UNIT II - FOOD PROCESSING

Lesson 1: Procedures Used in Processing Food

Objective

The student will be able to explain procedures used to process food safely.

I. Study Questions

A. Why are foods processed?

B. How can foods be processed?

C. How is food safety assured?

D. What methods should be used to clean and sanitize food processing equipment?

II. References

A. Martin, Phillip R. *Food Science and Technology* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1994. Unit II.

B. Activity Sheets

1. AS 1.1: Dehydration and Rehydration
2. AS 1.2: Food Processing--Magic Square

UNIT II - FOOD PROCESSING

Lesson 1: Procedures Used in Processing Food

TEACHING PROCEDURES

A. Introduction

The largest segment of employment in the food business is food processing. This unit will examine the various processing techniques and related issues.

B. Motivation

1. Give each student a piece of pizza. Before they eat it, have them dissect its ingredients and chart what processes took place before it became a pizza. A frozen pizza label can be used to identify all of its ingredients.

2. Show one or all of the following eight-minute careers videos from Hobar: Careers in Harvested Foods; Dairy Products and Processing; and Meat, Poultry, and Fish Processing.

C. Assignment

D. Supervised study

E. Discussion

1. Discuss with students why foods are processed. Food processing can be defined as any mechanical, chemical, or biological treatment to food. These processes may preserve the food or change the raw materials appearance or flavor.

Why are foods processed?

a. Processed food can be stored for longer periods of time.
b. Processing techniques slow down deterioration.
c. Processing helps guard against microbial contamination.
d. Processing can make foods more convenient, add variety, enhance flavor, and increase value (tenderization, size, weight, shape control).
e. Processing controls composition (protein, fat, moisture content).

2. Discuss with students the various ways that foods can be processed. Have students complete AS 1.1 and AS 1.2.

How can foods be processed?

a. Dehydration - the removal of water from foods: dried fruit, beef jerky
b. Fermentation - fermentation releases nutrients locked in plant cells; starch can be split into simple sugars
c. Milling - removal of chaff and all other foreign material; may be washed with water and separated by size
d. Fractionation - separate constituents (i.e., hulls, bran, germ, endosperm) from each other
e. Grinding - reducing the particle size, (e.g., ground beef, flour) - called comminution in the meat industry
f. Emulsifying - ingredients that normally would repel each other and separate are held together, or stabilized, by an emulsifying agent
g. Homogenizing - forcing milk or other liquids under high pressure through a valve which breaks large fat molecules into smaller ones
h. Hydrogenation - edible oil is converted to a semi-solid state (e.g., margarine and shortening), resulting in a product that is spreadable and resists rancidity
i. Combination - mixing of constituents back together
j. Texturization - wheat is transformed into pasta; restructured meats have been ground, flaked, or chopped and formed into steak or roast-like products
k. Chemical modification - addition of heat, enzymes, or microbes to produce a product (e.g., cider, pickles, popcorn, corn syrup)
l. Precipitating/centrifuging - separating the components based on their densities; a centrifuge speeds the process (e.g., milk casein precipitates forming the curd)
m. Extrusion - formulated dough or mash is forced through an extruder; high pressures cause the starch molecules to swell and then gel; this creates a puffing of the newly shaped product

3. Discuss with students how food safety is assured.

How is food safety assured?

a. Federal Meat Inspection Act of 1906 - provides mandatory inspection of animals, slaughtering conditions, and meat processing facilities; regulates interstate activities
b. Wholesome Meat Act of 1967 - all city and state meat regulations must meet federal standards
c. Federal Poultry Products Inspection Act of 1957 and Wholesome Poultry Products Act of 1968 - set federal standards on poultry.
d. Federal Trade Commission Act of 1938 - protects the public from false advertising in the food industry

e. Food, Drug, and Cosmetic Act of 1938 - set the basic principles of food safety and gave the FDA the power to enforce food safety measures
f. Infant Formula Act of 1980 - manufactured formulas must contain known essential nutrients at appropriate levels
g. Federal Grade Standards - uniform quality standards
h. State and Local Laws - various state and local laws usually administered by the Health Department
i. Food and Drug Administration (FDA) - assures consumers that the food they buy is safe, nutritious, and honestly represented; approves all additives before they can be used; lists over 600 ingredients that are safe and not considered additives; Generally Recognized As Safe (GRAS) e.g., sugar, table salt, cinnamon
j. USDA - monitors meat and poultry products; FDA monitors all other foods
k. USDA Grade A Pasteurized Milk Ordinance

4. Discuss the methods that should be used to clean and sanitize food processing equipment. Clean means to remove all visible filth. Sanitize refers to removing any microbial contamination.

What methods should be used to clean and sanitize food processing equipment?

a. Cleaning - removing all visible filth
    1. Hot water plus alkaline cleanser
    2. Acidic cleanser used to remove mineral deposits
b. Sanitize - Following cleaning, sanitize at 180°F with water or an approved chlorine or iodine rinse.
c. Metal equipment needs to be sprayed with an edible mineral oil to prevent rusting.

F. Other activities

Conduct "Bacteriological Examination of Food Equipment and Eating Utensils" experiment from *Food Science, Safety and Nutrition* by the National Council for Agricultural Education.

G. Conclusion

Food is processed, or changed mechanically, chemically, or enzymatically for a variety of reasons. Due to these reasons, several processes have been developed to provide consumers with a safe food supply. The U.S. Government, through the USDA and the FDA, regulate food safety standards. Producers and processors alike, work to deliver wholesome food to the consumer. A part of this

commitment to food safety is the proper cleaning and sanitization of processing equipment.

H. Competency

Explain procedures used to process food safely.

Related Missouri Core Competencies and Key Skills:

10C-5: Identify the variables and controls in a laboratory experiment involving osmosis and reach a conclusion from the given data.

I. Answers to Evaluation

1. Any three of the following: convenience, value adding, microbial contamination guard, slows down deterioration, variety, longer storage, composition control, flavor enhancement
2. j
3. d
4. h
5. f
6. d
7. k
8. i
9. g
10. b

J. Answers to Assignment Sheets

AS 1.1

Part A

1. Longer storage, more convenient, slows microbial activity, adds value
2. More chewy, less juicy, darkened, etc.
3. Answers will vary depending on type of foods compared.
4. Certain foods would lose their palatability, water-soluble vitamins, diversity of use, etc.
5. Yes, answers will vary depending on type of foods compared.

Part B

1. Normally, no they cannot. Cells have collapsed and cell walls are broken.

AS 1.2

The magic number is 39 .

A 2	B 7	C 18	D 12	Total 39
E 8	F 5	G 11	H 15	39
I 13	J 17	K 6	L 3	39
M 16	N 10	O 4	P 9	39
Total 39	39	39	39	

UNIT II - FOOD PROCESSING
Lesson 1: Procedures Used in Processing Food

Name _____
Date _____

EVALUATION

1. Name three reasons for food processing.

Match the definition in Column A with the correct term in Column B.

Column A

____2. Removal of chaff, foreign material, soil

____3. Separate the hulls, germ, bran, and endosperm

____4. Converting vegetable oil into shortening

____5. Process that keeps oils and water from separating

____6. Microorganisms break starch into sugars

____7. Removal of moisture

____8. Enriching food with needed ingredients

____9. Separate a solid from a solution

Column B

a. Extrusion
b. Precipitating/ centrifuging
c. Textuization
d. Emulsifyin
e. Homogenizing
f. Hydrogenation
g. Combination
h. Fractionation
i. Grinding
j. Milling
k. Fermentation
l. Dehydration

UNIT II - FOOD PROCESSING AS 1.1

Lesson 1: Procedures Used in Processing Food Name_____

Dehydration and Rehydration

Objective: Observe the effects of dehydration of food. Students will be able to calculate the moisture content of fresh food.

Activity Length: Part A: 1.5 days
Part B:1 day

Materials and Equipment:

sharp knife
scale
labels
fruit or vegetable (examples: apple, apricot, banana, bean, broccoli, cabbage, carrot, peach, pear, nectarine, orange, pumpkin, radish, and tomato)
dehydrator or standard oven
Fruit Fresh® or .1 percent solution sodium bisulfite

PART A: Dehydrate

Procedure:

1. Select food from those provided by your instructor.

2. Wash, peel, wash again, and remove the seeds from your fruit/vegetable.

3. Remove any surface moisture.

4. Cut into very thin slices.

5. Weigh cut produce. Divide produce into 2 equal portions. Record data in the table.

6. With ½ the fruit, apply Fruit Fresh® or sodium bisulfite. Follow label instructions.

7. Label produce with type of produce, your name, and with or without Fruit Fresh®. Dehydrate food.

NOTE: Check with your instructor for proper use of the dehydrator or the standard oven, which is set on 200°F.

8. Remove produce from dehydrator.

9. Weigh and record your data in Table 1.1.

10. Calculate percentage of moisture in original sample.

$$\frac{\text{original weight - dried weight}}{\text{original weight}} \times 100 = \text{percent moisture}$$

Table 1.1

Type of Produce	Weight of Original Sample	Dried Weight	Volume H_2O Lost	% H_2O removed from Original	Color after dehydrating

Key Questions:

1. What are the benefits of dehydrating food?

2. How was the food's texture, flavor, and general appearance affected by dehydrating?

3. How do the fruits with Fruit Fresh® compare to the fruits without Fruit Fresh®?

4. Describe reasons why all foods are not dehydrated.

Fill in information on Table 1.1 about three different foods that were dehydrated by classmates. Make sure you get some information on fruit dried with and without Fruit Fresh®. Compare the dehydrated foods to the original foods.

5. Is there any difference in the amount of water in the original foods? Why?

PART B: Rehydrate Name _____

Procedure:

1. Place dehydrated food in a water bath overnight under refrigeration.

2. Weigh rehydrated food.

3. Calculate the volume of moisture that was regained. Rehydrated wt minus dried wt. equals volume regained.

Table 1.2

Weight of Original Sample	Dried Weight	Rehydrated Weight	Volume Gained

Key Question:

1. Can rehydrated fruit/vegetables completely regain their original water content? Why or why not?

Adapted from: Frick, Marty. *Food Science, Safety and Nutrition*. The National Council for Agricultural Education, 1993 and Mehas, Kay; Sharon Rodgers. *Food Science and You*. 1st ed. Mission Hills, CA: Glencoe Publishing, 1989.

UNIT II - FOOD PROCESSING AS 1.2

Lesson 1: Procedures Used in Processing Food Name

Food Processing-Magic Square

Directions: Find the description on the following page which best fits each term. Write the number of the correct description in the space in each lettered square. If all your answers are correct, the total of the numbers, or the "Magic Number," will be the same in each row and column. Write the Magic Number in the space provided.

Terms

A. Anaerobic

B. Aerobic

C. Aseptic canning

D. Blanching

E. Commercially sterile

F. Controlled atmosphere

G. Cool storage

H. Food dehydration

I. Fortification

J. Frozen storage

K. Hypobaric storage

L. Irradiation

M. Pasteurization

N. Pathogenic

O. Precipitate

P. Shelf life

				Total
A	B	C	D	_____
E	F	G	H	_____
I	J	K	L	_____
M	N	O	P	_____
Total _____	_____	_____	_____	

Descriptions:

1. This is the protein, carbohydrates, fat, minerals, and vitamins that are dissolved in milk.

2. Without oxygen

3. Processing with a limited number of kinds of radiant energy that together are referred to as ionizing radiations. This process is also called "cold sterilization" because it does not produce a significant amount of heat.

4. This means to cause a solid substance to separate from a solution.

5. Is used for apples and other fruits that respire, and then over ripen in cold storage. The system is based on reduced temperatures, depletion of oxygen and increased levels of carbon dioxide.

6. Refrigerated storage area maintained under reduced pressure and high humidity.

7. In the presence of oxygen

8. Means the degree of sterilization at which all pathogenic and toxin-forming organism have been destroyed, as well as all other types of organisms, which if present, could grow in the product and produce spoilage under normal handling and storage conditions.

9. The time a food product can safely be stored before deteriorating.

10. Disease carrying microorganisms

11. Refers to storage at temperatures above freezing, from 16°C down to -2°C. Commercial and household refrigerators are usually run at 4.5° to 7°C.

12. This is a kind of pasteurization process used to inactivate natural food enzymes in fruits and vegetables. It is typically used when these products are to be stored frozen (freezing will not completely stop enzyme activity).

13. Addition of a nutrient to foods such as adding vitamin D to milk

14. Addition of water to dehydrated foods

15. This refers to the nearly complete removal of water from foods under controlled conditions.

16. This involves a comparative low order of heat treatment (usually temperature is below the boiling point of water). Pasteurization is used to destroy pathogenic organisms associated with foods like milk. It is also used to extend product shelf life for products such as beer, wine, and fruit juices.

17. This requires temperatures of -18°C or below.

18. This refers to a method in which food is sterilized or commercially sterilized outside of the can and then aseptically placed in previously sterilized containers that are subsequently sealed in an aseptic environment.

Credit: Frick, Marty. *Food Science, Safety and Nutrition*. The National Council for Agricultural Education, 1993.

UNIT II - FOOD PROCESSING

Lesson 2: Food Product Development

Objective

The student will be able to describe the complexity of the development of food products.

I. Study Questions

A. How are new food products developed and introduced into the marketplace?

B. How was margarine formulated?

II. References

A. Martin, Phillip R. *Food Science and Technology* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1994. Unit II.

B. Activity Sheet

AS 2.1: Soy Milk

UNIT II - FOOD PROCESSING

Lesson 2: Food Product Development

TEACHING PROCEDURES

A. Review

Review why food is processed and relate that processing procedures are determined by consumer demand. What if a consumer survey demands a product that is not yet available? What are the steps in product development?

B. Motivation

1. The students, collectively, make up a taste panel. Each student receives four chocolate chip cookies labelled A,B,C, and D: Cookie A has 2 times the salt, cookie B has 50 percent of the flour, cookie C is made like the recipe, and cookie D has 50 percent of the sugar called for in the recipe. Students evaluate each sample based on its appearance, flavor, aroma, and texture. Students should write down their comments and report outcomes. Discuss what students liked or didn't like about the cookies.

2. Also works to compare three brands of saltine crackers or vanilla wafers. Tang®, Koolaid®, and orange juice is also an interesting comparison.

C. Assignment

D. Supervised study

E. Discussion

1. Discuss how new food products are developed. Research in food science has been increasing as consumers become more mobile. Early research centered on practical problems in food preparation encountered in the home. Modern research is focusing on commercially important food products. While all product development begins with an idea, the complex series of steps that follow occur in no particular order. Have students complete AS 2.1.

How are new food products developed and introduced into the marketplace?

a. Idea - Food scientists (product developers) come up with ideas that may be generated by consumer complaints or suggestions, new regulations, new findings about nutrition, etc.

b. Bench-top development - production of prototypes
c. Objective testing - shelf-life and safety testing
d. Sensory evaluation - do consumers like the taste, color, etc.
e. Basic and applied research - to solve problems
f. Pilot plant production - evaluates production process
g. Engineering services - modify processing facilities
h. Marketing surveys - to determine if product meets the desires of consumers
i. Economic analysis - to determine costs of the product
j. Test marketing - to determine if consumers will buy product
k. National roll-outs - company commits to sell product
l. Advertising campaigns - to advertise the new product
m Brand maintenance - monitor the performance of the product

2. Discuss how margarine differs from butter.

How was margarine formulated?

a. The need for a new product was created by the shortage of butter during World War I.
b. The product developer's goal was to simulate butter using ingredients that were readily available.
    1. The emulsifier is obtained from soybeans.
    2. Hydrogenation is used to add hydrogen atoms to the fatty acids in soybeans.
    3. Hydrogenated oil, water, and lecithin are blended together to get the desired emulsion.
    4. Colors, flavors, and vitamins were added to make margarine a reasonable substitute for butter.

F. Other activities

Butter churning lab. Place appropriate quantity of cream in butter churn and let students churn until butter is complete, then lightly salt and form into desired shape. Rinse off and serve.

G. Conclusion

Food products are the product of lengthy efforts and only a few reach the product stage. All products begin as an idea that could be beneficial in terms of convenience, nutrition or economic reasons. The research and development process is a detailed process that precedes new product launch. Various foods eaten today are formulated foods resulting from food product development efforts.

H. Competency

1. Describe the complexity of the development of food products.

2. Related Missouri Core Competencies and Key Skills: None

I. Answers to Evaluation

1. a
2. b
3. d
4. a
5. c
6. b

J. Answers to Activity Sheet

AS 2.1

1. for lactose intolerant diets; value added product of soybeans, low fat product, etc.
2. instructor's discretion
3. instructor's discretion
4. instructor's discretion

UNIT II - FOOD PROCESSING Name _____

Lesson 2: Food Product Development Date _____

EVALUATION

Circle the letter that corresponds to the best answer.

1. How are engineering services used in new product development?

   a. To modify processing facilities
   b. To evaluate production process
   c. To determine if consumers will buy the product
   d. To monitor the performance of the product

2. How is pilot plant production used in new product development?

   a. To modify processing facilities
   b. To evaluate production process
   c. To determine if consumers will buy the product
   d. To monitor the performance of the product

3. Which technique is used to determine if consumers like the taste, color, etc., of the product being developed?

   a. Advertising campaigns
   b. Economic analysis
   c. National roll-outs
   d. Sensory evaluation

4. Which phase of new product development uses the production of prototypes?

   a. Bench-top development
   b. Economic analysis
   c. Marketing surveys
   d. Test marketing

5. Why was margarine formulated?

   a. Consumers were tired of eating butter at every meal.
   b. Dairy cattle were needed to pull two-wheel carts.
   c. Butter wasn't available because it was being fed to the soldiers.
   d. Butter doesn't keep so a substitute needed to be developed.

6. What was the product developer's goal when formulating margarine?

   a. To eliminate butter from the market place
   b. To simulate butter using ingredients that were readily available
   c. To make a butter substitute at any cost
   d. To replace butter as the spread for breads

UNIT II - FOOD PROCESSING AS 2.1

Lesson 2: Food Product Development Name _____

Soy Milk

Objective: Students will process soybeans to produce soy milk and design a food label for soy milk.

Activity Length: 2 periods

Background Information:

Commercial soy milk is often fortified with vitamins and minerals to approximate the composition of cow's milk. Soy milk may be used in place of cow's milk in most recipes. Due to the flavor difference between soy and cow's milk, you may prefer to use half soy milk and half cow's milk.

Soy milk is available commercially in dry, concentrated, and ready-to-use forms. Instructions for preparing, serving, and storing are on the package. Soy milk may also be prepared at home.

Materials and Equipment:

1 lb. (2½ c.) dry soybeans
Water
Blender
Cheesecloth
Cooking pot
2 T. Sugar
1 t. Salt

Procedure:

1. To prepare about 2 quarts of soy milk, use 1 pound (2 1/2 cups) dry soybeans. Sort and wash beans thoroughly.

2. Using 2 quarts of water, soak beans overnight or use the 2-minute-boil method.

3. Drain soaked beans, remove skins, and discard the soaking water. You only need to remove the skins from the beans if you wish to use the bean mash or pulp after the milk is made.

4. Using 3 quarts of water, grind the soaked beans in a blender. Place part of the beans and enough water to cover the beans in blender container; grind until very fine (about 2 minutes). Repeat until all beans have been ground and the 3 quarts of water have been used.

5. Strain ground beans through two layers of cheesecloth into a large kettle. Squeeze as much liquid from the mash as possible.

6. Boil the soy milk for 30 minutes, stirring occasionally to prevent scorching. It is necessary to cook the milk thoroughly to destroy a substance which interferes with trypsin, one of the digestive enzymes.

7. While the milk is still warm, add 2 tablespoons sugar and 1 teaspoon salt. Stir until dissolved.

8. Cover milk tightly and store in the refrigerator.

9. Strain milk before using because a skin often forms on the surface.

10. Following refrigeration, compare soy milk's flavor and texture to cow's milk and answer the following questions then design a label for a jar of soy milk to enhance its share of the market.

Key Questions:

1. Why is soy milk produced?

2. What are soy milk's positive attributes?

3. How does its flavor and texture compare to cow's milk?

4. What size market share do you expect soy milk to gain in the future?

Credit: Missouri Soybean Association and the Missouri Soybean Merchandising Council, P.O. Box 104778, Jefferson City, MO 65110-4778.

UNIT II - FOOD PROCESSING

Lesson 3: Milk Processing

Objective

The student will be able to identify products produced from different grades of raw milk.

I. Study Questions

A. What are the quality grades of milk?

B. What major products can be produced from raw milk?

C. What by-products result from milk processing?

D. What factors affect milk taste and composition?

II. References

A. Martin, Phillip R. *Food Science and Technology* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1994. Unit II.

B. Activity Sheets

1. AS 3.1: Determining Thresholds for Off-flavors in Milk Using a Triangle Sensory Test (Instructor)
2. AS 3.1: Determining Thresholds for Off-flavors in Milk Using a Triangle Sensory Test (Student)

UNIT II - FOOD PROCESSING

Lesson 3: Milk Processing

TEACHING PROCEDURES

A. Review

In Lesson 2, the difference between margarine and butter was discussed. This lesson will discuss how raw milk is processed into milk products.

B. Motivation

1. Show video,"The Dairy Plant," available from Creative Educational Video (CEV).

2. Have students taste test different types of milk: whole milk, 2 percent milk, 1 percent milk, cultured buttermilk, evaporated milk, sweetened condensed milk, milk substitute, and dried/reconstituted milk.

C. Assignment

D. Supervised Study

E. Discussion

1. Discuss the quality grades of milk.

What are the quality grades of milk?

a. Grade A raw milk
b. Manufacturing grade (can be referred to as Grade B or Grade C)
c. Reject

2. Discuss what major products are produced from raw milk.

What major products can be produced from raw milk?

a. Fluid milk (must be made from grade A milk only)
    1. Whole milk - greater than or equal to 3.25 percent fat (raw milk is usually 3.6-3.7 percent fat)
    2. Low-fat milk
        a. 2 percent fat
        b. 1.5 percent fat
        c. 1 percent fat

d. 1/2 percent fat
3. Non-fat milk - less than 0.5 percent fat (skim milk)
4. Chocolate milk - a combination of chocolate flavoring with whole, low-fat, or skim milk

b. Fermented milk (must be made from grade A milk)
1. Cultured buttermilk - skim milk that has been pasteurized, inoculated with lactic acid-producing bacteria, and held at 72°F.
2. Yogurt
3. Acidophilus milk

c. Creams (must be made from grade A milk)
1. Half-and-half - about 11 percent fat
2. Cream - 18 percent fat
3. Whipping cream - 30 percent fat
4. Coffee cream - 18 percent fat
5. Heavy whipping cream - 36 percent fat
6. Sour cream - cultured, 18 percent fat

d. Butter
e. Canned milk
1. Evaporated milk - 60 percent water removed
2. Sweetened condensed milk

f. Dried milk - usually nonfat dried milk
g. Cheeses
h. Ice cream

3. Discuss what by-products result from milk processing.

What by-products result from milk processing?

a. Buttermilk - from butter making; usually is dried for sale to bakers
b. Whey - liquid remaining after the curd develops and is separated and removed; it can be dried, demineralized, and concentrated

4. Discuss what factors affect milk flavor and/or composition.

What factors affect milk taste and composition?

a. Antibiotics - may inhibit growth of bacterial cultures
b. Added water
c. Sediment
d. Pesticide contamination - are not known to change flavor; only minutely change composition
e. Radionuclides - are not known to change flavor; only minutely change composition
f. High bacterial counts

g. Fat content
h. Age of milk
i. Species, breed, individuality of animal, age, stage of lactation, season of year, feed, time of milking, period of time between milkings, physiological condition of cow (calm or excited)
j. Facilities - unlikely to affect flavor or composition in today's operations
k. Temperature of milk and rate of cooling
l. Offensive feeds that could be in cow's feed

F. Other activities

1. Use the IML Dairy Foods contest slide set to help students in evaluating off flavors in milk.

2. Have student discuss their opinions on the different milks tasted. The instructor could cover the labels and relabel with "A," "B," "C," etc. to see if students are able to identify the different products.

G. Conclusion

Milk is a balanced food that plays a vital role in a healthy diet. Milk grades reflect differences in requirements for facilities and operations at the farm, during assembly and in processing as well as in permitted bacteria counts. Milk is very versatile and can be made into many different products.

H. Competency

1. Identify products produced from different grades of raw milk.

2. Related Missouri Core Competencies and Key Skills: None

I. Answers to Evaluation

1. Grade A raw milk, manufacturer's grade (Grade B or C)
2. Grade A
3. Whole - 3.25 percent or greater milk fat
   Low-fat - 2 percent, 1.5 percent, 1 percent, or 0.5 percent milk fat
   Chocolate - chocolate flavoring has been added to either whole or low-fat milk

4. Cultured buttermilk is skim milk that has been pasteurized, and then inoculated with lactic acid-producing bacteria and held at 72°F.

5. Whipping cream

6. b
7. a
8. d

UNIT II - FOOD PROCESSING Name _____

Lesson 3: Milk Processing Date _____

EVALUATION

Complete the following short answer questions.

1. Name the two quality grades of milk.

2. Which quality grade is used for fluid milk processing?

3. How much milk fat is contained in each of the following types of milk: whole, low-fat, and chocolate milk?

4. How is cultured buttermilk produced?

5. Which has a higher fat content, half-and-half or whipping cream?

Circle the letter that corresponds to the best answer.

6. From what product is whey a by-product?

   a. Cultured buttermilk
   b. Cheese
   c. Ice cream
   d. Butter

7. What has the greatest impact on milk composition?

    a. Breed of cow
    b. Age of cow
    c. Facilities
    d. Time of milking

8. A cow with mastitis would be discovered with which test?

    a. Pesticide test
    b. Sediment test
    c. Mycotoxin test
    d. Somatic cell count

UNIT II - FOOD PROCESSING AS 3.1
Instructor

Lesson 3: Milk Processing

Determining Thresholds for Off-flavors in Milk Using a Triangle Sensory Test

Objective: Students will determine thresholds for off-flavors in milk using a Triangle sensory test.

Materials and Equipment:

Note: These are needed to make the samples for 10 students; not one set for each student.

1/2 pt. of cultured buttermilk
1/2 gal. pasteurized, homogenized milk
1/3 cup silage
1/4 tsp. table salt
Garlic salt or fresh onion
5 flasks or containers, 500 ml or 1 pint, with closures or covers
1-one liter Erlenmeyer flask fitted with a one-hole rubber stopper into which a glass or plastic tube is inserted to the bottom of the stopper. Attach a 15-inch (40 cm) hose to the tube for delivery of vapors from the silage sample to milk
Tripod or ring stand and wire gauze and Bunsen burner
Fluorescent lamp without cover or shield
4 oz. cups - 3 for each test per number of students

Procedure:

A. Preparation:

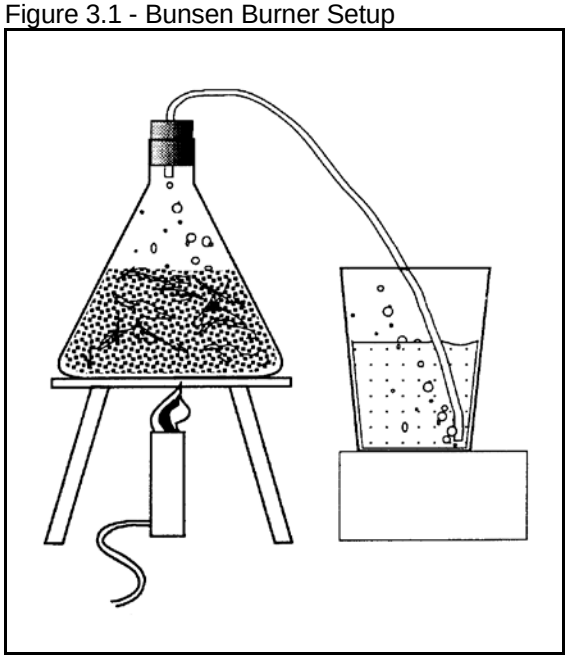
1. The formulas that follow are designed for 10 individuals and will provide more than 20 ml per person for tasting. If more than 10 students will be testing the samples, increase the amount of flavors in proportion to the number of students.

2. Flavors to be prepared are feed, high acid (sour), garlic/onion, oxidized and salty. These are chosen because they represent important flavors of milk and some other foods. Furthermore, they can be tasted within a 50-min. period. It is suggested that the flavorings be prepared before class. Prepare samples

at the beginning of class. For Phase I, use the strengths included under each test preparation.

a. Test A - Feed: this defect is prepared by boiling a suspension of silage in water and collecting in milk the steam that contains volatiles from the silage. Add about 1/3 cup of silage to about 125 ml (1/2 cup) of water in the 1-liter Erlenmeyer flask. Insert into the top of the flask the stopper with the tube and hose. Place on stand and heat with the Bunsen burner (see Figure 3.1). Collect steam volatiles in about 200 ml of milk in a 400 ml beaker or flask by inserting the hose into the milk while boiling the silage-water suspension. Collect volatiles for about 5 min. after boiling has started.

Figure 3.1 - Bunsen Burner Setup



To stop the operation remove the hose from the milk and turn off the burner at the same time. Do not leave the hose in the milk after the burner is off. To do so allows vacuum created in the flask, as it cools, to suck milk into the silage. Do not allow the hose to kink or to restrict air flow through the tube after the burner is off. A vacuum created in the flask can cause a defective flask to burst or can pull a slightly too small stopper into the flask.

Use this milk to flavor the sample to be tasted. The amount to use varies with the silage used. Start with 10 ml of silage-flavored milk in 200 ml of fresh milk. Adjust amount added after comparing the flavor and odor to that of an untreated portion of fresh milk.

b. Test B - High acid: Add 15 ml (1 tablespoon) of cultured buttermilk to 220 ml of fresh milk and stir. Compare flavor to that of fresh milk control and adjust amount added to increase or decrease flavor and odor intensity.

c. Test C - Garlic or onion: Add a sprinkle of garlic salt (about 50 grains estimated) to 220 ml of milk. Mix well, let set 5 min., mix again. Compare flavor and odor to that of untreated control. If flavor is too high, use this sample to treat fresh milk adding 10-20 ml each time until the flavor is slight, definite and pronounced.

Alternatively, press juice from a section of the interior of an onion and add single drops to 220 ml of milk until the flavor is slight, definite and/or pronounced.

d. Test D - Oxidized: This flavor is emphasized because of its high incidence in milk packaged in "see-through" plastic jugs that are displayed for sale under fluorescent light.

Place 220 ml of milk in a glass container and expose the sample for 20-30 min. to direct rays from a fluorescent lamp. Sample and lamp should be within 6 inches of each other. The reaction rate can be accelerated by addition of a washed copper penny or by a drop of 1% copper sulfate.

A similar flavor is produced in milk exposed to direct high intensity sunlight for 15 to 30 min.

Milks vary in their susceptibility to oxidation, so prolonged exposure to light or sample dilution may be necessary. Compare flavor of treated and untreated samples to make sure the off flavor is definitely discernible.

e. Test E - Salty: Place 0.1 g of salt in 9.9 ml of fresh milk. Use this 1:100 solution to add 1 ml to 100 ml of milk making the equivalent of 100 parts per million or 100 mg/liter. Compare the flavor to that of fresh milk. Adjust the flavor intensity upward by adding 1 ml at a time until the saltiness is slight, definite and/or pronounced.

B. Testing: Thresholds for flavor detection vary among individuals. It is essential to know that the flavor intensity is high enough for all individuals to recognize it. Of course, no one wants to taste a sample that is very pronounced in its off flavor, so do not over-flavor.

A good way to determine whether the flavor intensity is high enough is to do a triangle test. Here is the procedure.

Number small cups, such as 4 oz styrofoam, with 3-digit numbers. Numbers have been selected and included in the student form of AS 3.1. If different numbers are selected, a different record needs to be made for students.

For each off flavor to be tested you need 3 cups per person. For example, to test the salty sample with a group of 10 prepare 30 cups. Pour about 20 ml of the treated sample into about 15 cups and 20 ml of untreated sample into the

remainder. NOW the critical part is to make a chart showing how each of these samples is distributed to the students. Each person gets 2 cups of one set and 1 cup of the other set. Half the students will have two treated samples and the other half will have two untreated samples. They are served in random order. You must record the number and content of each cup for each student.

Present these "blindfold" samples to the group asking each person to indicate which two samples are alike. A table for record keeping has been provided in the student copy.

Indicate to students what they should do with samples after tasting. Also, you will need to let students know if they selected the correct samples for each test.

For Phase II, dilute or double the strength of the flavoring based on student results from Phase I. If all students selected the correct samples, dilute the strength of the flavoring. If less than seven students selected the correct samples, double the strength of the flavoring.

Credit: Robert T. Marshall, Professor Food Science and Nutrition, University of Missouri.

UNIT II - FOOD PROCESSING AS 3.1 Student

Lesson 3: Milk Processing Name _____

Determining Thresholds for Off-flavors in Milk Using a Triangle Sensory Test

Objective: Students will determine thresholds for off-flavors in milk using a triangle sensory test.

Activity Length: 1 class period

Background Information: In phase I, you will be testing five (5) different off-flavors. In each test, you will be tasting three different samples. All samples will be coded with numbers (420, 062, etc.) by your instructor. Depending on your instructor, you may be asked to complete Phase II which calls for tasting five additional sets.

Materials and Equipment:

Milk samples - provided by instructor
Container to discard tasted milk samples

Procedure:

1. Obtain the first samples (Test A) from your instructor.

2. Taste the milk in each cup in order presented, left to right. Do not swallow the milk. Put it in waste container. This is standard for a Triangle Sensory Test.

3. Answer the question, which two samples are the same by marking an "X" by the appropriate numbers in the table.

PHASE I	**Sample on Left**	**Sample in Middle**	**Sample on Right**
Test A	420	062	153
Test B	091	579	221
Test C	656	892	356
Test D	129	442	056
Test E	718	389	978
PHASE II	**Sample on Left**	**Sample in Middle**	**Sample on Right**
Test F	329	011	921
Test G	756	423	291
Test H	152	625	867
Test I	024	372	735
Test J	922	543	231

4. Return samples to instructor or dispose of samples as directed.

5. Give your responses to your instructor.

   Note: Your instructor will tabulate results.

6. Repeat steps 1-5 for Tests B, C, D, and E.

7. If directed by your instructor, complete Phase II by repeating steps 1 through 5 for Tests F, G, H, I, and J.

Key Questions:

1. In Phase I, did you select the correct samples in each test? Explain why you think you were able or not able to select the correct samples in each test.

2. How did you do compared to other students in the class?

3. If not all students selected the correct samples, why do you think there were differences?

4. If Phase II was completed, how did you do in selecting the correct samples in each test? Explain why you think you were able or not able to select the correct samples in each test.

5. In Phase II, how did you do compared to other students in the class?

6. If not all students selected the correct samples in Phase II, why do you think there were differences?

Credit: Robert T. Marshall, Professor of Food Science and Nutrition, University of Missouri-Columbia.

UNIT II - FOOD PROCESSING

Lesson 4: Processing Dairy Products

Objective

The student will be able to summarize how dairy products are processed and packaged.

I. Study Questions

A. What techniques are used to process raw milk?

B. Why is raw milk pasteurized and homogenized?

C. How are major dairy products processed?

D. Why should milk and dairy products be packaged?

E. How is the dairy processing industry organized?

II. References

A. Martin, Phillip R. *Food Science and Technology* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1994. Unit II.

B. Activity Sheets

1. AS 4.1: Pasteurization in a Double Boiler (Instructor)
2. AS 4.1: Pasteurization in a Double Boiler (Student)
3. AS 4.2: Making Plain Yogurt (Instructor)
4. AS 4.2: Making Plain Yogurt (Student)

UNIT II - FOOD PROCESSING

Lesson 4: Processing Dairy Products

TEACHING PROCEDURES

A. Review

Lesson 3 examined the products of raw milk, the grades of raw milk, and the factors that affect milk taste and composition. Review the grades of raw milk and explain that Grades A and B milk undergo the processes discussed in this lesson.

B. Motivation

Have students work in pairs to process ice cream. Each pair will need:

½ c. milk
½ c. whipping cream
¼ c. sugar
Fruit and nuts (optional)
1 pt freezer bag
1 ½-gal. freezer bag
3 c. ice
½ c. salt

Have students measure the milk, whipping cream, sugar, and vanilla and place in pint freezer bag. Fruit and nuts may be added. Seal bag tightly while keeping as much air as possible in bag. Place sealed bag inside ½-gallon bag. Add ice and salt. Close tightly. Take turns shaking the bag until ice cream is set, about 10-15 minutes. Discuss why salt was added to the ice.

C. Assignment

D. Supervised Study

E. Discussion

1. Discuss what techniques are used to process raw milk. Between the time the milk leaves the cow and arrives at the grocer, nine processes take place.

What techniques are used to process raw milk?

a. Quality control tests
b. Separation

c. Standardization
d. Clarification
e. Pasteurization
f. Homogenization
g. Fortification
h. Cooling
i. Packaging

2. Discuss why raw milk is pasteurized and homogenized. Milk is pasteurized to prevent disease and homogenized for improved taste and appearance. Have students complete AS 4.1.

Why is raw milk pasteurized and homogenized?

a. Pasteurization is necessary to rid milk of any disease-producing microorganism and to reduce total bacterial numbers for improved shelf life. Also, pasteurization destroys lipase and other natural enzymes.
   1. Batch method
   2. HTST - high temperature short-time method
b. Homogenization subdivides fat globules and clumps to a small enough size to prevent their rising to the top and forming a cream layer. Homogenized milk has a richer taste and has a whiter appearance than unhomoginized milk.

3. Discuss how major dairy products are processed. Have students work in groups to complete AS 4.2.

How are major dairy products processed?

a. Whole milk - milk fat level standardized to at least 3.25 percent, pasteurized, homogenized, fortified with Vitamin D, and packaged
b. Low-fat milk - milk fat level standardized to ½ percent, 1 percent, 1.5 percent or 2 percent, pasteurized, homogenized, fortified with vitamins A and D, and packaged
c. Non-fat milk - milk fat level lowered below 0.5 percent, pasteurized, homogenized, fortified with vitamins A and D, and packaged
d. Chocolate milk - either whole, low fat, or non-fat milk is mixed with either chocolate syrup or cocoa powder and sugar
e. Cultured buttermilk - skim, low fat or whole milk heated to 185°F for 30 minutes, inoculated with lactic acid-producing bacteria and held at 72°F until acidity reaches about 0.85 percent or pH reaches about 4.5
f. Yogurt - fermented whole or skim milk by *Streptococcus thermophilus*, and *Lactobacillus bulgaricus*; pH is lowered to point where casein clabbers or coagulates

g. Acidophilus milk - fermented whole milk that has *Lactobacillus acidophilus* bacteria added to digest lactose
h. Cream - separated centrifugally from fluid milk, then processed into various fat-content creams
i. Sour cream - following pasteurization, cream is cultured with lactic acid-forming bacteria
j. Butter - cream is churned to break the oil-in-water emulsion and to form a water-in-oil emulsion; washed with cold water and worked to reduce water content to 15 percent
k. Canned milk - 60 percent of water in the milk removed; carrageenan gum added to give a smooth texture; homogenized, canned, sterilized at 240°F for 15 minutes, sweetened condensed milk is canned milk with sugar added
l. Nonfat dried milk - dehydrated milk that can be stored for long periods
m. Ice cream - milk is heated to 110°F, sugar, emulsifier, stabilizer, and flavorings are added; it is pasteurized, homogenized, aged slightly, frozen to 22°F, and whipped with air; semi-solid ice cream is packaged then hardened to about -20°F
n. Natural cheese - pasteurized milk with the enzyme rennin added; the lactose in the milk is converted to lactic acid by bacterial cultures which reduce the pH from 6.7 to 4.6; at this point the soft curd develops which is then cut to release the whey; it is heated, pressed to 40 percent water, salted, shaped, ripened to alter texture, odor, and flavor; cottage cheese and cream cheese are not ripened
o. Processed cheese - different types of natural cheese are mixed and ground together and then melted to a uniform product with the aid of emulsifiers

4. Discuss why milk and dairy products should be packaged. Milk can be bought in glass, clear plastic, opaque plastic, cardboard, etc. How it can be packaged is not as important as why it should be packaged.

Why should milk and dairy products be packaged?

a. Increases shelf-life and freshness - decreases mold and bacterial contamination
b. Fluid milk contains light sensitive riboflavin (Vitamin B_2), thiamine, Vitamin A and Vitamin C - Opaque packaging reduces the breakdown of these
c. Dried milk must be packaged in a material impermeable to oxygen

5. Discuss how the dairy processing industry is organized. Cooperatives play an important role.

How is the dairy processing industry organized?

a. Individual producers belonging to cooperatives
b. Cooperative processes wholesale milk, cheese, ice cream, etc.
c. International Dairy Foods Association conducts research, educational, promotional, regulatory, legislative, and training activities.

F. Other activities

1. Complete Cottage Cheese Lab as instructed in the University of Missouri Extension Guide #G09550. It is included as Appendix B.

2. Invite a dairy cooperative representative to discuss the coop's role.

3. Teacher demonstration: Fill five test tubes of raw milk and 5 test tubes of pasteurized milk ¾ full and refrigerate at 45°F. Watch for changes, coagulation, gas bubbles, and digestion (clearing of fluid). Check pH with litmus paper for about two weeks.

4. Show the video from United Dairy Industry Association on milk commercials.

G. Conclusion

Before milk arrives at the grocery store, it is tested, standardized, clarified, pasteurized, homogenized, fortified, cooled, and packaged. Pasteurization is critical in maintaining milk quality and safety by killing spoilage and disease-producing microorganisms. Homogenization improves milk's texture and flavor. Proper packaging is needed to maintain freshness and increase shelf life.

H. Competency

1. Summarize how dairy products are processed and packaged.

2. Related Core Competencies and Key Skills:

9D-6: Identify the control, the dependent, and the independent variables in an experiment.
9E-5: Identify the basic and acidic ranges and the neutral point on the pH scale.

I. Answers to Evaluation

1. a
2. c

3. d
4. c
5. Homogenization provides a consistent texture and flavor. It prevents cream from rising.
6. Acidophilus milk is produced for lactose-intolerant people.
7. Instructor's discretion
8. Ice cream - 10 percent milk fat; sherbet - 1 to 2 percent milk fat
9. Packaging enhances freshness and shelf-life, is necessary for dried milk to hold nitrogen gas, and prevents riboflavin breakdown.

J. Answers to Activity Sheets

AS 4.1

1. most likely, tube A
2. most likely, tube B
3. most likely, tube G
4. whether spoilage was by acid-producing bacteria (pink)
5. to prevent cross contamination
6. 145°F is the critical temperature and it must be maintained for 30 minutes for pasteurization to take place (or 161°F for 15 seconds).

AS 4.2

1. Gelatin is a thickening agent.
2. D
3. E

UNIT II - FOOD PROCESSING
Lesson 4: Processing of Dairy Products

Name _____
Date _____

EVALUATION

Circle the letter that corresponds to the best answer.

1. Pasteurizing milk using the HTST method requires that milk is heated to ____ for ____.

   a. 161°F, 15 seconds
   b. 145°F, 30 minutes
   c. 130°F, 45 minutes
   d. 30°F, 145 seconds

2. Whole milk is a minimum of ____ milk fat.

   a. 1.0 percent
   b. 2.0 percent
   c. 3.25 percent
   d. 12.65 percent

3. Whole milk is fortified with ____ vitamin(s).

   a. C
   b. A & C
   c. A & D
   d. D

4. Low-fat milk and skim milk are fortified with ____ vitamin(s).

   a. C
   b. A & C
   c. A & D
   d. D

Complete the following short answer questions.

5. Why is milk homogenized?

6. Why is acidophilus milk produced?

7. Write an essay on the cheese-making process. Use each of the following terms appropriately: rennin, lactic acid, lactose, pH, cutting the curd, whey, salted, and shaped.

8. What is the difference between ice cream and sherbet?

9. Give two reasons why packaging dairy products is important.

UNIT II - FOOD PROCESSING AS 4.1
Instructor

Lesson 4: Processing Dairy Products

Pasteurization in a Double Boiler

Prepare litmus solution to be used in AS 4.1, Pasteurization in a Double Boiler.

Reagent: litmus, available from Signa Chemical Company, St. Louis, MO., 800-325-3010 (catalog number L7382, about $1/gram)

Procedure:

1. Add 5 g. litmus to 50 ml distilled water. Heat in a boiling water bath for 30 minutes or until dissolved. Make more or less solution depending on the class size. You will need 0.5 ml for each test tube of milk used.

2. Cover and cool overnight.

3. Filter through filter-paper (Whatman No. 12. A coffee filter will work fine.)

4. This solution is stable for at least one year if kept in a cool, dark place.

5. The day before use, pipette 0.5 ml of litmus solution into each test tube to be used the next day. Place the test tubes in a boiling water bath for 30 minutes. Remove from heat and allow to cool overnight. (If you have access to an autoclave, you can sterilize the solution at 121°C [250°F, 15 psi] for 20 minutes.)

Additional notes about pasteurization in a double boiler:

Step 2: Cultured yogurt, cottage cheese or sour cream could be substituted for the buttermilk, although best results will be obtained using fresh buttermilk. Be certain that the ingredients statement includes the words 'active starter culture' or similar.

Step 3: Maintaining the temperature may require adjustment of the heat source. Be certain that water touches the bottom of the upper pan in the double boiler at all times.

Step 7: If two sets of samples can be obtained, store one set at 7°C (45°F) and another at 25°C (72°F). Compare results between the two temperatures.

UNIT II - FOOD PROCESSING AS 4.1
Student

Lesson 4: Processing Dairy Products Name

Pasteurization in a Double Boiler

Objective: Students will determine the critical temperature needed to pasteurize milk.

Activity Length: 2 periods, 10 minutes for 10 periods thereafter

Materials and Equipment:

raw milk, or pasteurized milk with cultured buttermilk
double boiler
heat source
7 sterile pipets (5-10ml)
7 sterile test tubes containing litmus solution with screw caps
test tube rack
thermometers
ice bath
refrigerator
sterile stirring rod
sterile eye dropper
timer or watch

Procedure:

1. Place water in bottom pan of double boiler and bring to a boil.

2. Place raw milk or pasteurized milk containing 1 percent cultured buttermilk in top pan (minimum of 100 ml of milk).

3. Heat milk, stirring every 1-2 minutes with a stirring rod until the temperature reaches 63°C (145°F). Continue to stir and maintain 63°C (145°F).

4. Remove 5 ml of hot milk with a sterile pipet and place the milk into the test tubes containing the sterilized litmus solution. Screw on the cap, and mix the milk and litmus solution together well.

5. Immediately following the transfer of milk to the test tube, place the test tube in an ice/water bath and cool to about 7°C (45°F).

6. While maintaining 63°C (145°F) with the remaining milk in the double boiler, at 5-minute intervals remove 5 ml of milk and place it in sterile test tubes marked B, C, D, E, F, and G. Be sure to use a different, sterile pipet for each sample. Complete Step 5 after filling each test tube.

7. Store all tubes at 7°C (45°F) and observe daily for evidence of spoilage: coagulation, gas bubbles, solubilization (digestion of protein).

8. Record and analyze data for the effects of heating and time of heating before the milk begins to spoil.

9. Complete the chart describing the physical evidence of spoilage and color changes due to pH alterations.

	TUBE A	B	C	D	E	F	G
DAY 1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

Key Questions:

1. Which tube(s) showed signs of spoilage first?

2. Which tube(s) showed signs of spoilage second?

3. Did you have a tube that never showed signs of spoilage? If so, which one(s)?

4. What did the litmus solution tell you? (Some bacteria reduce--opposite of oxidize--litmus causing it to become colorless. If this happens, color will appear at the top of the tube where milk is exposed to O_2.)

5. Why did you use a different sterile pipet for each sample?

6. What can you conclude about the necessity of temperature and length of heating time for pasteurization to take place?

Adapted from: "Making Yogurt at Home," University Extension Guide #GH1183.

UNIT II - FOOD PROCESSING AS 4.2
Instructor

Lesson 4: Processing Dairy Products

Making Plain Yogurt

Objective: The student will be able to identify the ingredients needed to produce yogurt and explain why each is needed.

Activity Length: 2 periods (4 hours incubation time)

Background Information:

With the exception of a commercial yogurt maker with an electrically heated base, most of the equipment needed to prepare yogurt can be found in any kitchen. Make sure you have all the necessary equipment **before** you begin preparing yogurt. This recipe makes 4 to 5 cups. Yogurt can be stored in the refrigerator for about 10 days. This recipe can be doubled or tripled with no loss of quality, but make sure you can use that amount in 10 days or less. Adjust pan and container size accordingly.

Materials and Equipment: (1 set per group of students)

Double boiler that holds at least 5 cups
Candy thermometer with a range of 100°F to 300°F
Container for yogurt that holds at least 5 cups (glass, crockery, food-grade plastic or stainless steel), or use individual custard cups or jelly jars--then the yogurt can be eaten directly from the container in which it was made.
Other useful equipment: large spoon, large bowl, and aluminum foil or plastic wrap to cover yogurt containers if they don't have lids
Incubator to maintain a constant temperature of 108°F to 112°F when incubating yogurt. (The most foolproof method for incubating yogurt is in a commercial yogurt-maker with an electrically heated base. If you don't want to purchase a yogurt-maker, experiment with the other methods of incubation described in *Table 1* until you find one that fits your needs.)

1 quart milk (whole, low-fat, skim or reconstituted nonfat dry milk) **A safety precaution: If you use home-produced milk, either from a cow or goat, it must be pasteurized before preparing yogurt or any other milk product.**
Nonfat dry milk powder - use _ cup powder when using whole or low-fat milk, use _ cup powder when using skim or reconstituted nonfat dry milk
¼ cup commercial, unflavored, cultured yogurt*
2 to 4 tablespoons sugar or honey (optional)

½ package (1 teaspoon) unflavored gelatin (for thick, firm yogurt only)

*__Special hint:__ To make yogurt in the classroom or at home, an active (living) yogurt culture is needed as a "starter." Commercial, unflavored cultured yogurt, from the supermarket is usually used. Yogurt starter cultures can also be purchased at health food stores, but are quite expensive compared to commercial cultured yogurt. Once you start making yogurt, save some of your homemade yogurt to "start" your next batch. For best results, however, purchase commercial cultured yogurt to replenish a homemade culture every four to five batches.

Procedure:

1. Thoroughly wash equipment for making yogurt and container(s) with hot, soapy water. Rinse everything thoroughly and air dry. A dishwasher can also be used.

2. Pour boiling water into the yogurt container(s) and leave until ready to use.

3. Prepare the incubator following manufacturer's instructions (*see Table 1)*. Instruct students on how the incubator should be operated.

For Thin Yogurt:

4. Place cold, pasteurized milk in top of a double boiler and stir in nonfat dry milk powder. Add sugar or honey if a sweeter, less tart yogurt, is desired.

5. Heat milk to 200°F, stirring gently, and hold for ten minutes. **Do not boil**.

6. Place top of double boiler in cold water to cool milk rapidly to 112°F to 115°F. Watch the temperature carefully as it falls rapidly once it reaches 125°F. Remove pan from cold water.

7. Remove one cup of the warm milk and blend it with the yogurt, starter culture. Add

Table 1
Incubators

- **Method A:** Prewarm oven to 200°F and turn off. Use an oven thermometer to monitor temperature -- do not let it drop below 100°F. Turn oven on for short periods during incubation to maintain temperature of 108°F to 112°F.
- **Method B:** Line an ice chest (picnic cooler) with aluminum foil. Place four, one-quart jars filled with hot water (about 140°F) inside the ice chest with the yogurt container(s) and cover ice chest with a tight-fitting lid. Allow space between jars and container(s) of yogurt.
- **Method C:** Nestle several cardboard boxes inside each other, placing crushed newspapers between each box. Continue as directed in Method B for ice chest.
- **Method D:** A simple way to incubate a small amount of yogurt is to pour the mixture into a wide-mouth thermos and cover with a tight lid. When the yogurt is ready, loosen the thermos lid before storing in the refrigerator so the yogurt can cool rapidly.
- **Method E:** Set filled container(s) of yogurt on a towel-covered heating pad, set on medium heat, in a sheltered corner on a kitchen counter. Cover the jars with several towels.

this to the rest of the warm milk. Temperature should now be 110°F to 112°F.

8. Pour water out of the yogurt container.

9. Pour the yogurt immediately into the clean hot container(s), cover and place in prepared incubator. Close incubator.

10. Incubate about 4 hours. Yogurt should be set. The longer the incubation time, the more tart or acidic the flavor.
11. Refrigerate immediately. Rapid cooling stops the development of acid. Yogurt will keep for about ten days if held at 40°F or lower (normal refrigerator temperature).

For Thick, Firm Yogurt: (Follow steps 1 through 3 above.)

4. Place cold, pasteurized milk in the top of the double boiler and stir in nonfat dry milk powder. Stir in sugar or honey if sweeter, less tart yogurt is desired. Sprinkle gelatin over the milk. Let stand for 5 minutes to soften gelatin.
5. Heat milk to 200°F and hold for 20 to 30 minutes, stirring gently to dissolve gelatin. Continue from Step 6 under *Thin Yogurt*.

Adapted from: *Making Yogurt at Home*, University of Missouri Extension Guide #GH1183.

UNIT II - FOOD PROCESSING AS 4.2
Student

Lesson 4: Processing Dairy Products Name

Making Plain Yogurt

Objective: The student will be able to identify the ingredients needed to produce yogurt and explain why each is needed.

Activity Length: 2 periods (4 hours incubation time)

Materials and Equipment:

Double boiler
Candy thermometer
Container for yogurt that holds at least 5 cups (glass, crockery, food-grade plastic or stainless steel), or use individual custard cups or jelly jars with lids if possible.
Large spoon
Large bowl
Aluminum foil or plastic wrap to cover yogurt containers (if they don't have lids).
Incubator
1 quart milk (whole, low-fat, skim or reconstituted nonfat dry milk)
Nonfat dry milk power - Use _ cup powder when using whole or low-fat milk, use _ cup powder when using skim or reconstituted nonfat dry milk.
¼ cup commercial, unflavored, cultured yogurt*
2 to 4 tablespoons sugar or honey (optional)
½ package (1 teaspoon) unflavored gelatin (for thick, firm yogurt only)

Procedure:

1. Thoroughly wash equipment for making yogurt and container(s) with **hot**, soapy water. Rinse everything thoroughly and air dry. A dishwasher can also be used.

2. Pour boiling water into the yogurt container(s) and leave until ready to use.

3. Prepare the incubator following your instructor's directions.

For Thin Yogurt:

4. Place cold, pasteurized milk in top of a double boiler and stir in nonfat dry milk powder. Add sugar or honey if a sweeter, less tart yogurt is desired.

5. Heat milk to 200°F, stirring gently, and hold for ten minutes. **Do not boil**.

6. Place top of double boiler in cold water to cool milk rapidly to 112°F to 115°F. Watch the temperature carefully as it falls rapidly once it reaches 125°F. Remove pan from cold water.

7. Remove one cup of the warm milk and blend it with the yogurt starter culture. Add this to the rest of the warm milk. Temperature should now be 110°F to 112°F.

8. Pour water out of the yogurt container.

9. Pour the yogurt immediately into the clean hot container(s), cover and place in prepared incubator. Close incubator.

10. Incubate about 4 hours. Yogurt should be set. The longer the incubation time, the more tart or acidic the flavor.

11. Refrigerate immediately. Rapid cooling stops the development of acid. Yogurt will keep for about ten days if held at 40°F or lower (normal refrigerator temperature).

For Thick, Firm Yogurt: (Follow steps 1 through 3 above.)

4. Place cold, pasteurized milk in the top of a double boiler and stir in nonfat dry milk powder. Stir in sugar or honey if sweeter, less tart yogurt is desired. *Sprinkle gelatin over the milk.* Let stand for 5 minutes to soften gelatin.

5. Heat milk to 200°F and hold for 20 to 30 minutes, stirring gently to dissolve gelatin. Continue from Step 6 under *Thin Yogurt*.

Key Questions:

1. For thick yogurt, why was gelatin added?

2. If yogurt developed an acid taste, which of the following could be true?

    a. temperature reached was too cool
    b. too short incubation period
    c. insufficient dry milk used
    d. too long incubation period

3. If yogurt does not become firm, what may be the cause?

    a. incubation temperature too high
    b. incubation temperature too low
    c. inactive culture
    d. soiled containers
    e. all of the above

Adapted from: *Making Yogurt at Home*, University of Missouri Extension Guide #GH1183.

UNIT II - FOOD PROCESSING

Lesson 5: Processing Egg Products

Objective

The student will be able to compare egg processing techniques to egg products.

I. Study Questions

A. What are the major product forms of eggs?

B. What are the quality characteristics of eggs?

C. What factors influence egg quality?

D. How are eggs graded?

E. How are the different grades of eggs processed?

F. What are the sizes of eggs?

G. How is the egg processing industry organized?

II. References

A. Martin, Phillip R. *Food Science and Technology* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1994. Unit II.

B. Transparency Master

TM 5.1: Egg Structure

C. Activity Sheet

AS 5.1: Candling Eggs

UNIT II - FOOD PROCESSING

Lesson 5: Processing Egg Products

TEACHING PROCEDURES

A. Review

Just as a cow's diet influences milk quality, Vitamin D, calcium, and xanthophyll influence egg quality. This lesson looks at egg processing from hen to grocer.

B. Motivation

1. Store an egg at room temperature for 1-3 days. Break onto a sheet of glass or a mirror. Compare to an egg stored at refrigeration temperatures. Notice yolk height, albumen height and thickness, albumen spread, yolk color, present of chalazae cords.

2. Make an egg white foam with eggs stored at two different temperatures. Add a pinch of cream of tarter to another egg before whipping. Put egg white foam in glass beaker and observe over a class period. How does temperature and pH affect foaming ability of eggs?

C. Assignment

D. Supervised Study

E. Discussion

1. Discuss what major products come from eggs.

What are the major product forms of eggs?

a. Shell eggs
b. Refrigerated liquid eggs
c. Frozen eggs
d. Dried eggs
e. Specialty products

2. Discuss the quality characteristics of eggs. Candling is passing eggs on rollers over high intensity lights to evaluate the interior. Haugh Unit System measures albumen height with a micrometer. Have students complete AS 5.1, Candling Eggs. TM 5.1 illustrates the physical structure of eggs.

What are the quality characteristics of eggs?

a. Exterior shell
    1. Cleanliness
    2. Soundness
    3. Texture
    4. Shape
b. Interior - candling process or Haugh Unit System used
    1. Air cell depth
    2. Albumen - clarity and firmness
    3. Yolk - outline distinctness, size, shape, blemishes

3. Discuss what factors influence egg quality. Brown eggs are laid by hens with red ear lobes (e.g., Rhode Island Red, New Hampshire, Plymouth Rock). White eggs are laid by hens with white ear lobes. Egg color does not affect egg quality, except for consumer's perception. (Brown eggs almost always command higher prices.)

What factors influence egg quality?

a. Facilities, equipment, and handling
b. Hen's diet
    1. Minerals and vitamins influence shell strength
    2. Feeds with xanthophyll result in a medium, yellow yolk
c. Breed of hen
d. Hen's age - older hens lay eggs with thinner shells
e. Hen's physiology - ruptured blood vessel may result in a blood spot
f. Time after laying (age of egg)
g. Genetics

4. Discuss how eggs are graded. The Egg Products Inspection Act of 1970 certifies USDA grading of all eggs carrying the official grade shield.

How are eggs graded?

Eggs are graded by a USDA grading service based on:

a. AA - stands up tall; yolk is firm and there is a large proportion of thick albumen to thin albumen; shell is clean, sound, oval shaped, smooth texture
b. A - medium in height, yolk is still firm while albumen begins to spread out, shell is clean, sound, oval shaped, smooth texture
c. B - yolk is flat, more thin albumen than thick albumen; shell is clean, but possibly misshapened, rough or faulty textured

5. Discuss how the different grades of eggs are processed. All liquid and dried egg products must be pasteurized in the U.S.

   How are the different grades of eggs processed?

   a. Grade AA and A are regularly marketed as shell eggs. Surplus are processed.
   b. Grade B - processed, rarely sold as shell eggs

6. Discuss how eggs are sized. Size is not related to the quality grade.

   What are the sizes of eggs?

   a. Jumbo - 30 oz/dozen
   b. Extra Large - 27 oz/dozen
   c. Large - 24 oz/dozen
   d. Medium - 21 oz/dozen
   e. Small - 18 oz/dozen
   f. Peewee - 15 oz/dozen

7. Discuss how the egg processing industry is organized.

   How is the egg processing industry organized?

   Vertical integration - contracts between producers and large companies

F. Other activities

1. Hard boil 1 egg per 2 students. Have students dissect the egg and weigh its components. Refer students to Figure 5.1, Egg Composition in student reference.

2. Have students do "Easy Eggsperiments" from the American Egg Board.

G. Conclusion

Eggs are a valuable part of the human diet. Eggs are versatile in that they may be processed into a variety of forms. Egg quality is based on both interior and exterior characteristics of the egg. These characteristics are determined by a combination of the hen's genetics as well as her environment. This vertically integrated business grades eggs before they reach the grocer and processes them accordingly.

H. Competency

1. Compare egg processing techniques to egg products.

2. Related Missouri Core Competencies and Key Skills: None

I. Answers to Evaluation

1. b
2. a
3. a
4. b
5. a
6. A
7. B
8. AA
9. b
10. d
11. Three of the following: shell eggs, refrigerated liquid eggs, frozen eggs, dried eggs, or specialty products.
12. Instructor's discretion

J. Answers to Activity Sheet

AS 5.1

1. Instructor's discretion

2. 0_2 supply for embryo, should it develop

3. Normally the large end

UNIT II - FOOD PROCESSING Name _____

Lesson 5: Processing Egg Products Date _____

EVALUATION

Identify which characteristics are used to determine exterior quality or interior quality.

____1.	Air cell depth	a. Exterior quality characteristics
____2.	Shape	b. Interior quality characteristics
____3.	Cleanliness	
____4.	Albumen clarity	
____5.	Shell texture	

Match the characteristic with the type of grade.

____6..	Medium yolk height, normal shell	AA
____7.	Flat yolk, thin albumen	A
____8.	Tall yolk, firm albumen	B

9. What grade or grades of eggs are sold as shell eggs?

   a. Grade AA
   b. Grade AA and A
   c. Grade A
   d. Grade A and B

10. In the processing industry, producer's contract with large companies to produce eggs. What does the producer supply?

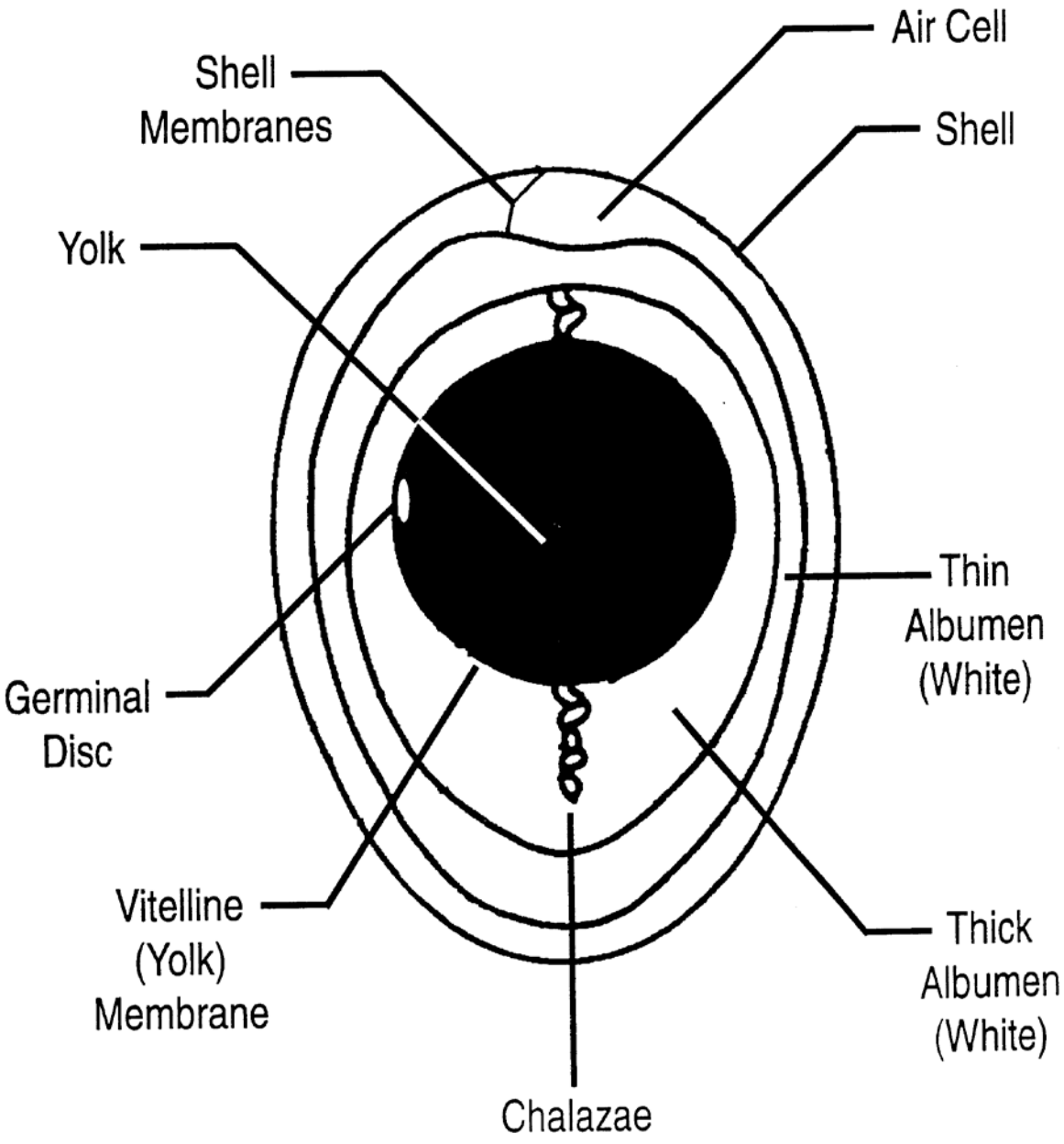
    a. Housing and feed
    b. Birds and feed
    c. Feed and labor
    d. Housing and labor

11. Name three major products made from eggs.

12. Discuss how a hen's diet can influence egg characteristics. Use xanthophyll, calcium, and vitamin D in your discussion.

Egg Structure

TM 5.1



UNIT II - FOOD PROCESSING AS 5.1

Lesson 5: Processing Egg Products Name_____

Candling Eggs

Objective: Students will candle an egg to determine its interior quality, thus teaching them an understanding of egg grading.

Activity Length: 30 minutes

Materials and Equipment:

Aged eggs (store at room temperature 1-3 days, or buy 2 weeks in advance)
Fresh eggs
Candling lights (a strong flashlight works well)
Egg cartons
Break-out tray (paper plate will work), sheet of glass or a mirror
Ruler

Procedure:

NOTE: Complete the procedure with fresh eggs. Then use aged eggs.

1. Hold the egg up to the candling light in a slanting position.

2. Notice the air cell, the yolk, and the white. The air cell is nearly always in the large end of the egg. Therefore, put the large end next to the candling light.

3. Hold the egg between your thumb and first two fingers.

4. Then by turning your wrist quickly, you can cause the inside of the egg to whirl. This will tell you a great deal about the yolk and white. NOTE: When you are learning to candle, you will find it helpful to break (on break-out tray) and observe the eggs. Notice the viscosity of white, flattening of yolk, air sac size and location and presence of any blood spots.

Key Questions:

1. Draw a diagram of one aged egg and one fresh egg noting their air cell size and location.

2. What purpose does the air cell serve?

3. On which end of the egg is the air cell located for each egg candled? Large or small.

UNIT II - FOOD PROCESSING

Lesson 6: Products and By-Products From Meat Animals

Objective

The student will be able to list the products and by-products from meat animals.

I. Study Questions

A. What are the major meat animal species?

B. What are examples of fresh meat products?

C. What are examples of processed meat products?

D. What are examples of meat by-products?

II. References

A. Martin, Phillip R. *Food Science and Technology* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1994. Unit II.

B. Transparency Master

TM 6.1: Anatomical Regions on Swine

C. Activity Sheets

1. AS 6.1: Cutting up a Chicken
2. AS 6.2: Bratwurst Production

UNIT II - FOOD PROCESSING

Lesson 6: Products and By-Products From Meat Animals

TEACHING PROCEDURES

A. Review

So far in this unit, an examination of processing techniques for milk and eggs has taken place. The largest industry to be studied is the meat industry.

B. Motivation

Have each student select an index card listing one of the following anatomical regions on a swine carcass: skin, ear, bone, adrenal gland, blood, brain, intestine, pituitary gland, hair, spleen, stomach, gall bladder, pancreas, and thyroid. Display TM 1.1. Display visual aids: soap, bone meal, leather article, hair conditioner, vitamins, ointment with cortisone as an ingredient, casings, glue, antacid, a brush, and dice. Include pictures or items depicting epinephrine, insulin, melatonin, and a hormone (i.e., implant). Have each student match the index card to the appropriate anatomical region on TM 1.1 and to the by-product visual aids. Answers follow:

A pineal gland - melatonin
B pituitary gland - hormones
C ear - leather articles
D hide/skin/leather - leather articles, glue
E stomach - antacid
F adrenal gland - epinephrine
G bone - bone meal, dice
H spleen
I intestine - casings
J pancreas - insulin
K gall bladder - cortisone
L hair - brush
M blood - hair conditioner
N thyroid gland - thyroxin

C. Assignment

D. Supervised study

E. Discussion

1. Discuss the major meat animal species.

   What are the major meat animal species?

   a. Cattle - beef and veal
   b. Swine - pork
   c. Sheep - lamb and mutton
   d. Chicken and turkey - poultry
   e. Fish/shellfish

2. Discuss examples of fresh meat products? Display National Live Stock and Meat Board meat carcass posters.

   What are examples of fresh meat products?

   a. Primal cuts (wholesale)
      1. Chuck/shoulder
      2. Rib
      3. Loin
      4. Round/ham/leg
      5. Whole fish or fish fillets
      6. Whole fryers or turkeys
   b. Subprimal cuts (retail)
      1. Loin (short loin); toploin steak, tenderloin steak, T-Bone, porterhouse loin chop, butterfly chop
      2. Sirloin; sirloin steak, sirloin chop
      3. Leg (ham)/round; round steak, eye of round roast, top round steak, ham center slice, center slice
      4. Shoulder/chuck blade; 7-bone pot roast, blade roast, top blade steak, mock tender, bladesteak, blade chop
      5. Shoulder/chuck arm - arm pot roast, cross rib pot roast, short ribs, arm steak, arm picnic roast, arm chop
      6. Breast - brisket, shank cross cut, breast, riblet, spareribs, bacon, rolled breast
      7. Rib - ribeye steak, rib roast, rib chop
      8. Half or quarter portions of poultry; chicken breasts, fillets, sliced turkey breast
      9. Fish - sticks, squares, or fillets

3. Discuss examples of processed meat products. Approximately 35 percent of beef, veal, pork, and lamb produced in the U.S. is processed. Seventy-five percent of this is pork.

   What are examples of processed meat products?

a. Sausages
    1. Fresh - fresh pork sausage
    2. Uncooked and smoked - kielbasa
    3. Cooked - braunschweiger, liverwurst
    4. Cooked and smoked - bologna, frankfurters
    5. Dry and/or semi-dry - pepperoni
    6. Fermented - salami
    7. Loaves - pickle loaf, Vienna sausage loaf
b. Cured whole muscle cut
    1. Ham
    2. Corned beef
    3. Bacon
    4. Pastrami
    5. Pork shoulder
c. Restructured
    1. Boneless ham
    2. Smoked, sliced beef
d. Breaded
    1. Fish sticks
    2. Chicken patties

4. Discuss examples of meat by-products also called offal.

What are examples of meat by-products?

a. Edible (variety meats): liver, heart, tongue, brain, sweetbread, tripe, oxtail, chitterlings, mountain oysters, lard
b. Inedible
    1. Fats - soap, animal feeds, oils, fatty acids
    2. Tankage - soft tissue by-products processed in wet-rendering system
    3. Bone meal
    4. Feather meal
    5. Blood meal
    6. Fish meal
    7. Hides and pelts
    8. Adrenals - epinephrine, corticosteroids
    9. Blood - plasmin, thrombin, fertilizers, hair conditioner
    10. Brain - vitamin D_3 production, thromboplastin
    11. Gall bladder - cortisone, chenodeoxycholic acid
    12. Intestines - heparin and casings
    13. Pancreas - insulin
    14. Ovaries - estrogen, progesterone

15. Parathyroid - hormone and protease
16. Pineal gland - melatonin
17. Pituitary - growth hormones, prolactin, adrenocorticotropic hormone
18. Skin - gelatin, glue
19. Spleen - splenin fluid
20. Stomach - antacid
21. Thyroid - thyroxin
22. Hair - brushes, upholstering
23. Feathers - pillows
24. Bones - dice, crochet needles, buttons

F. Other activities

1. Students research and report current per capita trends in meat consumption in the U.S. Compare U.S. figures to third world countries' statistics.

2. Identify the primal cut regions on a carcass.

3. Show video, "Introduction to Meat Judging." (31 min.) available from IML. Discuss retail cuts.

G. Conclusion

The meat industry is the largest segment of the food processing industry. Beef, pork, chicken and turkey, lamb, and fish are the major meats. Meat is retailed as fresh or processed products. Meat by-products play a significant role as well.

H. Competency

List the products and by-products from meat animals.

Related Missouri Core Competencies and Key Skills: None

I. Answers to Evaluation

1. b
2. e
3. d
4. a
5. c
6. a
7. f
8. b

9. c
10. f
11. a
12. d
13. a
14. c
15. a
16. a
17. b
18. b
19. c
20. d
21. a
22. d
23. Beef, pork, veal, lamb, mutton, chicken, turkey, fish
24. Chuck, rib, loin, round
25. Edible - liver, heart, tongue, brain, etc.
    non-edible - fats (soaps), tankage, meat meal, etc.

J. Answers to Activity Sheets

AS 6.1

1. class discretion
2. added value
3. neck, wings, back, etc.

AS 6.2

No questions

UNIT - FOOD PROCESSING Name_____

Lesson 6: Products and By-Products From Meat Animals Date

EVALUATION

Match primal cuts with the appropriate subprimal cuts.

1. ____ Tenderloin
2. ____ Rib-eye steak
3. ____ Brisket
4. ____ Drumstick
5. ____ Top round steak
6. ____ Thigh
7. ____ Blade steak
8. ____ T-bone steak
9. ____ Ham center slice
10. ____ Arm roast

a. Whole fryer

b. Loin

c. Round/ham/leg

d. Breast

e. Rib

f. Chuck/shoulder

Circle the letter that corresponds to the best answer.

11. Subprimal cuts are usually portions than primal cuts.

    a. Smaller
    b. Larger
    c. Fatter
    d. Thinner

12. What is the majority of processed meat?

    a. Veal
    b. Poultry
    c. Beef
    d. Pork

Match the example on the left with the type of processed meat on the right

13.___Pepperoni

14.___Boneless ham

15.___Vienna sausage

16.___Bratwurst

17.___Bacon

18.___Corned beef

19.___Smoked, sliced beef

20.___Fish sticks

21.___Bologna

22.___Chicken patties

a. Sausage

b. Whole muscle

c. Restructured

c. Restructured

d. Breaded

Complete the following short answer questions.

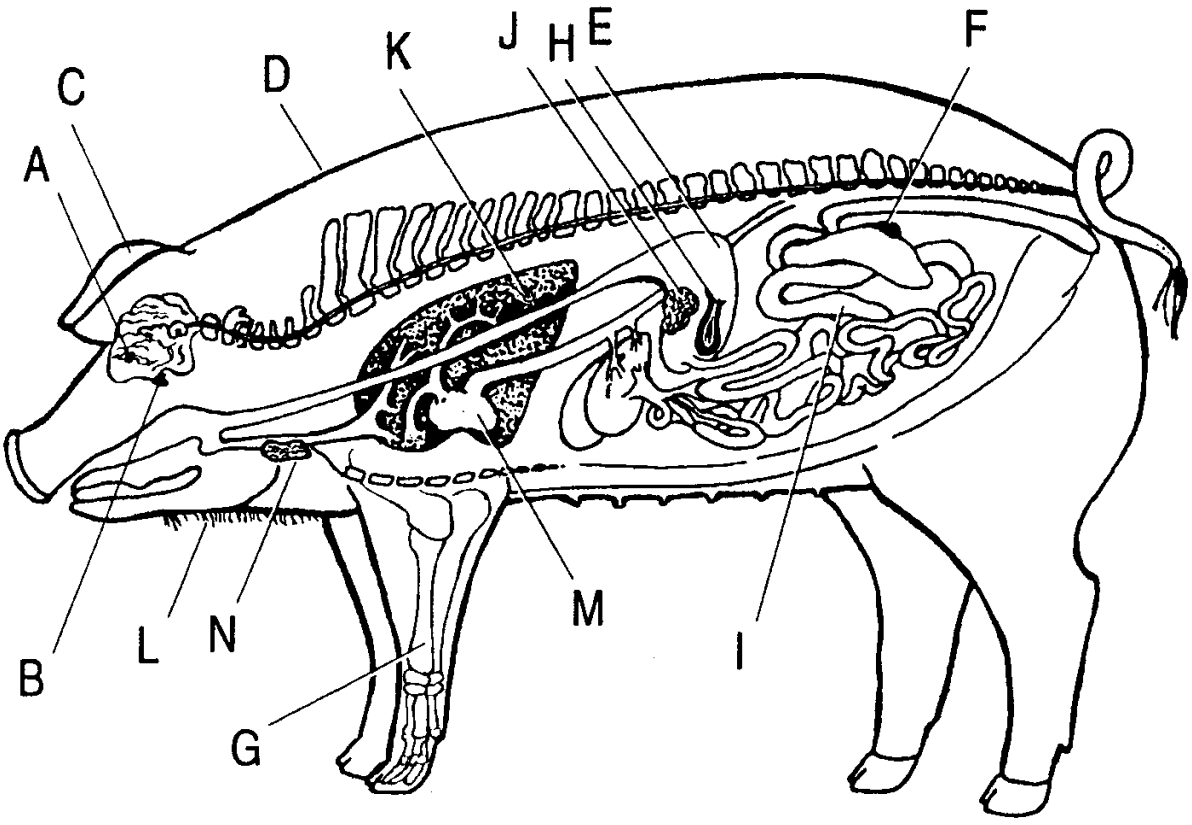
23. Name five major sources of meat.

24. What are the four primal cuts on a beef carcass?

25. Name the two classes of meat by-products and give two examples of each.

TM 6.1

Anatomical Regions on Swine



UNIT II - FOOD PROCESSING AS 6.1

Lesson 6:Products and By-Products From Meat Animals Name_____

Cutting Up A Chicken

Objective: Students will perform a processing technology, in this case making boneless retail cuts, that improve the efficiency of cooking.

Activity Length: 2 class periods

Background Information: Bone-in chicken parts provide food service operators with a multitude of product options. Bone-in parts can be cut in-house or purchased from processors. Because so many further processed products are available, it is important to evaluate costs carefully, considering labor requirements as well as cost per pound and cost per serving. Pre-cut parts or further processed products may be a better value.

Materials and Equipment:

Whole chicken
Sharp knife (boning knife, short chef's knife, or medium chef's knife)
Cutting board
Freezer bags
Scales

Procedure:

Cutting Tips

- Chicken should be very cold and slightly stiff for easy cutting.
- Cover and refrigerate parts as soon as they have been cut.

Cutting the Whole Body Chicken into Parts

1. Thoroughly clean work area.

2. Wash hands.

3. Remove chicken from the refrigerator or freezer. If frozen, thaw partially before cutting.

NOTE: It is easier, and safer, to cut a chicken into parts while the meat is still very cold and slightly stiff. It does not need to be completely thawed.

4. Lay chicken on its back on a cutting board with neck cavity facing away.

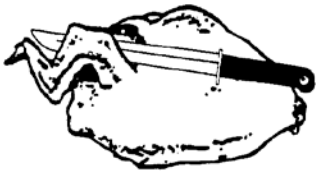
5. Remove giblets and neck from the chicken's body cavity.

6. Cut tail off.

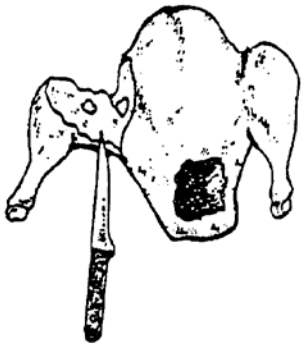
7. Put chicken on its side, then forcefully pull the wing away from the body. Cut into the hollow between the breast and wing.

8. Continue pulling the wing away from the body. Cut around the wing joint.

9. Bend wing back, exposing the joint. Cut through. Repeat for other wing.



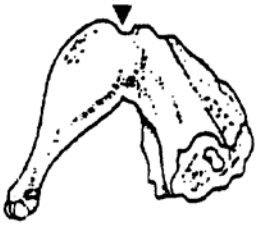
10. Separate each wing into three parts: Slice skin around joint at the small bony end. Bend back, exposing joint and cut through. Repeat for other joint.



11. Place chicken on side, then pull drumstick away from the body.

12. Cut through skin between the back and thigh.

13. Cut down to the joint where thigh connects to back.



14. Push on drumstick and thigh to open joint at the back bone and cut through. Repeat for other leg.

15. Find the natural fat line between the drumstick and thigh, then pull skin tightly over top of leg, feeling for a small indentation to find the joint.

16. Lay thigh skin side down and cut through joint, bending drumstick back gently while cutting.

17. Stand chicken up on neck joints and locate cartilage line running down ribs.

18. Cut down ribcage to neck joints on both sides, bending the two parts away from each other to expose the joints.

19. Cut through shoulder joints on each side and cut through skin, separating breast and

Skinning and Boning the Breast

20. Cut membrane between skin and meat. Pull off skin.

21. Start at neck cavity and cut along top edge of breast bone.

22. Cut along edge of wishbone, peeling breast from bones, leaving as little meat on the bones as possible.

23. Remove half-breast and repeat for other side.

Boning the Thigh

24. Place the thigh skin-side down. Cut down to the bone, then along the full length of the bone.

25. To free the ends, slip the knife under the bone halfway down its length.

26. Cut away from your hand, freeing one end of the bone from the flesh.

27. Turn the thigh around, lift the free end of the bone with one hand, and cut the other end free.

Key Questions:

1. What was the most difficult processing technique of this lab?

2. Why do processors debone chicken breasts and thighs?

3. What chicken parts do you think are processed into boneless breaded chicken patties?

UNIT II - FOOD PROCESSING AS 6.2

Lesson 6:Products and By-Products From Meat Animals Name _____

Bratwurst Production

Objective: Students will experience firsthand the processing techniques used to transfer a fresh meat into a processed meat by making an emulsion.

Activity Length: 2 periods

Materials and Equipment:

70%-80% lean pork	Black pepper
Salt	Mace spice
Nonfat dry milk	Coriander spice
Water	Hot mustard
Stove	Meat grinder
Blender	Cellulose casings
Scale	Stuffer (optional)

Procedure:

1. Grind 5 lbs. of 70-80 percent lean pork and place in blender.

2. Add: 1.5 oz salt
   .75 oz water
   .16 oz black pepper
   .08 oz mace
   .08 oz coriander
   .08 oz hot mustard

3. Blend for 5 minutes.

4. To complete the emulsion, add .75 oz water and 1.5 oz nonfat dry milk to the ingredients in the blender.

5. Blend for 5 minutes.

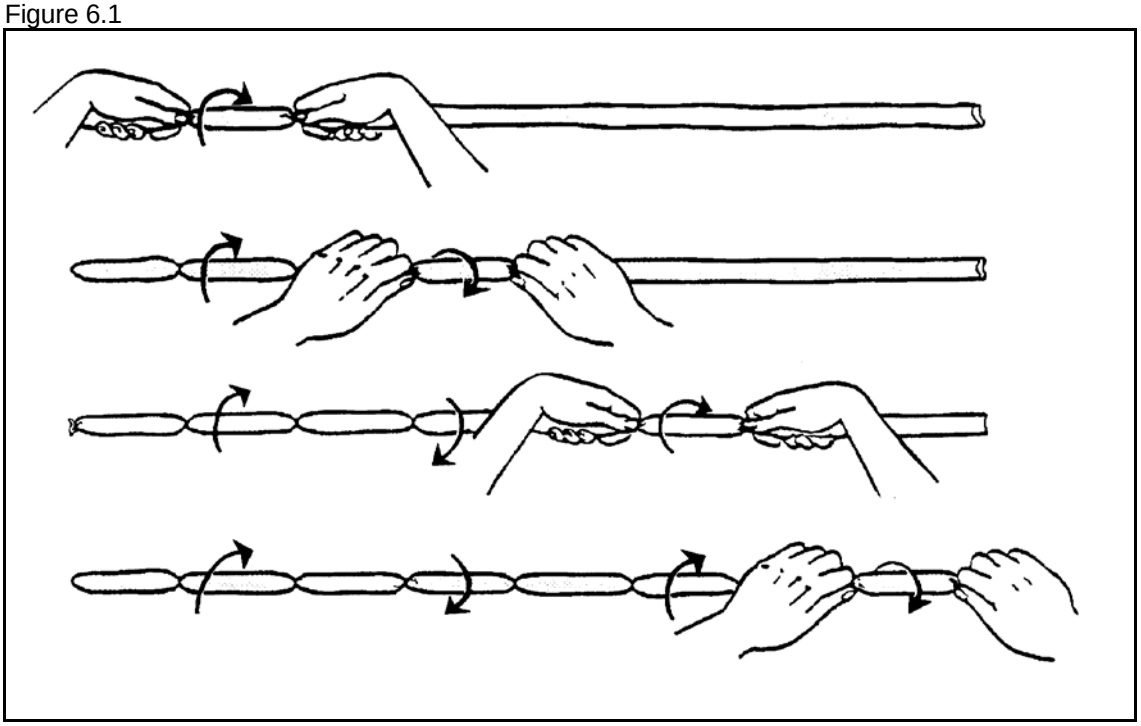
6. Place emulsion into a stuffer (a plastic funnel with a push stick will substitute).

7. Attach casing to stuffer.

8. Stuff casings.

9. Link casing see figure 6.1.

Figure 6.1



In handlinking bratwurst using a twist method, the casing can be virtually any length 1) start on one end and pinch the casing between thumb and forefinger at points 5 and 10 inches from the end. Using both hands, twist the link between your hands away from yourself; 2) pinch the casing at 5-inch intervals from the same end, except this time twist the link between your hands toward yourself 3) and 4) continue twisting every other link in the opposite direction as the preceding twist until the end of the casing is reached.

10. Cook bratwurst. Bratwurst can be pan fried, braised, broiled or grilled.

Adapted from: Romans, Jones, Costello, Carlson, Ziegler. *The Meat We Eat*. 12th ed. Danville, IL: Interstate Printers and Publishers, 1985.

UNIT II - FOOD PROCESSING

Lesson 7: Processing Meat Animals

Objective

The student will be able to describe the processing of meat animals.

I. Study Questions

A. What are the steps involved in processing meat animals?

B. What techniques are used to process fresh meat products?

C. What factors affect meat quality?

D. How is the meat processing industry organized?

II. Reference

A. Martin, Phillip R. *Food Science and Technology* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1994. Unit II.

UNIT II - FOOD PROCESSING

Lesson 7: Processing of Meat Animals

TEACHING PROCEDURES

A. Review

Review the major meat animal sources.

B. Motivation

1. Rigor mortis can be observed using the sterno-mandibularis muscle from a pork or beef carcass. Obtain muscle from a local slaughter house. Cut muscle into two pieces with the grain. Nail the ends of one piece to a small board. Freeze both muscles within 20 minutes of slaughtering in its stretched position. Allow muscle to thaw. Measure the rigor mortis activity as it shortens.

2. Explain the Kosher processing method to students by explaining its history. Show students a package of meat with the Kosher meat stamp. Kosher Inspection is performed by authorized persons following the standards set forth by the Mosaic and Talmudic laws. The word Kosher means "properly prepared" in the Hebrew language. Kosher meat must come from an animal that has split hooves and chews its cud.

   The slaughter involves draining the blood and then soaking and salting each side of the meat. Salting draws out the remaining blood as it is required by biblical law. (Leviticus 7:14) "You shall not eat the blood of any creature for the life of every creature is its blood."

C. Assignment

D. Supervised Study

E. Discussion

1. Discuss the steps of processing meat animals.

   What are the steps involved in processing meat animals?

   a. Cattle
      1. Immobilization
      2. Rodding the weasand

3. Heading
4. Shanking
5. Siding
6. Evisceration
7. Splitting
8. Refrigerating
9. Inspecting
10. Grading

b. Hogs
1. Immobilization, stunning and sticking
2. Scalding/skinning
3. Hair and scurf removal
4. Skinning
5. Head removal
6. Evisceration
7. Splitting
8. Inspection
9. Refrigeration
10. Grading

c. Lambs
1. Immobilization, stunning, and exsanguination
2. Pelting
3. Head removal
4. Separate esophagus and trachea
5. Evisceration
6. Refrigeration
7. Inspection
8. Grading

d. Poultry
1. Immobilization and sticking
2. Defeathering - scalding and defeathering or dry-picking
3. Chilling
4. Evisceration
5. Grading

e. Fish
1. Remove head behind gills
2. Descale
3. Remove tail
4. Remove entrails
5. Rinse and chill

2. Discuss what techniques are used to process fresh meat products. The majority of processed meat is shipped in a box as either quarters, primal cuts, or subprimal cuts. Lamb carcasses are normally shipped whole.

   What techniques are used to process fresh meat products?

   a. Carcass size reduction
      1. Beef - quartering: cut between 12th & 13th ribs: 52 percent weight in forequarters, 48 percent weight in rearquarters
      2. Lamb - whole
      3. Veal - fore and rear saddles
      4. Pork - complete subprimal processing
   b. Primal (wholesale) cuts fabrication
   c. Subprimal (retail) cut fabrication
      1. Roast
      2. Steak/chop
      3. Ground meat
   d. Deboning
   e. Pattie production
   f. Shelf-life extension - refrigeration is the most popular
   g. Tenderization - mechanical, enzymatic
   h. Control of composition by restructuring
   i. Portion control

3. Discuss what factors affect meat quality.

   What factors affect meat quality?

   a. Production-related factors
      1. Age of animal
      2. Health of live animal
      3. Nutrition of live animal
      4. Sorting and hauling of live animal
      5. Heredity
   b. Processing related factors
      1. Sanitation of processing plant
      2. Efficient immobilization and proper exsanguination
      3. Postmortem temperature
      4. Postmortem handling
      5. Processing sanitation
      6. Water holding capacity
      7. Color control

4. Discuss how the meat processing industry is organized.

How is the meat processing industry organized?

1. Poultry - vertical integration
2. Pork - some vertical, some independent
3. Lamb & beef - mostly independent
4. National Live Stock and Meat Board, National Broiler Council and National Turkey Federation represent producers, processors, and retailers in product research, education, and promotion.

F. Other activities

1. Show a video on slaughtering.

2. Taste test tenderized flank steak versus non-tenderized.

G. Conclusion

The process of transforming a meat animal into retail steaks, roasts, burgers, etc., is complex. Beef, veal, pork, lamb, mutton, and poultry products all undergo inspection and grading before they reach the retail meat case. Fish, on the other hand, are not required to be inspected. Meat quality is a concern of all and is determined by production techniques, genetics and processing factors.

H. Competency

Describe the processing of meat animals.

Related Missouri Core Competencies and Key Skills: None

I. Answers to Evaluation

1. 6 Grading
   1 Stunning
   4 Eviscerating
   5 Refrigerating
   2 Sticking
   3 Skinning

2. d
3. e
4. b
5. c
6. a

7. Compare: both are scalded to denature proteins. Contrast: pork scalding loosens hairs, poultry scalding loosens feathers.
8. Its thickness - steak 3/4 - 1", roast 2" or more.
9. The younger the animal, the more tender its muscle.

10. Stress causes higher temperatures, reduced pH and early rigor mortis onset. It can result in PSE meat.

11. National Live Stock and Meat Board
    National Broiler Council
    National Turkey Federation

UNIT II - FOOD PROCESSING Name_____

Lesson 7:Processing of Meat Animals Date_____

EVALUATION

1. Place the following beef processing steps in the correct order by placing numbers in the blanks to indicate which step comes 1st, 2nd, 3rd, etc.

___Grading
___Stunning
___Eviscerating
___Refrigerating
___Sticking
___Skinning

Match the carcass size reduction technique with the type of meat animal.

___2. Veal	a.	Whole or pre-cut
___3. Beef	b.	Whole
___4. Lamb	c.	Complete subprimal processing
___5. Pork	d.	Fore and rear saddles
___6. Poultry	e.	Quartering

Complete the following short answer questions.

7. Compare and contrast the scalding of hogs versus poultry.

8. What is the basic difference between a steak and a roast?

9. How can an animal's age affect its meat quality?

10. How can stress on an animal affect its muscle character?

11. What national organizations represent the meat industry?

UNIT II - FOOD PROCESSING

Lesson 8: Quality Grades, Inspections, and Brand Names in Meat Industry

Objective:

The student will be able to explain the relationship between quality grades, inspections, and brand names in the meat industry.

I. Study Questions

A. Who is responsible for inspecting and grading meat?

B. Why are some meat products not inspected?

C. What are the quality grades of meat?

D. What does a meat inspector look for in a meat inspection?

E. What is the difference between USDA quality grades and processors' brand names?

II. Reference

Martin, Phillip R. *Food Science and Technology* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1994. Unit II.

UNIT II - FOOD PROCESSING

Lesson 8: Quality Grades, Inspections, and Brand Names in Meat Industry

TEACHING PROCEDURES

A. Review

Review the factors that affect meat quality. These determine the grades which are explained in this lesson.

B. Motivation

Bring a complete package/label from a fresh cut of meat. Point out the inspection and quality grade stamp. Pre-test their knowledge of what these stamps indicate. Which stamp assures quality? Which stamp dictates price/pound?

C. Assignment

D. Supervised study

E. Discussion

1. Discuss who is responsible for inspecting and grading meat.

Who is responsible for inspecting and grading meat?

a. Inspection
    1. Qualified USDA inspectors
    2. Kosher inspectors - also must meet USDA standards
b. Grading - qualified USDA meat graders, paid for with other processing costs

2. Discuss why some meat products are not inspected.

Why are some meat products not inspected?

a. Laws do not require fish sold in the U.S. to be inspected.
b. Laws do not require meat processed "not for sale" to be inspected.
c. Squabs, gamebirds, rabbits, and most wild game are exempt from the law.

3. Discuss the quality grades of meat. See student reference for quality grade factors.

What are the quality grades of meat?

a. Beef - young
    1. Prime
    2. Choice
    3. Select
    4. Standard
b. Beef - old
    1. Commercial
    2. Utility
    3. Cutter
    4. Canner
c. Veal
    1. Prime
    2. Choice
    3. Good
    4. Standard
    5. Utility
    6. Cull
d. Pork
    1. Acceptable
    2. Utility
e. Sheep
    1. Lamb
        a. Prime
        b. Choice
        c. Good
        d. Utility
    2. Yearling mutton
        a. Prime
        b. Choice
        c. Good
        d. Utility
    3. Mutton
        a. Choice
        b. Good
        c. Utility
        d. Cull
f. Poultry
    1. Grade A

2. Grade B
3. Grade C

4. Discuss what a meat inspector looks for during a meat inspection.

   What does a meat inspector look for in a meat inspection?

   a. Unwholesome or adulterated carcasses
   b. Sanitary processing
   c. Honest labeling
   d. Correct temperatures
   e. Correct use of additives
   f. Lab analysis

5. Discuss the difference between a USDA quality grade and processors' brand names.

   What is the difference between USDA quality grades and processors' brand names?

   a. Quality grade - shield shaped stamp with purple ink.
   b. Different brand names may designate different grades, but they will be different from one company to another.

F. Other activities

1. Require each student to acquire an inspection/grading label and explain what it means.

2. Taste test different brand names of the same meat cut to determine the brand name/quality grade association.

3. Visit a packing house and observe the inspector/grader at work.

4. Show a video on meat inspection, meat judging, or meat evaluation. Several videos are available form Nasco Agricultural Sciences catalog, 1-800-558-9595.

5. Order National Live Stock & Meat Board Marbling photos. Study photos and correct quality grade associated with each. Also, measure the L.E.A. using a grid on a pork loin.

G. Conclusion

Beef, Pork, Lamb and Poultry products are inspected by USDA or Kosher inspectors. Quality grading is completed by qualified USDA meat graders. Some

meat products are not inspected and these include fish, "Not for sale" meat, rabbits, gamebirds, etc. Beef grades include prime, choice, select, standard, commercial, utility, cutter, and canner. Pork is graded as acceptable and utility. Poultry grades are A, B, and C. Meat inspectors carefully examine a number of factors before placing their approval stamp on the carcass. Finally, brand names and quality grades are not the same.

H. Competency

Explain the relationship between quality grades, inspections, and brand names in the meat industry.

Related Core Competencies and Key Skills: None

I. Answers to Evaluation

1. c
2. a
3. c
4. a
5. b
6. d
7. a
8. c
9. b
10. Prime, Choice, Select, Standard, Commercial, Utility, Cutter, Canner

11. Purple

12. Sanitary processing; honest labeling; correct temp; lab analysis; correct use of additives

13. disjointing, broken bones, broken skin, bruised, pin feathers, conformation, fleshing, fat covering

UNIT II - FOOD PROCESSING Name _____

Lesson 8: Quality Grades, Inspections, and Brand Names in Meat Industry Date _____

EVALUATION

Circle the letter that corresponds to the best answer.

1. Who is responsible for meat inspection?

   a. U.S. Department of Health
   b. National Live Stock and Meat Board
   c. Food Safety and Inspection Services
   d. State of Missouri

2. A young steer carcass might grade:

   a. Prime
   b. Good
   c. Commercial
   d. Utility

3. An old cow's carcass may grade:

   a. Prime
   b. Choice
   c. Utility
   d. Good

4. Pork quality grades are:

   a. Acceptable and Utility
   b. Prime and Choice
   c. Grades A, B, or C
   d. Good and Standard

5. Veal carcasses are quality graded on:

   a. Size
   b. Color
   c. Texture
   d. Parts

6. Which of the following is <u>not</u> a quality grade of a lamb?

   a. Prime
   b. Choice
   c. Good
   d. Cull

Match the stamp on the right with what it stands for on the left.

_____ 7. Inspected and passed

_____ 8. Quality grade stamp

_____ 9. Kosher stamp

A. 

B. 

C. 

Complete the following short answer questions.

10. List the eight carcass quality grades for beef.

11. What color ink is used for inspection and grading stamps?

12. List two factors a meat inspector looks for in a meat inspection.

13. Name one factor that could lower a poultry carcass from Grade A to a Grade B carcass.

UNIT II - FOOD PROCESSING

Lesson 9: Products from Grain Crops

Objective

The student will be able to identify the products of grain crops.

I. Study Questions

A. What primary grains are used for food products?

B. What are the primary food products of grain crops?

C. What by-products are produced from grain crops?

D. What non-food products are produced from grain crops?

II. References

A. Martin, Phillip R. *Food Science and Technology* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1994. Unit II.

B. Activity Sheets

1. AS 9.1: Soybean Processing
2. AS 9.2: Corn Sweeteners

UNIT II - FOOD PROCESSING

Lesson 9: Products from Grain Crops

TEACHING PROCEDURES

A. Review

Meat carcasses are individually inspected and graded before they can be processed and/or sold commercially. Grain, on the other hand, is graded in very large quantities, or batches, before processing.

B. Motivation

Bring several snack foods made from different grain crops. Have students identify which grain was used to make the food product. (e.g., crackers, cookies, breakfast cereals)

C. Assignment

D. Supervised study

D. Discussion

1. Discuss the primary grains used for food products.

What primary grains are used for food products?

a. Cereal grains
    1. Wheat
    2. Corn
    3. Oats
    4. Barley
    5. Rice
    6. Rye
    7. Grain sorghum
    8. Buckwheat
b. Oil-bearing grains
    1. Soybean
    2. Peanut
    3. Sunflower
    4. Cottonseed
    5. Canola (rapeseed)
c. Dry legumes

1. Dry peas
2. Beans - navy, pinto, black, etc.
3. Lentils

2. Discuss with students what primary food products come from grain crops. Have students complete AS 9.1.

What are the primary food products of grain crops?

a. Cereal grains
   1. Wheat
      a. Hard - Durum - pasta, breadmaking
      b. Soft - cake and cookie flour
   2. Corn
      a. Whole - popcorn
      b. Milled - meal, flour, starch, oil, syrup (sweeteners)
   3. Oats - flour or rolled, bran
   4. Barley - malt, flour, whole
   5. Rice - most important human food
      Flour, whole
   6. Rye - flour

b. Oil-bearing
   1. Soybean - 20 percent oil, 44-48 percent protein
      Soy flour, soy milk, tofu (soy cheese), soy sauce, lecithin
   2. Sunflowers - whole (dried) or 50 percent oil
   3. Peanut - roasted whole, peanut butter
   4. Canola - (rapeseed) - oil

c. Dry legumes
   Dried peas and beans - protein rich, low in oil

3. Discuss with students what by-products are produced from grain crops. These by-products are used in livestock feeds and pet food. Have students complete AS 9.2.

What by-products are produced from grain crops?

a. Wheat bran
b. Corn gluten
c. Rice hulls
d. Germ
e. Distiller's grain
f. Peanut hulls
g. Midlings

4. Discuss with students what non-food products are produced from grain crops.

   What non-food products are produced from grain crops?

   a. Corn - corn starch/biodegradable plastic, diapers, packing nuts, ethanol, paper production, encapsulated herbicides, etc.
   b. Soybean - soy diesel, soy ink, new stone, paints, magnetic media, leather softener, rust inhibitors, lubricants, paper coating, dust inhibitor, etc.
   c. Peanut - hulls used as "cinders" on slick roads, etc.

F. Other activities

Soak wheat or corn until soft and dissect the seeds to examine the bran, endosperm, and germ.

G. Conclusion

Grains that are processed into food are classified as cereal grains, oil-bearing grains, and dry legumes. A variety of food products ranging from pasta, flour, and bran to soy milk and peanut butter are derived from grains. As food grains are processed, a variety of by-products result that often become livestock feed. In addition to by-products, several non-food products are produced from these food grains.

H. Competency

Identify the products of grain crops.

Related Core Competencies and Key Skills: none

I. Answers to Evaluation

1. c
2. a
3. a
4. a
5. b
6. b
7. c
8. a
9. a
10. b
11. a
12. b

13. d
14. a
15. protein, oil
16. Hard wheat - bread and pasta making, soft wheat - cake and cookie flour
17. Popcorn, rice, rolled oats, roasted soybeans, and others as appropriate
18. Wheat bran, corn gluten, rice hulls, germ, distiller's grain, and others as appropriate
19. Teacher's discretion

J. Answers to Activity Sheets

AS 9.1 - Instructor's discretion
AS 9.2 - Instructor's discretion

UNIT II - FOOD PROCESSING Name _____

Lesson 9: Products from Grain Crops Date _____

EVALUATION

Match the grain on the left with its proper category on the right.

1._____Pinto beans

2._____Wheat

3. _____Corn

4. _____Rye

5._____Peanuts

6._____Sunflowers

7. _____Dried peas

8. _____Rice

9._____Barley

10._____Soybeans

11._____Oats

12._____Canola

a. Cereal grain

b. Oil-bearing grain

c. Dry legume

Circle the letter that corresponds to the best answer.

13. What grain is eaten more than any other?

a. Soybeans
b. Corn
c. Barley
d. Rice

14. Soybeans are _____ percent oil and _____ percent protein.

    a. 20, 44-48
    b. 40, 8-12
    c. 40, 16-20
    d. 44-48, 20

15. Dried beans are high in _____ and low in _____.

    a. Starch, protein
    b. Oil, protein
    c. Protein, starch
    d. Protein, oil

16. Explain the primary way hard wheat is used versus soft wheat.

17. Give two examples of whole grain products used for food.

18. List three examples of by-products from processing food grains.

19. Write a short essay on non-food products made from corn and soybeans. Include plastics, ink, ethanol, and soy diesel in your discussion.

UNIT II - FOOD PROCESSING AS 9.1

Lesson 9:Products from Grain Crops Name _____

Soybean Processing

Objective: Process the soybean into an edible food product.

Activity Length: Overnight soak, 1 hour dry time, 1 lab period

Materials and Equipment:

Soybeans, dry (must be cleaned)
Water
Quart oil for frying
Salt
Deep fat fryer
Paper towels

Procedure:

1. Clean soybean sample by removing all foreign material and washing thoroughly.

2. Soak soybeans in water overnight.

3. Drain beans thoroughly. The skins may be removed if desired. Place beans on absorbent paper and allow to air-dry about one hour. (Your instructor may have done this step for you.)

4. Place oil in a deep fat fryer or a heavy, deep saucepan. Heat oil to 350°F.

   CAUTION: Oil is very hot. Be careful when working around the heated oil.

5. Put about 1 cup beans in a fryer basket. Lower basket slowly into the hot fat. Moisture in beans may cause excessive splattering if beans are lowered rapidly into the fat.

6. Fry beans about 6 to 8 minutes or until crisp and lightly browned.

7. Remove from oil.

8. Drain beans on absorbent paper.

9. Sprinkle with salt.

10. When cool, sample. The remaining beans should be stored in a tightly covered container.

Credit:The Missouri Soybean Association and the Missouri Soybean Merchandising Council, P.O. Box 104778, Jefferson City, MO 65110-4778.

UNIT II - FOOD PROCESSING AS 9.2

Lesson 9:Products from Grain Crops Name _____

Corn Sweeteners

Objective: Identify corn sweeteners used in snack foods.

Background Information: Wet-milling of corn yields several corn sweeteners. Corn syrup, fructose, dextrose, and dextrin are the most common. As you investigate food products and the corn sweeteners used in them, you will gain a greater appreciation of how important grains are to American tastes and eating habits.

Procedure: Examine ten packages, bottles, or boxes of snack foods. List the product by brand name and the sweetener or sweeteners used.

	Product	Sweetener(s)
1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____
5.	_____	_____
6.	_____	_____
7.	_____	_____
8.	_____	_____
9.	_____	_____
10.	_____	_____

UNIT II - FOOD PROCESSING

Lesson 10: Processing of Grain Crops

Objective

The student will be able to explain the processing of grain crops.

I. Study Questions

A. What are the steps in processing grain crops?

B. What techniques can be used to preserve grain products?

C. Why is grain inspected?

D. What factors are considered in grading grain?

E. How are the different grades of grain used?

F. What is the structure of the food grain industry?

II. References

A. Martin, Phillip R. *Food Science and Technology* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1994. Unit II.

B. Activity Sheet

AS 10.1 Processing Wheat

UNIT II - FOOD PROCESSING

Lesson 10: Processing of Grain Crops

TEACHING PROCEDURES

A. Review

Review the leading food grains. Relate to the class that only a small percentage of these grains are consumed as "whole grain." Most grains are milled before they reach the supper table. This lesson examines the processing of grains.

B. Motivation

1. Blindfold two students, and have them taste several breakfast cereals to try to identify the cereal name. Record their responses. You may want to taste whole grain corn, wheat, and oats, in addition. How successful were the students in identifying what they were eating? Relate how extrusion improves the texture of these grains.

2. Give an overview of the history of grain marketing. The following information is a synopsis from "Historical Facts about Grain Marketing" from the Cooperative Extension Service.

   Pure food and market inspectors existed in Athens in 400 B.C.

   In 1625, which was five years after the Mayflower landed, a shipload of corn was exchanged for 700 pounds of furs.

   Wheat was used as legal tender for taxes, whereas Indian Corn was legal tender for debts in 1631. In 1640 wheat was established in New England and shipments were made between colonies. The U.S. imported grain from 1835-1837 because of early frosts and poor production. Then the Ohio and Erie canals were opened. A barrel of flour brought $3 in 1826 and $6 in 1835. Corn went from 12 to 20 cents per bushel in that same time period.

   In 1848 the Chicago Board of Trade was established. In 1857 a Grain Inspection Department was established in Chicago. The Chicago Board of Trade set up the first grain standards using numerals for wheat, corn, oats, and barley. In 1869, the Kansas City Board of trade was reorganized.

C. Assignment

D. Supervised study

E. Discussion

1. Discuss the steps in processing grain crops. Have students complete AS 10.1. The instructor may wish to have several types of grains for students to process.

   What are the steps in processing grain crops?

   a. Harvest
   b. Transport
      1. rail
      2. barge
      3. truck
   c. Milling - cereal grains
      1. Dry milling - remove foreign seeds and soil; condition to proper moisture; separate germ, bran (hull), endosperm; grind, roll and sieve
      2. Wet milling - water slurry used to separate germ, bran, and endosperm
   d. Malting - germinate barley seeds to activate enzymes
   e. Roasting - oil seeds
      Grains are steamed and crushed to expose oil
   f. Enrichment and fortification
   g. Extrusion

2. Discuss what techniques can be used to preserve grain products.

   What techniques can be used to preserve grain products?

   a. Drying below 14 percent - grains, meals, flours, pasta
   b. Regulating osmotic pressure - syrups with high sugar content
   c. Irradiation - destroys any insects, molds, bacteria

3. Discuss why grain is inspected. The quality of the whole can be no better than the sum of its parts.

   Why is grain inspected?

   a. To determine its quality/wholesomeness
   b. To establish a price

4. Discuss what factors are considered when grading grain. Recall that grain is graded to determine its quality and therefore its destination. Also, a fair price must be established based on its quality.

   What factors are considered in grading grain?

   a. Test weight
   b. Moisture
   c. Damaged/split grains
   d. Heat damaged grains
   e. Foreign material
   f. Diseased/treated kernels

5. Discuss how the different grades of grain are used. The lower the grade number, the higher the quality. Naturally, the highest quality will be used for human food while the lower quality is used for animal feed.

   How are the different grades of grain used?

   a. Grades U.S. #1 and #2 are suitable for human food processing.
   b. Grades U.S. #3, #4, #5 and sample grade are processed for animal feed. They may be upgraded with U.S. #1 grain to meet U.S. #2 standards, depending on reason for initial grade.

6. Discuss the structure of the food grain industry.

   What is the structure of the food grain industry?

   a. Very diverse; ranges from multi-million dollar conglomerates to local processing businesses
   b. Kansas City Board of Trade - wheat sales
   c. Chicago Board of Trade - multi-grain sales
   d. Contract growers - raise specific varieties for specific mills

F. Other activities

1. Using the flour processed in AS 10.1, make bread, biscuits, or other products. Discuss why and how the end products differ.

2. Visit a local grain elevator and examine the grain grading equipment and run a sample.

3. Invite a local grain grader to speak to class about his/her job.

4. Display samples of different grades of grain. See if students can tell which grade is which.

G. Conclusion

A vast majority of grains are processed before consumption. A part of this processing is the preservation process accomplished by drying, irradiating, or regulating osmotic pressure. Grain is graded to establish a fair price and to determine its future use. Several factors of grain quality determine its grade.

H. Competency

Explain the processing of grain crops

Related Missouri Core Competencies and Key Skills: None

I. Answers to Evaluation

1. a
2. c
3. d
4. To replace vitamins and minerals lost during milling.
5. Four of the following: moisture, test weight, damaged/split kernels, heat damage grain, foreign material, diseased/treated kernels
6. Teacher's discretion

J. Answers to Activity Sheet

AS 10.1

Instructor's discretion

UNIT II - FOOD PROCESSING Name _____

Lesson 10: Processing of Grain Crops Date _____

EVALUATION

Circle the letter that corresponds to the best answer.

1. On which grain is the malting process used?

   a. Barley
   b. Corn
   c. Soybean
   d. Wheat

2. What are two of the methods used to preserve grain products?

   a. Moisture below 20%, high salt content
   b. Moisture below 20%, high sugar content
   c. Moisture below 14%, high sugar content
   d. Moisture below 14%, low sugar content

3. Which U.S. grades of grain are the primary source for food grain products?

   a. Grades 5 and sample
   b. Grades 4 and 5
   c. Grades 3 and 4
   d. Grades 1 and 2

Complete the following short answer questions.

4. Why are certain grains enriched?

5. List 4 of the factors used to evaluate grain in grading.

6. Compare the Kansas City Board of Trade and the Chicago Board of Trade based on what crop(s) they trade.

UNIT II - FOOD PROCESSING AS 10.1

Lesson 10:Products from Grain Crops Name_____

Processing Wheat

Objective: Process wheat into flour.

Activity Length: 1 period

Materials and Equipment:

1 pound wheat grain (You may substitute oat, rye, and barley.)
Steel- or stone-wheel grinder
Bowl to receive flour
Scales

Procedure:

1. Read manufacturer's instructions for operating the grinder.

2. Weigh the bowl and record the weight or set the scale to the weight of the bowl.

3. Weigh out one pound of grain. Record in Table 10.1.

4. Tightly secure the grinder to a bench or table.

5. Place grain where it can be easily reached and bowl where it will receive the flour from the grinder.

6. Place grain in receiving hopper according to manufacturer's directions.

7. Turn crank slowly, with a steady pressure.

8. Continue grinding until all grain is ground.

9. Weigh flour. Record in Table 10.1.

Table 10.1

Type of Grain Used	Weight of Grain	Weight of Flour

Key Questions:

1. Does the flour look like flour purchased from the store? Why or why not?

2. Did the pound of grain equal one pound of flour? Why or why not?

UNIT II - FOOD PROCESSING

Lesson 11: Fruit, Vegetable, and Nut Products

Objective

The student will be able to identify fruit, vegetable, and nut products and factors that determine quality.

I. Study Questions

A. What are the major classes of fruits, vegetables, and nuts?

B. What are the products from fruits, vegetables, and nuts?

C. What factors determine quality of fruits, vegetables, and nuts?

D. What are the by-products of fruits, vegetables, and nuts?

E. What crop characteristics influence how they are used?

II. References

A. Martin, Phillip R. *Food Science and Technology* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1994. Unit II.

B. Activity Sheet

AS 11.1: Nut Butter

UNIT II - FOOD PROCESSING

Lesson 11: Fruit, Vegetable, and Nut Products

TEACHING PROCEDURES

A. Review

Grain crops are graded for quality. Similarly, fruits, vegetables, and nuts are graded. Review the variables that are examined when grading grain, and relate them to the variables examined for grading fruits and vegetables.

B. Motivation

1. Display examples or illustrations of different varieties of fruits, vegetables, and nuts (i.e., pear tomatoes, cherry tomatoes, slicing tomatoes). Have students explain why each variety is important. Relate variety types to market niche.

2. Have a grocery store produce manager give a presentation (pear tomatoes - ketchup tomato, cherry-color and size, slicing tomatoes-shape).

C. Assignment

D. Supervised study

E. Discussion

1. Discuss the major classes of fruits, vegetables, and nuts.

What are the major classes of fruits, vegetables, and nuts?

a. Fruits
    1. Melons - cantaloupes, watermelons
    2. Drupes (single pits) - apricots, cherries, peaches, plums
    3. Berries - grapes, cranberries
    4. Pomes (many pits) - apples, pears
    5. Citrus - oranges, grapefruits, lemons
    6. Tropical - bananas, dates, figs, pineapples, mangos, papayas

b. Vegetables
    1. Earth vegetables - sweet potatoes, onions, potatoes
    2. Herbage vegetables - cabbage, spinach, lettuce, celery, rhubarb
    3. Fruit vegetables - peas, green beans, sweet corn, squash, tomato

c. Nuts

1. Cultivated tree nuts
2. Wild nuts

2. Discuss the products from fruits, vegetables, and nuts. Have students complete AS 11.1.

What are the products from fruits, vegetables, and nuts?

a. Fresh - melons, bananas
b. Frozen - corn, lima beans, strawberries
c. Juices - apple, grape, orange
d. Canned - peaches, peas
e. Purees - baby food, tomato sauce
f. Processed - applesauce, cranberry sauce
g. Jellies/jams
h. Dried fruits and vegetables
i. Nut meats
j. Shell nuts
k. Cracked nuts
l. Roasted nuts

3. Discuss the factors that affect quality grades.

What factors determine quality of fruits, vegetables, and nuts?

1. Maturity
2. Instrumental evaluation
3. Color
4. Size
5. Shape
6. Firmness/texture
7. Aroma
8. Variety
9. Harvesting method
10. Acid concentration
11. Sugar to acid ratio
12. Physical damage/disease

4. Discuss fruit, vegetable, and nut by-products.

What are the by-products of fruits, vegetables, and nuts?

a. Rinds/peels/shells
b. Pits
c. Non-juice solids

5. Discuss the crop characteristics that influence how the produce is used.

   What crop characteristics influence how they are used?

   a. Time of maturity and yield
   b. Weather response
   c. Pest and disease resistance
   d. Shape
   e. Size
   f. Resistance to physical damage
   g. Storage stability
   h. Suitability to certain processing methods
   i. Color of flesh
   j. Firmness when cooked and raw
   k. Amount of juice
   l. Acidity level
   m. Solids content

F. Other activities

Canning grape juice - Remove grapes from stems. Wash sound, ripe grapes. Cover them with water and heat slowly to a simmer - do not boil. Cook slowly until the fruit is very soft. Then strain the grapes through a bag - separating the juice from the pulp. Add 1/2 cup of sugar to each quart of juice. Pour juice into sterile jars and process 15 minutes (pressure cook or retort) in boiling water bath.

G. Conclusion

Classification of fruits, vegetables, and nuts is based on their origin, anatomy, and/or how they are eaten. These produce types are quality graded and create a variety of by-products.

H. Competency

Identify fruit, vegetable, and nut products and factors that determine quality.

Related Missouri Core Competencies and Key Skills: None

I. Answers to Evaluation

1. h
2. f
3. g
4. a

5. c
6. d
7. e
8. i
9. b
10. In-shell, cracked, nut meats, roasted

11. Rinds, peels, shells, non-juice solids

12. Instructor's discretion

J. Answers to Activity Sheet

AS 11.1

1. To remove the skin
2. Answers will vary
3. Answers will vary

UNIT II - FOOD PROCESSING Name_____

Lesson 11: Fruit, Vegetable, and Nut Products Date _____

EVALUATION

Match the class of fruit, vegetable, or nut on the left with an example on the right.

___1.	Earth vegetable	a.	Honeydew
___2.	Herbage vegetable	b.	Banana
___3.	Fruit vegetable	c.	Cherry
___4.	Melons	d.	Blackberry
___5.	Drupes	e.	Apple
___6.	Berry	f.	Celery
___7.	Pomes	g.	Pea
___8.	Citrus	g.	Pea
___9.	Tropical	h.	Onion
		i.	Grapefruit

Complete the following short answer questions.

10. Name three products from nuts.

11. List two by-products of fruit, vegetable, and nut processing.

12. Essay - Assume you live near a tomato juice processing plant. You have contracted to raise tomatoes for this plant next year. Write a paragraph using each of the following characteristics: shape, size, color, juice, content, and storage stability to describe the variety of tomatoes you will likely raise.

UNIT II - FOOD PROCESSING AS 11.1

Lesson 11: Fruit, Vegetable, and Nut Products Name _____

Making Nut Butter

Objective: To process a nut by pressing out its oil and producing a nut butter.

Activity Length: 1 period

Materials and Equipment:

¼ c. Pecans, walnuts, almonds, etc. (raw)
Nut grinder
Rolling pin
Plastic bags
Knife
Water
Small pan used to heat almonds
Salt

Procedure:

1. Select one type of nut to process.

2. Grind or crush nut meats.

    a. If using pecans or walnuts, dice nuts and place through a nut grinder or use a double plastic bag and rolling pin to reduce the particle size.

    b. If using almonds or peanuts, place in pan, cover with water, and boil for 5 minutes. Then remove skin. Grind with a nut grinder or crush with a rolling pin while in a double plastic bag.

3. Place in a plastic-bag and roll with rolling pin exerting as much pressure as possible to squeeze out oils.

4. As oil is pressed out, nut particles will cling together to form a "butter."

5. Lightly salt.

6. Examine your butter and complete Table 9.1. Also, check with students who processed different nuts and record your opinions in the table.

Table 11.1 Nut Butter Qualities

Type of Nut	Color of Butter	Rank in order of Oil Content	Spreading Qualities	Taste Preference

Key Questions:

1. Why do you need to boil the almonds or peanuts before they are crushed?

2. How do the different nut butters compare?

3. Which nut butter had the best flavor?

UNIT II - FOOD PROCESSING

Lesson 12: Processing Fruits, Vegetables, and Nuts

Objective

The student will be able to explain how fruits, vegetables, and nuts are processed.

I. Study Questions

A. How are fruits, vegetables, and nuts processed?

B. How do processing techniques affect the nutritional value of fruits, vegetables, and nuts?

C. How are fresh fruits, vegetables, and nuts treated and packaged to enhance their appearance and shelf life?

D. How is the industry that processes fruits, vegetables, and nuts organized?

II. References

A. Martin, Phillip R. *Food Science and Technology* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1994. Unit II.

B. Activity Sheets

AS 12.1: Enzymatic Browning

UNIT II - FOOD PROCESSING

Lesson 12: Processing Fruits, Vegetables, and Nuts

TEACHING PROCEDURES

A. Review

Review the major classes of fruits, vegetables, and nuts. Ask your students to name an example of each. Compare these raw products to what is found in the grocery store. Would any fruit, vegetable, or nut require processing?

B. Motivation

The "Love Apple".... what is it? It is a fruit, but gets treated like a vegetable. It is a perennial, but gets treated like an annual. It was probably domesticated in Mexico and arrived in Europe in the 1500's. Thomas Jefferson, a gardener ahead of his time, raised it. Robert Gibbon Johnson is slightly famous because he ate one on the courthouse steps in Salem, NJ, in 1820. It was believed to be poisonous due to the family from which it came, the nightshade family. It supplies vitamins A an C. It normally self pollinates. It provides the pizazz on pizza, sauce for spaghetti, base for soup, garnish on a salad, and main ingredient in catsup. What is it? Tomato
ref. Credit: Rick, Charles M. *Science of Food & Agriculture*, Jan. 1986.

C. Assignment

D. Supervised Study

E. Discussion

1. Discuss how fruits, vegetables, and nuts are processed.

How are fruits, vegetables, and nuts processed?

a. Fruits and vegetables
    1. Harvest
    2. Transported to plant
    3. Cleaned and sorted
    4. Some go to a ripening chamber
    5. Additional processing depends on end product
        a. Fresh - cooled, washed
        b. Frozen - washed, pitted, stemmed, cut or cored before freezing; some may be blanched

c. Canned - blanched, peeled and/or cored, filled in cans, air removal, sealed, retorted, cooled, and labeled.

b. Nuts
   1. Harvest with mechanical tree shaker
   2. Hulled by mechanical nut hullers
   3. Sorted by size and/or color
   4. Dried to 9.5 percent moisture
   5. Additional processing depends on end product
      a. Nut meats - remoistened, shelled, and packaged
      b. In-shell nuts - washed, polished, and waxed
      c. Roasted nuts - heated in oil, oil coated, salted, and oiled again (Dry roasted are heated without oil.)

2. Discuss how processing techniques affect the nutritional quality of fruits, vegetables, and nuts.

   How do processing techniques affect the nutritional value of fruits, vegetables, and nuts?

   a. Fresh fruits/vegetables are highest in overall nutrition.
   b. Frozen items are a close second.
   c. Canned items lose minerals and vitamins - canning extends the processing period but some minerals and vitamins are lost.
   d. Dried fruits are devoid of Vitamin C.
   e. The composition of nuts is not usually affected by processing.

3. Discuss how fruits, vegetables, and nuts are treated and packaged to enhance their appearance and shelf life.

   How are fresh fruits, vegetables, and nuts treated and packaged to enhance their appearance and shelf life?

   a. Ethylene gas - ripening agent
   b. Sodium bisulfite - retards browning
   c. Sulfur dioxide - retards browning
   d. Waxing - prevents dehydration in apples and nuts
   e. Irradiation - inhibits sprouting in potatoes
   f. Cool temperatures - slows enzymatic reactions
   g. Nuts in opaque containers - prevents rancid flavors
   h. Fruits and vegetables stored in containers with holes to allow for respiration
   i. Artificial coloring - enhances eye appeal

4. Discuss the organization of the fruit, vegetable, and nut industry.

How is the industry that processes fruits, vegetables, and nuts organized?

a. Contract production
b. Cooperatives
c. Very large parent companies
d. Immigrant, migrant labor
e. Organizations promote products

F. Other activities

Effect of roasting upon color, flavor, and texture of peanut butter.

G. Conclusion

Fruits, vegetables, and nuts are processed to maintain a steady supply in the off season. Following harvesting, fruits, vegetables, and nuts undergo different processing techniques depending on the end product. In general, the nutritional quality is highest in raw fruits and vegetables. Various techniques are used to enhance shelf-life and market value.

H. Competency

Explain how fruits, vegetables, and nuts are processed.

Related Missouri Core Competencies and Key Skills:

9D-5: Describe the relationship between technologies which improve our lives and the environmental problems that can result from them.
9D-6: Identify the control, dependent, and the independent variables in an experiment.

I. Answers to Evaluation

1. e
2. b
3. a
4. c

5. 3
   1
   2

6. Contract production - growers supply processors certain quantities of a specific crop

Cooperatives - several producers have joined together to collectively market their products
Migrant workers - laborers who travel from farm to farm during the growing and harvesting season

J. Answers to AS 12.1

1. Enzymatic browning occurs when plant tissue is exposed in a brown colored pigment, melanin, being produced as a result of a series of biochemical reactions.

2. Warm temperatures and plenty of air exposure enhance the browning process. An enzyme called polyphenol oxidase acts as a catalyst to speed up the process which can occur rapidly at warm temperatures when the pH is between 5.0 and 7.0.

3. Acids such as ascorbic acid and citric acid are commonly used in the food industry.

4. Citric acid acts as a delating agent to prevent the fruit from browning. Citric acid inhibits the polyphenol oxidase enzyme by reducing copper ions which are necessary for the enzyme to be active.

UNIT II - FOOD PROCESSING Name _____

Lesson 12: Processing Fruits, Vegetables, and Nuts Date _____

EVALUATION

Match the processing technique on the left with the descriptions on the right.

1.	Treating with ethylene gas	a.	Prevents enzymatic browning
2.	Blanching	b.	Inactivation of enzymes by heating
3.	Adding sodium bisulfite	c.	Blanching, peeling, can filling, air removal, sealing, retorting
4.	Canning	d.	Washing and polishing
		e.	Used in ripening chambers
		f.	Heated, oiled, salted, oiled

Complete the following short answer questions.

5. Rank the following in the order of their nutrient quality. Begin by placing a "1" by the item with the most nutrients.

   _____ dried fruit

   _____ fresh fruit

   _____ canned fruit

6. The fruit, vegetable, and nut industries are characterized by contract production, cooperatives, and migrant workers. Explain what these three terms mean.

UNIT II - FOOD PROCESSING AS 12.1

Lesson 12:Processing Fruits, Vegetables, and Nuts Name _____

Enzymatic Browning

Objective: The student will investigate the process of browning in fruits and test the effects of various substances in preventing browning.

Activity Length: 1 hour

Materials and Equipment:

Fresh fruit or vegetable (apples, bananas, peaches, pears, avocados will work well)
Vinegar - acetic acid
Lemon juice - citric acid
Fruit Fresh®
Beakers or wide-mouth jars
Tongs
Paper towels
Water

Procedures:

1. Prepare 200 ml of each of the following solutions and place them in 4 separate jars.

   fruit fresh
   lemon juice
   vinegar
   water

2. Cut the pieces of fresh fruit or vegetables into six pieces of approximately equal size.

3. Using tongs, dip a separate piece of the sample fruit into each of the three acid solutions and water and place the samples on a paper towel. Rinse the tongs after each use.

4. Put an untreated piece of the sample on the paper towel.

5. Record on the 0 min line what each piece looks like as soon as they are all placed on the towel. For texture, look at the fruit but do not touch. Touching the surface of the fruit adds bacteria from your hands.

6. Observe all 5 samples every ten minutes for the class period. Record your observations.

Time	Record Observations														
	Fruit Fresh			Lemon Juice			Vinegar			Water			Air		
	Color*	Odor	Texture	Color*	Odor	Texture	Color*	Odor	Texture	Color*	Odor	Texture	Color*	Odor	Texture
0 min															
10 min															
20 min															
30 min															
40 min															
50 min															

*Color Code

5 completely dark brown
4 fully covered light brown
3 half covered light brown
2 slight or scant brown patches
1 no browning present

Questions

1. What causes browning when fresh fruits and some vegetables are peeled or cut?

2. What conditions enhance the browning process? Why?

3. How do food additives or treatment processes in use today prevent or retard browning in fruits and vegetables.

4. Why do citrus juices retard browning in fresh fruits?