJX-5-Jumbo-Jerky->

[Works/dp/B001795P3K/ref=sr\\_1\\_12?dchild=1&keywords=jerky+cannon&qid=1595280021&sr=8-12](https://www.amazon.com/Works/dp/B001795P3K/ref=sr_1_12?dchild=1&keywords=jerky+cannon&qid=1595280021&sr=8-12)

- Gloves
  - [https://www.amazon.com/s?k=disposable+gloves&crid=7NWHQBQRRED&srefix=disposable%2Caps%2C206&ref=nb\\_sb\\_ss\\_ts-a-p\\_1\\_10](https://www.amazon.com/s?k=disposable+gloves&crid=7NWHQBQRRED&srefix=disposable%2Caps%2C206&ref=nb_sb_ss_ts-a-p_1_10)
- Sharpie
  - [https://www.amazon.com/s?k=sharpie+markers&crid=2FYRSH2A4RIUG&srefix=shar%2Caps%2C210&ref=nb\\_sb\\_ss\\_ts-a-p\\_1\\_4](https://www.amazon.com/s?k=sharpie+markers&crid=2FYRSH2A4RIUG&srefix=shar%2Caps%2C210&ref=nb_sb_ss_ts-a-p_1_4)
- Tape
  - [https://www.amazon.com/s?k=masking+tape&crid=3DCU6JZUPK1WU&srefix=mas%2Caps%2C206&ref=nb\\_sb\\_ss\\_ts-a-p\\_1\\_3](https://www.amazon.com/s?k=masking+tape&crid=3DCU6JZUPK1WU&srefix=mas%2Caps%2C206&ref=nb_sb_ss_ts-a-p_1_3)

## Lesson 2:

- Empty petri dishes
  - [https://www.amazon.com/s?k=petri+dish&crid=2HWEGEFEZOZFI&srefix=petri+dish%2Caps%2C211&ref=nb\\_sb\\_ss\\_ts-a-p\\_1\\_10](https://www.amazon.com/s?k=petri+dish&crid=2HWEGEFEZOZFI&srefix=petri+dish%2Caps%2C211&ref=nb_sb_ss_ts-a-p_1_10)
- Agar or pre-made agar petri dishes
  - Agar: [https://www.amazon.com/Seaweed-Solution-Laboratories-SG\\_B008YE9DUC\\_US-Nutrient/dp/B008YE9DUC/ref=sr\\_1\\_5?crid=PS0PK1UOQ2V5&dchild=1&keywords=agar+for+petri+dishes&qid=1595280175&s=industrial&srefix=agar+for+%2Caps%2C195&sr=1-5](https://www.amazon.com/Seaweed-Solution-Laboratories-SG_B008YE9DUC_US-Nutrient/dp/B008YE9DUC/ref=sr_1_5?crid=PS0PK1UOQ2V5&dchild=1&keywords=agar+for+petri+dishes&qid=1595280175&s=industrial&srefix=agar+for+%2Caps%2C195&sr=1-5)
  - Pre-made agar petri dishes [https://www.amazon.com/Potato-Dextrose-Agar-Plates-Prepoured/dp/B07JN7GFWW/ref=sr\\_1\\_7\\_sspa?crid=PS0PK1UOQ2V5&dchild=1&keywords=agar+for+petri+dishes&qid=1595280582&s=industrial&srefix=agar+for+%2Caps%2C195&sr=1-7-spons&psc=1&spLa=ZW5jcnlwdGVkUXVhbGlmaWVyPUExM1hYSzRKMUM2UVpRJMvUyY3J5cHRlZElkPUeWNTcwMDIyWFZLSdILWjM1UTRIJmVuY3J5cHRlZEFkSWQ9QTEwNDZnZgZMUlNUjFFM0MzQzNSJndpZGdldE5hbWU9c3BfbXRmJmFjdGlvbj1jbGlja1JlZGlyZWNOJmRvTm90TG9nQ2xpY2s9dHJ1ZQ==](https://www.amazon.com/Potato-Dextrose-Agar-Plates-Prepoured/dp/B07JN7GFWW/ref=sr_1_7_sspa?crid=PS0PK1UOQ2V5&dchild=1&keywords=agar+for+petri+dishes&qid=1595280582&s=industrial&srefix=agar+for+%2Caps%2C195&sr=1-7-spons&psc=1&spLa=ZW5jcnlwdGVkUXVhbGlmaWVyPUExM1hYSzRKMUM2UVpRJMvUyY3J5cHRlZElkPUeWNTcwMDIyWFZLSdILWjM1UTRIJmVuY3J5cHRlZEFkSWQ9QTEwNDZnZgZMUlNUjFFM0MzQzNSJndpZGdldE5hbWU9c3BfbXRmJmFjdGlvbj1jbGlja1JlZGlyZWNOJmRvTm90TG9nQ2xpY2s9dHJ1ZQ==)
- Cotton Swabs
  - [https://www.amazon.com/200pcs-Cotton-Wooden-Handles-Applicator/dp/B07QLPS14V/ref=sr\\_1\\_11?dchild=1&keywords=cotton+swabs&qid=1595280643&sr=8-11](https://www.amazon.com/200pcs-Cotton-Wooden-Handles-Applicator/dp/B07QLPS14V/ref=sr_1_11?dchild=1&keywords=cotton+swabs&qid=1595280643&sr=8-11)