UNIT I - PRINCIPLES OF FOOD PRESERVATION

Lesson 1: Introduction to Food Preservation

Objective

The student will be able to describe factors related to food preservation.

I. Study Questions

   A. Why are foods preserved?

   B. Why is food preservation important?

   C. What techniques can be used to preserve food?

   D. What are the causes of food deterioration?

   E. How does time and the type of storage affect food quality?

II. References

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

   B. Transparency Master

      TM 1.1: Approximate Storage Life of Frozen Foods

   C. Activity Sheets

      1. AS 1.1: Effects of Packaging Material in Maintaining Meat Quality
      2. AS 1.2: Effects of Light on Food Flavor

UNIT I - PRINCIPLES OF FOOD PRESERVATION

Lesson 1: Introduction to Food Preservation

TEACHING PROCEDURES

A. Introduction

Give an overview of this unit and a sample of the activities.

B. Motivation

1. Ask students to explain what they think the saying "You're not worth your salt" means. Salt has always been a very valuable commodity: used as a flavoring agent and as a preservative. Since it was so valuable, it was a source of payment for hired labor. If Jack Worker was lazy or inefficient, thus overpaid, he may have been called a worker not worth his salt.

2. Ask students if they know where the term "Uncle Sam" originated. The term "Uncle Sam" originated during the War of 1812. Pork was shipped in barrels that were stamped with the letters "U.S." and "Sam Wilson," the name of the meat packer. Soldiers referred to the meat as Uncle Sam's meat.

C. Assignment

D. Supervised study

E. Discussion

1. Discuss with students why there is a science of food. Emphasize how food science and technology cover all phases of food production from production/handling to processing/preserving, packaging, distribution, marketing, and consumption. In the United States, an adequate food supply exists because of suitable natural resources, a favorable and diverse climate, educated producers/processors, and the application of science and technology. However, food is a perishable commodity and must be preserved.

   Why are foods preserved?

   a. To ensure an abundant and diverse food supply throughout the year
   b. To prevent microbial growth
   c. To maintain the taste and texture of food

d. To provide food products in a more convenient form

2. Discuss the historical significance of food preservation and how it will be useful in the future. Food has always been a basic necessity for life. From the beginning of time, humans have fished, gathered, hunted, cultivated the soil, and raised animals for food. An adequate food supply, or lack of one, has contributed to the rise and fall of many nations. Even today, starvation and malnutrition are major problems in many countries. How will your future be affected by an adequate food supply? What preservation techniques may be expanded or developed in the future?

Why is food preservation important?

a. Food preservation is necessary for life unless fresh food is gathered on a daily basis.
b. Historically
   1. Early civilizations developed in areas where food was plentiful.
   2. Before "sun-drying", fruits and vegetables were eaten seasonally.
   3. Before salt curing, meat was preserved only for a minimal length of time.
   4. Napoleon was successful largely because he provided a healthy diet for his soldiers. He suffered his greatest defeat when it became difficult to feed his troops.
   5. Early Asians preserved food with spices and sugar.
   6. American pioneers depended on salted, pickled and smoked meat and fish and dried beans.
      a. Meat was processed/preserved in winter months.
      b. Sausages were cooked and covered with melted lard.
      c. Milk, eggs, and butter were kept in springhouses.
      d. Fruits and vegetables were preserved in root cellars, by burying, or by drying.
   7. The railroads in the 1830's and the refrigeration car in the 1880's brought considerable changes.
c. Future
   1. World population continues to grow while productive acreage declines. Longer preservation techniques are needed.
   2. Convenience may dictate processing, so preservation technology will need to keep current.
   3. Energy expense of irradiation, refrigeration, and freezing may be reduced by new technology.
   4. Medical use of some types of chemotherapy alters the immune system, which requires that meals be sterilized by irradiation.

3. Discuss techniques that can be used to preserve food by controlling microbes and enzymes. Have students work in groups to begin complete AS 1.1. On day 30, the activity will be completed.

   What techniques can be used to preserve food?

   a. Heat
      1. Pasteurization
      2. Sterilization
   b. Cold
      1. Refrigeration
      2. Freezing
   c. Drying
      1. Dehydration
      2. Freeze-drying
   d. Irradiation
   e. Packaging
      1. Vacuum
      2. Modified atmosphere/controlled atmosphere
   f. Additives
      1. Salt
      2. Smoke
      3. Sugar
      4. Spices
      5. Others
      6. Acid
   g. Fermentation - 'natural' additives
      1. Acid
      2. Alcohol

4. Discuss the causes of food deterioration. Food is subject to physical, chemical, and biological deterioration. In practical terms, food is actually undergoing deterioration from the time it is harvested or slaughtered. The critical question is: How slow or how rapid is this process? Have students complete AS 1.2.

   What are the causes of food deterioration?

   a. Microorganisms
   b. Natural food enzymes
   c. Pests
      1. Insects
      2. Rodents

    3. Birds
    4. Parasites
  d. Other factors
    1. Temperature abuse (warm and cold)
    2. Light
    3. Moisture
    4. Oxygen

5. Discuss how the time and type of storage affect food quality. At best, the quality of fruits, vegetables, nuts, meat, grain, dairy products, and eggs is only maintained (not improved) in storage. In most cases, the quality actually suffers. There are several critical factors that determine time of storage. Use TM 1.1.

   How does time and the type of storage affect food quality?

   a. Quality of raw food product
   b. Food handling immediately after harvest - Was it cleaned and chilled rapidly? In the case of fruits and vegetables, were refrigeration units placed in the fields or was the produce transported to the units at a later time? Sweet corn will metabolize its own sugar following harvest. If cooled to 32°F, only 10 percent of its sugars will be converted to starch in one day. At 68°F, 25 percent may be converted in the same time period. Portable hydrocoolers can jet spray freshly picked fruits and vegetables with cold water that may contain a germicide to inactivate surface microbes. The products would then be placed in a refrigeration unit. The use of cold N_2 will facilitate evaporative cooling. Animal carcasses must be lowered to an internal temperature of 36°F within 24 hours of slaughter.
   c. Relative humidity - A critical factor in long-term food storage is air moisture, or relative humidity (RH) during storage and handling.
      1. Most microorganisms thrive in moist environments. Thus, to inhibit their growth and multiplication, RH levels must be controlled.
      2. Environments that are too dry will dehydrate the product unintentionally and lower its quality.
         a. Beef stored at less than 90 percent RH dries out. If RH is between 90-98 percent, the beef will mold. At higher levels bacteria cause spoilage.
         b. Cheeses are wrapped in film or coated to inhibit mold growth.
      3. Meat tissue may be covered with a film of plastic to decrease moisture loss.

4. Eggs may be coated with a thin film of mineral oil to maintain moisture level.

d. Storage temperature - Refrigeration, or cool storage, refers to temperatures in the range of 30°-61°F. Freezing refers to temperatures below 30°F.
   1. Pure water freezes at 32°F, while most foods will not begin to freeze until 30°F is achieved.
   2. Refrigeration may preserve food for days or weeks.
   3. Freezing can preserve food for months or years.
   4. Neither freezing nor refrigeration completely destroys all microbes. Once food is thawed, rapid multiplication is possible.
   5. Refrigeration is one of the gentlest methods of food storage in terms of maintaining taste, nutritional value, and texture.
   6. Refrigeration accelerates the staling of breads.

e. Additional processing - For long-term storage of food, heat, dehydration, irradiation, fermentation, or complete freezing is necessary.

F. Other activities

1. Salt/sugar cure a ham. See MU Agricultural Guide #2526, "Country Curing Hams." It is included as Appendix A.

2. Assign students to visit local grocery stores and report the type of light used in meat, fruit, vegetables, dairy, and egg counters. Determine which food products are packaged in transparent, translucent, and opaque containers. Investigate what temperature the grocery store maintains and if the relative humidity reading is monitored.

G. Conclusion

Foods are preserved for human safety, quality enhancement, convenience, and to provide a constant supply. Food preservation was important in the past, is important today, and will be important in the future. There are many techniques used to preserve food that control microbes and enzymatic activity. Without these techniques, physical, chemical, and biological deterioration are possible. Food quality is also influenced by the time and type of storage.

H. Competency

1. Describe factors related to food preservation.

2. Related Missouri Core Competencies and Key Skills:

9D-6: Identify the control, the dependent, and the independent variables in an experiment.

9D-5: Describe the relationship between technologies which improve our lives and the environmental problems that can result from them.

I. Answers to Evaluation

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

7. To insure an abundant, safe, diverse food supply. To enhance its taste and texture and for convenience.

8. Early American colonists would slaughter animals in the cold months. Their meat would be salted, pickled, or smoked. Sausage was cooked and covered with lard. Fruits and vegetables were dried, buried, or stored in root cellars. Fresh milk, butter, and eggs were kept cool in springhouses.

9. Heat denatures proteins, breaks emulsions, dries food and can destroy vitamins. Enzymatic and non-enzymatic reactions increase as heat is increased.

10. Too much moisture can cause lumping, crystallization, and stickiness. Too little moisture can cause dehydration and staleness.

11. Bacteria, mold, yeast.

12. Except for certain fruits and vegetables, the sooner a food product is cooled to 32°-40°F, the longer it can be stored. The conversion of sugars to starch is reduced by cooling.

13. Because microorganisms require moisture for survival, relative humidity levels are critical to food storage. Careful control of RH is vital. Too high = spoilage; too low = dehydration.

J. Answer to Activity Sheets

AS 1.1

1. They make a difference in food quality.
2. Class discretion
3. Light barrier; O_2 barrier
4. Class discretion
5. Tissue darkens and stiffens
6. Proper sealing and taping
7. Use packaging that is opaque and seals against O_2.

AS 1.2

1. Class discretion
2. Class discretion
3. Opaque containers reduces oxidation and rancidity.
4. Oxidation and rancidity
5. Class discretion; may include sealed bags, sealed tubes, foil bags
6. Class discretion
7. Class discretion

UNIT I - PRINCIPLES OF FOOD PRESERVATION Name ___________________

Lesson 1:Introduction to Food Preservation Date ___________________

EVALUATION

Circle the letter that corresponds to the best answer.

1. The removal of moisture in a food product is called:

   a. Freezing.
   b. Dehydrating.
   c. Irradiating.
   d. Sterilizing.

2. Removing all the oxygen from a food package is called:

   a. Sterilizing.
   b. Freeze drying.
   c. Heating.
   d. Vacuum packaging.

3. Sterilizing is applying a temperature of ______ and maintaining it for _______ minutes.

   a. 100°F, 15
   b. 180°F, 5
   c. 240°F, 15
   d. 420°F, 30

4. What are two preservation techniques that create a high osmotic pressure?

   a. Sweetening and sterilizing
   b. Salting and vacuum packaging
   c. Sweetening and salting
   d. Salting and fermenting

5. In fermentation, bacteria convert carbohydrates into:

   a. Acids and alcohol
   b. Sugars and acids
   c. Alcohol and salts
   d. Sugars and salts

6. What additives are used to preserve foods?

   a. Salt, flavorings, and oils
   b. Flavor enhancers and sugar
   c. Food coloring, sugar and flavorings
   d. Salt, spices, and sugar

Complete the following short answer questions.

7. Why is food preserved?

8. Describe the food preservation techniques used by early American colonists.

9. Describe how an increase in heat affects food preservation.

10. Compare and contrast too much moisture and too little moisture on food preservation.

11. Name three general types of microorganisms.

12. Why is refrigeration useful in food storage?

13. How does relative humidity affect food storage?

TM 1.1

Approximate Storage Life of Frozen Foods

Approximate Storage Life (in months unless indicated otherwise)

	-18°C (0°F)	-12°C (10°F)	-6.7°C (20°F)
Orange juice (heated)	27	10	4
Peaches	12	<2	6 days
Strawberries	12	2.4	10 days
Cauliflower	12	2.4	10 days
Green beans	11-12	3	1
Peas	11-12	3	1
Spinach	6-7	3	21 days
Chicken (raw)	27	15 1/2	<8
Fried chicken	<3	<1	18 days
Turkey pies	>30	9 1/2	2 1/2
Beef (raw)	13-14	5	<2
Pork (raw)	10	<4	<1 1/2
Lean fish (raw)	3	<2 1/2	<1 1/2
Fat fish (raw)	2	1 1/2	24 days

Courtesy U.S. Department of Agriculture

UNIT I - PRINCIPLES OF FOOD PRESERVATION AS 1.1

Lesson 1:Introduction to Food Preservation Name ________________________

Effects of Packaging Material in Maintaining Meat Quality

Objective: To examine the effects of packaging a food with a variety of common packaging materials.

Activity Length: Day 1 - 20 minutes
Day 30 - 30 minutes

Materials and Equipment:

Beef sirloin - 1/4 lb per group of students
Freezer space for about 30 days
Plastic wrap used to package beef in the store
Freezer foil
Freezer paper
Plastic freezer bags
Pyrex bowl (covered)
Plastic or freezer plate (to be used for the "no wrap" meat)
Microscope

Procedure:

1. Cut the beef into 6 equal pieces.

2. Wrap each piece of beef with one of the packaging materials. Label each piece of beef with the group's name and the kind of packaging and place it in the freezer.

   a. Plastic wrap used to package beef at store
   b. Freezer foil
   c. Freezer paper
   d. Plastic freezer bag
   e. Pyrex bowl (covered)
   f. No wrap" on plastic or freezer plate

3. Store the meat for 30 days and then thaw it.

4. Observe the meat as it thaws. Observe it under a microscope. The meat can be thawed in a microwave, except when foil is used.

5. Compare each of the pieces for general appearance: color, odor, the amount of drip (free water and juice coming from the meat), freezer burn, frost, and freshness. Evaluate each piece of beef on a scale of 1-5 with 5 being excellent and 1 being unacceptable. Record your answers on Table 1.1.

6. Evaluate the packaging methods between each of the groups.

Table 1.1

	Color	Odor	Amount of drip	Freezer burn	Frost	Freshness
Plastic wrap						
Freezer foil						
Freezer paper						
Plastic freezer bags						
Pyrex bowl						
No wrap						

(Rating Scale: 1 = unacceptable, 5 = excellent)

Key Questions:

1. What did you discover about packaging materials?

2. Which packaging materials are acceptable for freezing meat?

3. What qualities of the packaging materials allow them to preserve beef meat at an acceptable level?

4. What material would you <u>not</u> use to package beef in for freezer storage?

5. What does freezer burn look like?

6. What additional steps should you use to prepare beef to be frozen?

7. Based on your discoveries, what recommendations would you make for packing beef into freezer containers?

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

UNIT I - PRINCIPLES OF FOOD PRESERVATION AS 1.2

Lesson 1:Introduction to Food Preservation Name ________________________

Effects of Light on Food Flavor

Objective: To observe and sample the effect light has on the flavor of corn chips stored in different ways for various periods of time.

Activity Length: 30 minutes to set up, 10 minutes each on days 3, 5, 7, and 9

Background Information:

Food is placed in packaging for a variety of reasons. This experiment will help you understand the effect light has on food quality. The packaging selected by the processor is determined by the protecting quality (from microorganisms), its ability to protect the food from damage, and its ability to preserve or maintain the food over time. As you are probably aware, fat oxidizes and becomes rancid (spoiled), causing undesirable flavors and odors. These flavors can develop in high fat foods, such as peanut butter, corn chips, or nuts. The method by which these foods are packaged can influence whether they become rancid or not. Light and oxygen can accelerate the process.

Materials and Equipment:

3 clear plastic jars and lids per group
aluminum foil
1-2 bags corn chips
graph paper
jar labels (masking tape)

Procedure:

1. Obtain three clear glass or plastic jars with lids (for each student or group of students). Label jars 1, 2, and 3. Wrap jar #1 with a light preventing layer (aluminum foil or construction paper). Place this protecting layer so that no light enters the jar.

2. Place equal amounts of corn chips (about 1/3 cup) in each jar. Smell and taste one chip from each jar. Record your opinion on Day 1 of Table 1.1. Place the lids on the jars.

3. Label the jars with your name, the date, and class period. Place the jars in a location that will not get extreme heat. Place jar #1 (the control) near jars #2 and #3. Place jar #2 near a window in order that it will receive sunlight. Place jar #3 under a continuous light source.

4. Observe, smell and taste corn chips from the jars every other day for 10 days (5 total samples). Rate the flavor of the chips on the following five-point scale. Rate the flavor based on how the chips originally tasted.

5. Make a graph of the data you collect as a result of this experiment. Chart the data on the flavor of the corn chips versus the storage time, for all three samples. The flavor should be on the side of the graph (y-axis) and the days should be on the bottom (x-axis). Use a different color pen or marker to show taste ratings and order ratings.

Scale:

1 = The Worst
2 = Bad Flavor
3 = OK (no opinion)
4 = Good Flavor
5 = The Best

Chart

Day	Rating of chips protected from light		Rating of chips exposed to sunlight		Rating of chips exposed to continuous light	
	taste	odor	taste	odor	taste	odor
1						
3						
5						
7						
9						

Key Questions:

1. When did the flavor of the corn chips begin to deteriorate?

2. When did you first detect a difference in the odor of the food?

3. What effect did wrapping the jar have on the quality of the chips?

4. What type of reactions occurred with the chips that caused them to deteriorate?

5. List three types of containers that food processors use to retain the quality of chips?

6. Do you see corn chips or potato chips or other types of high fat products being marketed which do not follow these rules? Why?

7. What types of precautions could chip processors use in the design of packages to better maintain the product over time?

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.* Peoria, IL: Glencoe, Publishing, 1989.

UNIT I - PRINCIPLES OF FOOD PRESERVATION

Lesson 2: Food Perishability

Objective

The student will be able to describe factors that contribute to food deterioration.

I. Study Questions:

A. Which food characteristics influence deterioration rate?

B. How does acidity/alkalinity influence the perishability of food products?

C. What is the relationship between water, salt, sugar, and osmotic pressure as they relate to food preservation?

D. How does microbial activity affect food preservation?

E. How are chemical preservatives used in foods?

F. How does the ambient environment affect the perishability of foods?

II. References

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

B. Transparency Master

TM 2.1: Food Additives Used as Preservatives

C. Activity Sheets

1. AS 2.1: Osmosis and Diffusion Across a Semi-permeable Membrane
2. AS 2.2: Bacteria Are Found Everywhere

UNIT I - PRINCIPLES OF FOOD PRESERVATION

Lesson 2: Food Perishability

TEACHING PROCEDURES

A. Review

Ask students to summarize their conclusions from the previous lesson and describe how these conclusions relate to this lesson.

B. Motivation

1. Place one green banana in plastic bag. Leave one green out. Immature produce can be ripened more quickly if sealed in an air-tight bag. Relate ethylene gas to natural vegetable/fruit hormones and demonstrate its ripening characteristic on sealed produce. Fruits and vegetables produce several hormones. A product of hormonal activity, not a hormone itself, ethylene is a natural ripening agent. Check the bananas the next class period to see how they have ripened.

2. Rank the following food items in the order they would deteriorate at room temperature considering they were freshly packaged the day you purchased them: honey, hot dogs, hamburger, tomato, corn flakes, milk.

3. On a survival trip to the Teton mountains in December, which of the following foods would you take: butter, oranges, dried beans, bacon, soda, potatoes, chocolate, watermelon?

4. To observe deterioration, leave a glass of milk out overnight. Examine milk.

C. Assignment

D. Supervised study

E. Discussion

1. Discuss which food characteristics influence deterioration rate.

   Which food characteristics influence deterioration rate?

   a. pH
   b. Moisture (water activity level)
   c. Temperature of the product

   d. Oxygen level
   e. Physical characteristics

2. Discuss how the degree of acidity/alkalinity influences the perishability of food products.

   How does acidity/alkalinity influence the perishability of food products?

   a. The more acidic, or lower pH the food is, the slower the deterioration rate.
   b. Bacterial growth generally favors a pH near neutral (7.0).

3. Discuss the relationship between water, salt, sugar, and osmotic pressure as they relate to food preservation. AS 2.1

   What is the relationship between water, salt, sugar, and osmotic pressure as they relate to food preservation?

   a. When sugar or salt is added, the osmotic pressure increases and the water activity (Aw) decreases.
   b. When the osmotic pressure is high enough to draw water away from microbial cells, or prevent normal diffusion of water into microbial cells, the cytoplasm within the microbial cell dehydrates.

4. Discuss how microbial activity affects food preservation.

   How does microbial activity affect food preservation?

   a. Physical changes - more apparent than chemical changes
      1. Slime formation, undesirable odors and flavors, color changes caused by aerobic bacteria and yeasts
      2. Sticky surface caused by aerobic molds
   b. Chemical changes - Proteins, lipids, carbohydrates, and other complex molecules are degraded into simpler molecules.

5. Discuss how chemical preservatives are used in foods. Use TM 2.1 during the discussion.

   How are chemical preservatives used in foods?

   Chemical preservatives, often called additives, are substances added to food to improve appearance, flavor, texture, or storage properties. They generally work by acting directly on biological and chemical reactions that decrease food quality.

6. Discuss how the ambient environment affect the preservation of foods.

   How does the ambient environment affect the perishability of foods?

   a. The absence of O_2 prohibits the growth of all molds and aerobic bacteria and retards cellular respiration.
   b. CO_2 and O_3 have been used in the holds of ships to curtail aerobic growth. CO_2 can cause souring due to carbonic acid formation. O_3, ozone, kills most microorganisms, but may increase rancidity in some products.
   c. Nitrogen (N_2) is used for immersion freezing and as a cooling agent to preserve foods. N_2 boils at -196°C, so liquid N is colder than this. N_2 is also used to displace O_2 in many food packages.
   d. The presence of O_2 permits aerobic bacteria, molds, yeasts, and respiration.
   e. CO_2 used to purge fermented products removes any O_2.
   f. CO_2 used in soft drink production - contributes to acidic preservative action.
   g. CO_2 levels are increased to 2-5 percent while O_2 levels are only 3 percent, the remainder N_2, used to preserve apples and other fruits. This low O_2 level retards respiration and hence deterioration rate. Normal atmosphere O_2 level is 21 percent.
   h. Use of ethylene gas speeds ripening and color development in citrus and bananas.
   i. Eggs are stored in enriched CO_2 storehouses to minimize microbial spoilage.

F. Other activities

1. Take pH readings of various food/beverage solutions: several types of soda, milk, coffee, orange juice, sauerkraut, pickles, green beans, water, egg white vs. egg yolk, etc.

2. Examine food ingredient statements on various food packages and identify chemical preservatives used. What other techniques are used to preserve the product - package, atmosphere, refrigerate after opening, etc.

G. Conclusion

Food preservation relies on a variety of factors. A product's physical characteristics, access to O2, temperature, water activity level, and pH are all critical factors that must be managed to delay deterioration. Unless these variables are carefully monitored, microbial activity/deterioration will take place.

Other controls to prevent spoilage are the use of additives and gaseous atmosphere modifications.

H. Competency

1. Describe factors that contribute to food deterioration.

2. Related Missouri Core Competencies and Key Skills

9D-6: Identify the control, the dependent, and the independent variables in an experiment.
10C-5: Identify the variables and controls in a laboratory experiment involving osmosis and Reach a conclusion from the given data.
10E-1: Compare and contrast organic and inorganic compounds.

I. Answers to Evaluation

1. c
2. d
3. a
4. d
5. a
6. b
7. The dialysis tube would lose water by osmosis because the concentration of salts is greater in the salt water solution. It would collapse.
8. Increased surface area; water and nutrients are more available to microbes; O_2 is more available.
9. Acid denatures a microorganism's protein. Therefore, the greater the acid concentration, the less perishable the food product becomes. Some acids directly poison some microbes.
10. Slime formation; sticky surface; undesirable flavor and odor; color change.
11. Sodium benzoate; nitrates and nitrites; BHA; BHT; TBQH; sorbic acid, sodium and calcium propionates, chlorine compounds, ethylene oxide and ethylene formate, salt; sugar; smoke; acids; sulfer dioxide

J. Answer to Activity Sheets

AS 2.1

Part A
1. Yes
2. Iodine, the starch solution turned brown-black
3. The starch molecule is too large to move through semi-permeable membrane

Part B
1. Should be egg A
2. Egg B
3. The vinegar dissolves the shell.
4. They will absorb water, enlarge to an artificial size, and become susceptible to deterioration.
5. Instructor's discretion

AS 2.2

1. Bacteria are just one type of microorganism. Microorganisms are found everywhere, and include molds, yeasts, protozoa, viruses, and bacteria.
2. A safe rule of thumb is to: keep hot foods hot, keep cold foods cold, and keep all food preparation surfaces and equipment clean.
3. Penicillium is a mold that provides us with the antibiotic, penicillin. However, some molds produce toxins that can make us very sick. Some molds make our food look taste, or smell bad.
4. Some yeasts are used to make foods, for example, the yeast that makes bread rise or the yeast that turns the sugar in grapes to alcohol in wine.
5. Instructor's discretion.

UNIT I - PRINCIPLES OF FOOD PRESERVATION Name _______________

Lesson 2:Food Perishability Date _______________

EVALUATION

Circle the letter that corresponds to the best answer.

1. The ______________________________ the pH of a food item, the longer the food will keep.

    a. More constant
    b. Greater
    c. Lower
    d. Higher

2. Which of the following do all microorganisms require for survival?

    a. Temperature above 50°F
    b. Oxygen
    c. pH 5.0 or higher
    d. Moisture

3. When the level of salt is increased, the osmotic pressure ________________________ while the water activity ________________________.

    a. Increases, decreases
    b. Increases, Increases
    c. Decreases, increases
    d. Decreases, decreases

4. Microbial conversion of carbohydrates to organic acids is an example of a ___________________________ change.

    a. Physical
    b. Mechanical
    c. Technical
    d. Chemical

5. What does aerobic mean?

    a. In the presence of O_2

b. In the presence of CO_2
c. In the absence of O_2
d. In the absence of CO_2

6. What gas is most frequently used for immersion freezing?

a. Carbon dioxide
b. Nitrogen
c. Oxygen
d. Ozone

Complete the following short answer questions.

7. Describe what would happen if you placed a dialysis tube completely filled with pure water into a salt water solution.

8. Give two reasons why retail cuts of meat are more vulnerable to deterioration than a whole carcass.

9. Describe how acidity influences the perishability of food.

10. Name one physical change of food due to microbial activity.

11. Name three food chemical preservatives.

TM 2.1

Food Additives Used as Preservatives

Acetic acid
Ascorbic acid
Benzoic acid
Butyl paraben
Calcium lactate
Calcium propionate
Calcium sorbate
Citric acid
Ethylene oxide
Heptylparaben
Methylparaben
Potassium propionate
Propylparaben
Salt
Sugar
Sodium benzoate
Sodium erythorbate
Sodium nitrate
Sodium propionate
Sodium sorbate
Sorbic acid
Sucrose
Sulfur dioxide

UNIT I - PRINCIPLES OF FOOD PRESERVATION AS 2.1

Lesson 2:Food Perishability Name ________________________

Osmosis and Diffusion Across a Semi-permeable Membrane

Objective: Students will identify the variables and controls in a lab experiment involving osmosis and diffusion across a semi-permeable membrane.

Activity Length: Part A: 60 minutes
Part B:60 minutes

Materials and Equipment:

Part A dialysis tubing, small plastic sandwich bags, or sausage casing
0.5% starch solution (1 tsp. cornstarch to 1 cup hot water, stir well)
1.0% tincture of iodine solution (4 or 5 drops of tincture of iodine to 1 cup water, stir well)
2 - beakers

Part B 4 eggs per group
vinegar
salt
corn syrup
beakers
water

PART A: Osmosis

Procedure:

1. Obtain two beakers and two strips of dialysis tubing (small plastic sandwich bags and sausage casing may be substituted). Tie one end of tubing with string and open the other end by gently rolling the tubing between your thumb and forefinger. Fill this tube with starch solution and close the tubing. (Use a tight knot to be sure it does not leak.) Rinse the tubing under water and then submerge the bag in a beaker filled with iodine solution.

2. Prepare the second tube by filling it with iodine solution, closing the ends and rinsing under water before submerging the bag in a beaker filled with starch solution. Allow both bags to remain undisturbed for at least 30 minutes before completing your observations.

Key Questions:

1. Is there any evidence that either substance has moved through the membrane of the dialysis tubing?

2. Which molecule moves through the membrane, starch or iodine? How can you tell?

3. Why does the other molecule not move through the membrane?

PART B: Diffusion Name

Procedure:

Each group obtains four fresh eggs. Label the eggs A, B, C, and D. Measure the circumference of each egg and include in Table 1.1. Place egg A in a zip-lock bag filled 1/2 full with water. This is your control. Place egg B in a zip-lock bag filled 1/2 full with salt water. Use one tablespoon of salt per 1 cup of water. Place egg C in a zip-lock bag filled 1/2 full with corn syrup. Put egg D in vinegar solution. Allow eggs to set undisturbed for 30 minutes and then observe. Take circumference readings again and include in Table 1.1.

Table 1.1 Egg Circumference

Circumference	Egg A	Egg B	Egg C	Egg D
Before experiment				
After 30 minutes				
Percent increase or decrease				

Key Questions:

1. Which egg had the largest increase in size?

2. Did any egg shrink?

3. Why do you think an acid rinse (vinegar) is not used on eggs?

4. In egg processing, why are eggs not allowed to soak in water while cleaning?

UNIT I - PRINCIPLES OF FOOD PRESERVATION AS 2.2

Lesson 2:Food Perishability

Bacteria Are Found Everywhere

Objective: To recognize that microorganisms are found everywhere and can grow under favorable conditions. Students will compare and contrast organic and inorganic compounds by observing the microbes they carry.

Activity Length: Three class periods

Materials and Equipment:

Petri dish or film with sterile nutrient agar (1 per student)
Scott tape and masking tape
Cotton swabs
Inoculation sources (coin, raw meat)
Marking pens

Procedure:

1. Each student should have a petri dish (make sure that lids are not removed until you are told to remove them).

2. Select a contamination source.

3. Obtain inoculation sources from instructor.

4. Inoculate petri film with <u>one</u> of the following:

   Open the petri dish just before adding the contaminate.

   •hands--gently touch fingers to the agar, or gently lay your hand on the agar and remove it, or lightly trace an S pattern on the agar with your finger tip.

   •lips -- touch your lips lightly to the agar.

   NOTE: agar is nontoxic.

   •hair--remove a piece of hair from your head and gently lay it on the agar. Try to avoid touching the agar with your fingers.

•cough--hold the plate 2-3 inches from your mouth and cough directly onto the agar.

•coin--place a coin (not a penny, the copper will keep many microorganisms from growing) on top of the agar in the middle of the plate. Or, gently rub or roll the coin over the surface of the agar (try not to dig a hole in the agar).

•saliva--place a clean cotton swab in your mouth and moisten it with saliva. Gently rub the moistened swab over the surface of the agar.
•raw meat--place a small piece of raw meat (i.e., ground beef) on top of the agar in the center of a plate, or gently rub the meat over the surface of the agar.

•floor--drag finger across the floor, then trace an S pattern on the agar with the same finger.

•fork--wipe the eating surface of a clean fork on the agar.

•cup--wipe the drinking surface (top of cup) on the agar.

5. Immediately close the petri dish.

6. Use scotch tape to seal the plates. (Wrap the tape around the edge of the plate.)

7. Use masking tape or marking pens to label each plate with your name and the source of bacteria. (Label plates on the bottom, write small enough that you will be able to see the bacteria once they grow.)

8. Incubate the plates upside down at 85°F. (You can incubate the plates at room temperature, but it will take longer for the microorganisms to grow.) NOTE: Keep the plates away from windows since UV light kills bacteria. You incubate them upside down so that the moisture droplets that form don't fall on the agar.

9. WASH YOUR HANDS AFTER HANDLING THE PETRI DISHES!
CAUTION: Some microorganisms on the dishes could make you sick. Always wash your hands after handling the petri dishes!!!

10. The plates will incubate for two days, but you will examine them after 24 hours.

11. Examine the plate after 48 hours.

12. Observe the number of colonies, color of colonies, shape of colonies, and any other characteristics.

NOTE: Do not remove lids from petri plates.
SAFETY NOTE: Agar plates should be autoclaved after the experiment is completed. This prevents the possible transmission of disease to anyone or anything that might come in contact with the trash. The biology instructor or local hospital may be able to help.

Key Questions:

1. What are bacteria?

2. What are three things that can be done to limit bacteria growth in the foods students prepare at home?

3. Name a type of mold that is helpful.

4. Some yeasts are used for what purpose?

5. How many colonies were found on your agar and what was their color?

Adapted from: Frick, Marty. *Food Science, Safety and Nutrition*. The National Council for Agricultural Education, 1993 and *Safe Food Preparation: It's on Your Hands.* University Extension Guide #GH1165.

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.

				Total
A 2	B 7	C 18	D 12	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	Column B
____2. Removal of chaff, foreign material, soil	a. Extrusion
	b. Precipitating/ centrifuging
____3. Separate the hulls, germ, bran, and endosperm	c. Textuization
	d. Emulsifyin
____4. Converting vegetable oil into shortening	e. Homogenizing
	f. Hydrogenation
____5. Process that keeps oils and water from separating	g. Combination
	h. Fractionation
____6. Microorganisms break starch into sugars	i. Grinding
	j. Milling
____7. Removal of moisture	k. Fermentation
	l. Dehydration
____8. Enriching food with needed ingredients	
____9. Separate a solid from a solution	

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.

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

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; <u>not</u> 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:

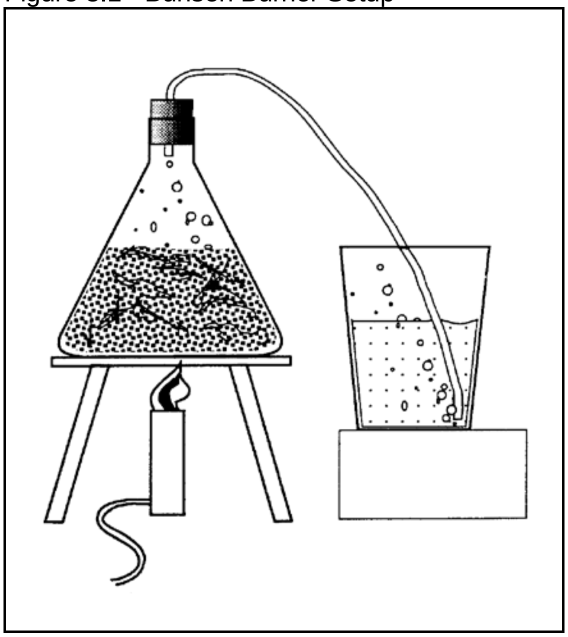
1. The formulas that follow are designed for 10 individuals and will provide more than 20 ml per person for tasting. If more than 10 students will be testing the samples, increase the amount of flavors in proportion to the number of students.

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?

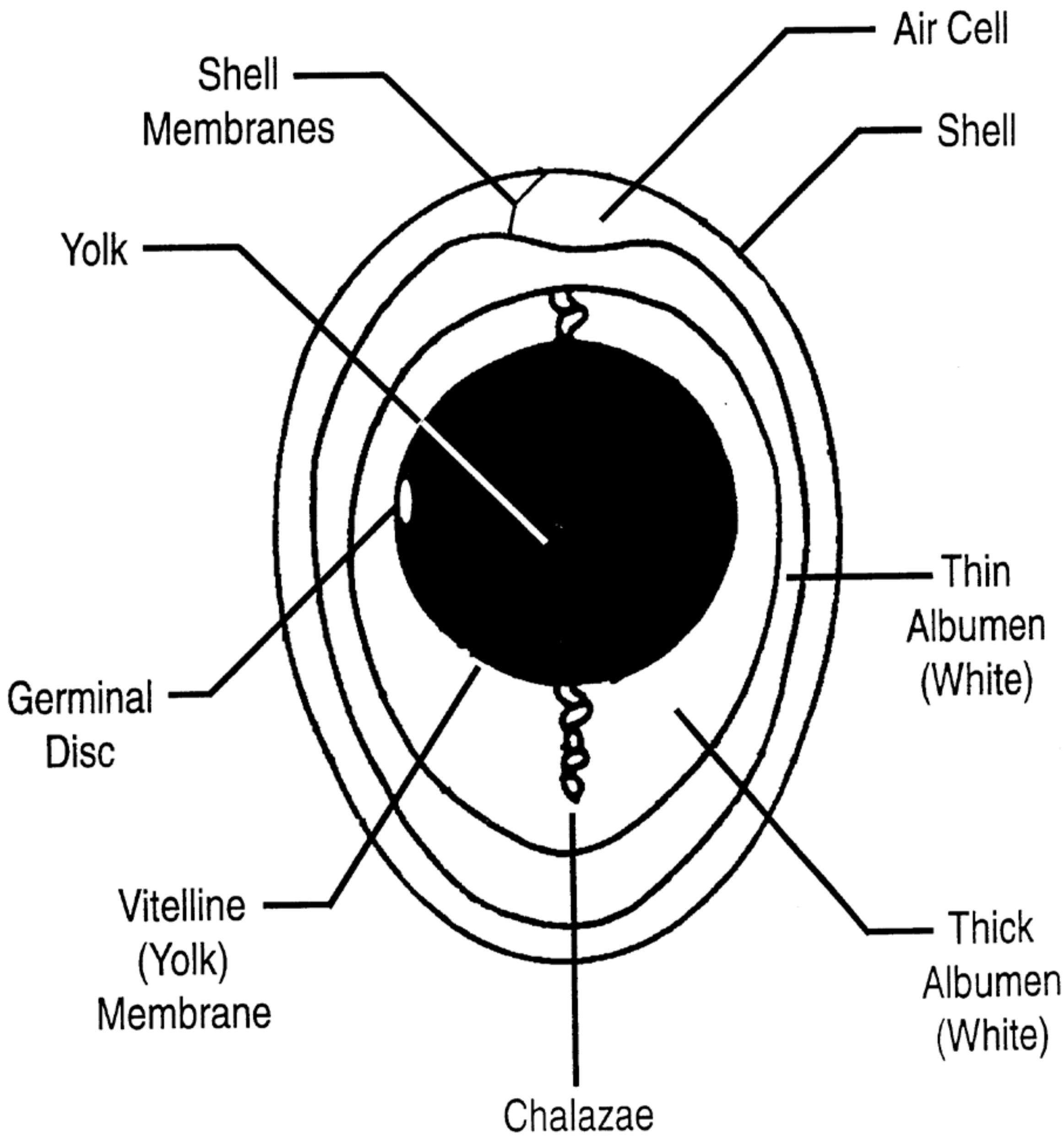
   a. Housing and feed
   b. Birds and feed
   c. Feed and labor
   d. Housing and labor

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	a. Sausage
14.____Boneless ham	b. Whole muscle
15.____Vienna sausage	c. Restructured
16.____Bratwurst	c. Restructured
17.____Bacon	d. Breaded
18.____Corned beef	
19.____Smoked, sliced beef	
20.____Fish sticks	
21.____Bologna	
22.____Chicken patties	

Complete the following short answer questions.

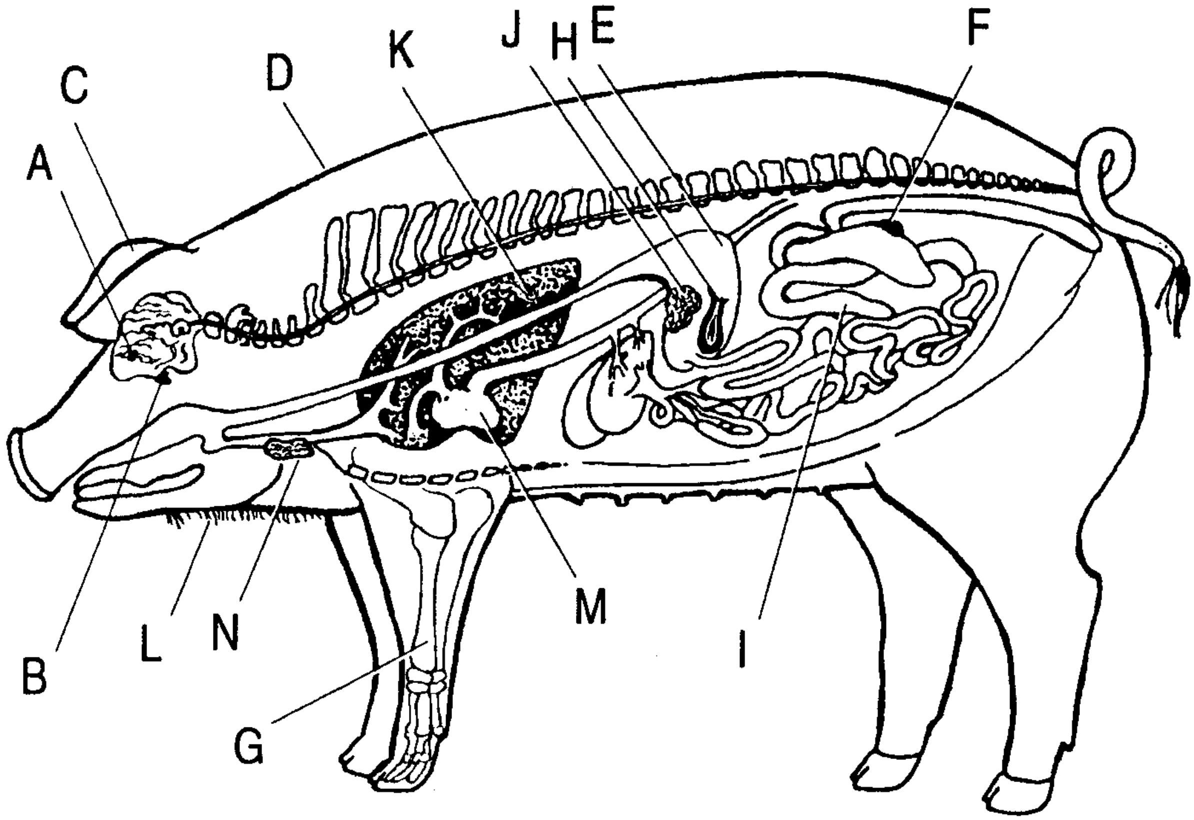
23. Name five major sources of meat.

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.

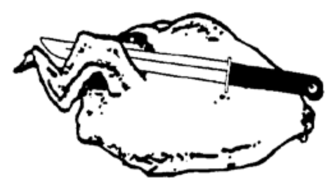
5. Remove giblets and neck from the chicken's body cavity.

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.

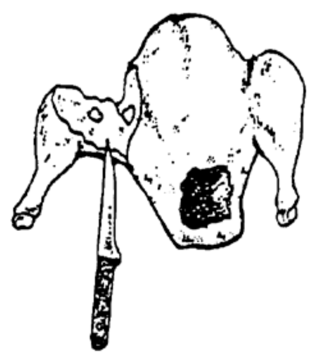
8. Continue pulling the wing away from the body. Cut around the wing joint.

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.

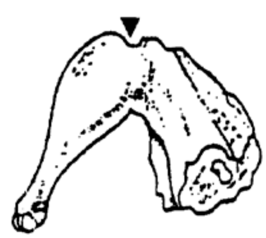
11. Place chicken on side, then pull drumstick away from the body.



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)

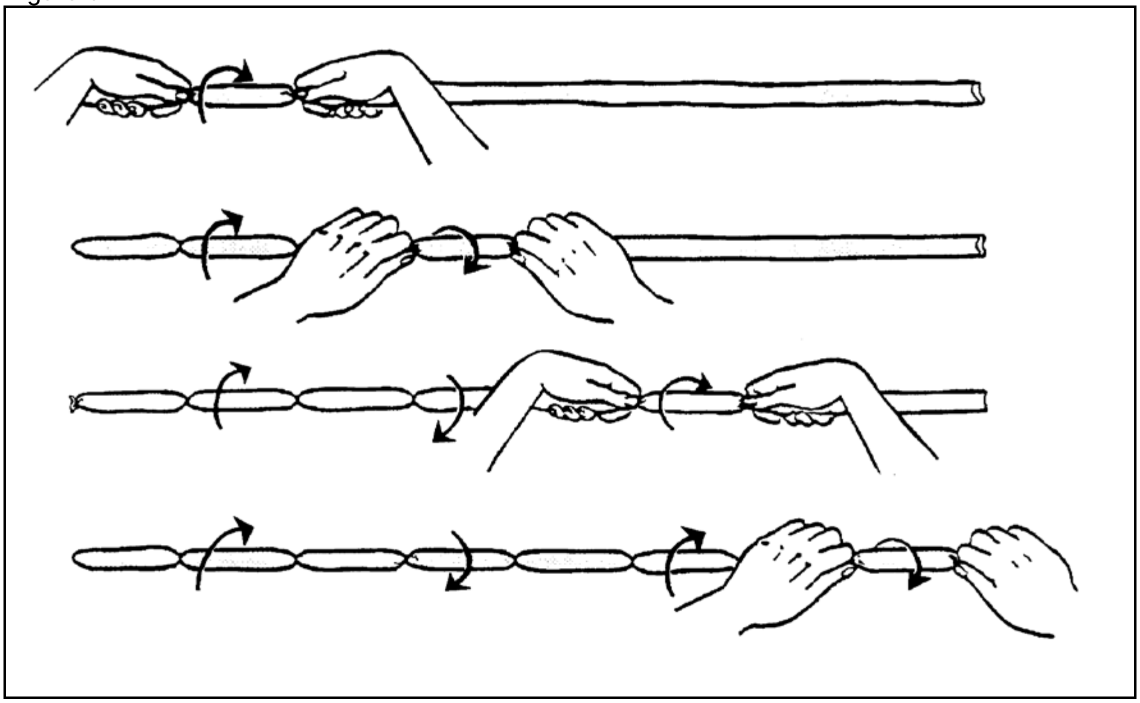
Procedure:

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 <u>may</u> 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		a.	Cereal grain
2.______Wheat		b.	Oil-bearing grain
3. ______Corn		c.	Dry legume
4. ______Rye			
5.______Peanuts			
6.______Sunflowers			
7. ______Dried peas			
8. ______Rice			
9.______Barley			
10.______Soybeans			
11.______Oats			
12.______Canola			

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? <u>Tomato</u>
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. <u>3</u>
<u>1</u>
<u>2</u>

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
2. Blanching
3. Adding sodium bisulfite
4. Canning

a. Prevents enzymatic browning

b. Inactivation of enzymes by heating

c. Blanching, peeling, can filling, air removal, sealing, retorting

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															

*<u>Color Code</u>

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

<u>Questions</u>

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?

UNIT III - THE BIOCHEMISTRY OF FOODS

Lesson 1: Factors That Affect Food Safety and Quality

Objective

The student will be able to identify the factors that affect food safety and quality.

I. Study Questions

   A. What factors contribute to food spoilage?

   B. How do contaminants influence food safety?

   C. What production factors assure food safety and quality?

   D. How do food additives influence food safety and quality?

   E. How is food safety monitored?

   F. How do consumers assess the risk associated with food safety?

II. References

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

   B. Activity Sheets

      1. AS 1.1 Nitrates in Meat
      2. AS 1.2 Food Safety Issues
      3. AS 1.3 Food Safety Concerns Survey

UNIT III - THE BIOCHEMISTRY OF FOODS

Lesson 1: Factors That Affect Food Safety and Quality

TEACHING PROCEDURES

A. Introduction

Define biochemistry in relation to food science. Biochemistry is the scientific study of the chemical properties of living matter, in this case food.

B. Motivation

1. Show the video, The Nature of Change, and discuss BST: The Facts, which are available from:
   Monsanto Publication
   800 N. Lindbergh Blvd
   St. Louis, MO 63167
   (314) 694 - 1000

2. Brainstorm with students to get their ideas on where biotechnology in food science might be going. One example is the fast-paced development of seedless watermelons.

   Dennis J. Gray and Gary W. Elmstrom, of the University of Florida, have developed a tissue culture process that clones thousands of seedless watermelon plants in just months instead of years. Seedless watermelons could gain a large market share if their reproductive efficiency can be heightened.

   Seedless watermelons do produce a small number of seeds, but only enough to postpone the complete development of a new cultivar for 10-15 years. A parent line with two copies of each chromosome in each cell is crossed with another parent line consisting of four copies of each chromosome/cell. The offspring is seedless because only three copies of each chromosome are present in each cell.

C. Assignment

D. Supervised study

E. Discussion

1. Discuss with students the factors that contribute to food spoilage.

   What factors contribute to food spoilage?

   a. Microorganisms
   b. Natural enzymes
   c. Insects, parasites, and rodents
   d. Temperature
   e. Moisture/dryness
   f. Air - oxygen
   g. Light
   h. Time

2. Discuss how contaminants influence food safety.

   How do contaminants influence food safety?

   a. Microorganisms ferment sugars; hydrolyze starches and fats; digest proteins; form acids, pigments and discolorations. These lead to rancid flavors, putrid odors, gas and foam production, and poisonous toxin production.
   b. Enzymes catalyze reactions that lead to microbial invasion, rancid flavors, and browning.
   c. Insect spoilage leads to microbial invasion; parasites inhabit the consumer; rodents spread diseases, and fecal material.
   d. Natural dehydrating causes skin breakage which allows bacterial invasion. Freezing causes cell swelling, which causes the cell membrane to rupture.
   e. Temperature, moisture, air, light, and time can lead to microbial invasion.

3. Discuss what production factors assure food safety.

   What production factors assure food safety and quality?

   a. Quality Assurance Programs - document production and food processing practices
   b. Proper control of temperature and humidity
   c. Use of pesticides
   d. Use of animal drugs
      1. Follow withdrawal guidelines to avoid residues
      2. Proper injection procedures
      3. Proper handling of animals
   e. Grain producers - grade standards regulate grain quality

4. Discuss how food additives influence food safety. Food additives are to improve a food's appearance, flavor, texture, nutritional value or storage properties. The Food Additives Amendment of 1958 covers both intentional and incidental additives. See the student reference for definitions and examples of the food additives. Have students complete AS 1.1.

   How do food additives influence food safety and quality?

   a. Preservatives
   b. Antioxidants
   c. Stabilizers/thickeners
   d. Sequestrants
   e. Nutrient supplements
   f. Surface active ingredients
   g. Bleaching and maturing agents
   h. Buffers, acids, alkalies
   i. Nitrates/nitrites
   j. Food colors
   k. Non-nutritive and special dietary sweeteners
   l. Flavoring agents
   m. Miscellaneous

5. Discuss how food safety is monitored.

   How is food safety monitored?

   a. USDA's Food Safety and Inspection Service - inspectors
   b. FDA inspects processing plants
   c. Local, county, and state health departments

6. Discuss how consumers assess the risk associated with food safety. Have students complete AS 1.2 and AS 1.3. Discuss their answers to AS 1.3.

   How do consumers assess the risk associated with food safety?

   a. Common sense/rational thinking
   b. Irrational/fearful

F. Other activities

1. Have students survey their parents' concern about food safety. Have them complete AS 1.3.
   See how the parents' concerns compared to the class.

2. Have students prepare a paper from topics provided by the instructor. The paper should include: a summary of the facts; their personal views and the views of a classmate; and a journal article supporting their position.

3. Have students complete an activity from <u>The Chemistry of Food Additives</u> by Flinn Scientific, P.O. Box 29, Batavia, IL 60510, (708) 879-6900.

G. Conclusion

Various factors contribute to food spoilage. Microbes digest food and leave behind unpleasant reminders. Proper quality-assured handling can greatly promote food safety. Food quality is regulated by local, state, and federal authorities.

H. Competency

Identify the factors that affect food safety and quality.

Related Missouri Core Competencies and Key Skills:

9D-5: Describe the relationships between technologies which improve our lives and the environmental problems that can result from them.
10L-5: Identify the pros and cons of an environmental issue, take a position, and support.

I. Answers to Evaluation

1. Four of the following: microorganisms; natural enzymes; insects, parasites, rodents; temperature; moisture/dryness; air - oxygen; light; time

2. a
3. c
4. a, c
5. a
6. b
7. a
8. Two of the following:
   a. Follow withdrawal guidelines - leave no residues
   b. Proper injection procedures - do not damage tissue
   c. Proper handling - avoid bruising
   d. Honesty - consistent quality of entire truck with grain sample

9. d
10. c

11. f
12. a
13. l
14. h
15. c
16. d
17. e
18. k
19. g
20. j
21. b
22. i

J. Answers to Activity Sheets

AS 1.1

1. The sample with nitrite added is the one that looks more like ham since this is the treatment ham gets.

2. Students will choose the sample containing nitrate. The color alone does not justify the addition of nitrite since it also affects the taste (flavor). Without it, the ham would taste like a salty pork roast. Nitrites also act as powerful antioxidants. Nitrates also inhibit the growth of *clostridium botulinum* that causes botulism. This is an excellent opportunity to discuss the risk benefit of food additives.

3. Answer will vary.

   The changes of color illustrate the reactions explained in the chart. Since the meat was not totally processed and the possible microorganisms are still present in the sample, meat should be disposed of and not consumed. One needs to know that nitrite in large concentrations is toxic, therefore, potentially dangerous.

   The meat utilized in the experiment will be in the oxymyoglobin although the surface may be brown (metmyglobin). The addition of nitrate to one portion will form the dark red nitrosomyoglobin after 24 hours in the refrigerator.

   Heating the nitrosomyoglobin will form the more stable nitrosohemochrome (light pink). In the untreated sample, oxymyoglobin (bright red) will be in the interior, and on the surface. A gray brown denatured myoglobin (brown) in the control sample will result after heating. This is the characteristic color of uncured, cooked meat.

AS 1.2 Instructor's discretion.

AS 1.3 Discuss student's responses. According to the United States Food and Drug Administration (FDA) the ranking for most important food safety considerations is as follows:

_1_ Disease--causing microorganisms

_3_ Environmental contaminants (lead poisoning for example)

_6_ Food additives

_4_ Naturally occurring toxins (poisonous plants for example)

_5_ Pesticide residue

_2_ Poor nutrition

UNIT III - THE BIOCHEMISTRY OF FOODS Name ___________________

Lesson 1: Factors That Affect Food Safety and Quality Date ___________________

EVALUATION

Match the spoilage with the agent that caused it.

1.	____	Ferment sugars	a.	Microbes
2.	____	Enzymatic browning	b.	Insects, parasites, rodents
3.	____	Cause rancidity	c.	Enzymes
4.	____	Hydrolyze starch and fats		
5.	____	Spread disease		
6.	____	Cause microbial invasion		

Complete the following short answer questions.

7. Name four factors that contribute to food spoilage.

8. Name two production procedures and how they ensure food safety.

Circle the letter that corresponds to the best answer.

9. Who monitors food safety?

   a. USDA only
   b. FDA only
   c. USDA and county and state inspectors
   d. USDA, FDA, and local, county, and state inspectors

10. Risk assessment should be based on:

    a. Emotions
    b. Only the media
    c. Common sense
    d. Traditions

Match the type of food additive on the right with the best description on the left.

11.____Emulsify oil-in-water and water-in-oil mixtures, ex., lecithin

12.____Extend shelf life and prevent deterioration, ex., sodium benzoate

13.____Low-calorie sweeteners, dietetic and diabetic foods

14.____Modify pH

15.____Chelate trace metals, prevent oxidation and off-coloring, ex., EDTA

16.____Thickeners, ex., pectin

17.____Whiten flour and milk

18.____Contribute to pink color in meat

19.____Added to foods deficient in necessary nutrients

20.____Spices, herbs, extracts

21.____Prevent breakdown of vitamins and lipids, ex., BHA

22.____Caramel, extract of annatto, natural grape red

a. Preservatives

b. Antioxidants

c. Sequestrants

d. Stabilizers

e. Bleaching/maturing agents

f. Surface active ingredients

g. Nutrient supplements

h. Buffers, acids, alkalies

i. Food colors

j. Flavoring agents

k. Nitrates/nitrites

l. Non-nutritive additives

UNIT III - THE BIOCHEMISTRY OF FOODS AS 1.1

Lesson 1: Factors That Affect Food Safety and Quality Name ___________________

Nitrites in Meat

Objective: To observe the differences between fresh red meat with and without sodium nitrate added, and observe the changes after both samples are heated.

Activity Length: Two 50-minutes periods

Background Information: Cured meat is the result of a process whereby the addition of a nitrate salt causes flavor and color changes in fresh meat. The cure also acts as a preservative and inhibits the growth of pathogenic microorganisms. The nitrate salt in this process is always used in conjunction with a least some other additive such as salt, sugar, spices, and/or smoke.

Materials and Equipment:

200 g ground beef
Scale
0.016 g Sodium nitrate
2 Beakers
1 Plastic bag
Wax paper
Refrigerator
Stove or hot plate
Pan for steaming meat
Labels (masking tape will do)
Pen

Procedure:

1. Divide the freshly ground hamburger into two samples of 100 g each.

2. Put one of the samples of hamburger in a plastic bag and add 0.016 g of sodium nitrate. Mix thoroughly by kneading the bag for about 3 minutes. Label beakers A and B.

3. Empty the contents of each bag in a beaker. Pack meat down to get rid of as much air as possible. Cover the beakers with a piece of wax paper. Record which beaker contains nitrate. Also put your name on each beaker.

4. Examine and record both the surface color and the interior color of each sample. Do not taste either sample.

5. Place beakers in a refrigerator overnight.

6. After 24 hours, remove the beakers from the refrigerator and examine the surface and interior of the meat, compare colors.

7. Heat each beaker over a steam bath for 15-20 minutes.

8. Once again, examine the samples as before. Do not taste either sample.

9. Record your results on Table 1.1.

Table 1.1

	Control (no nitrite)		Experimental (with nitrite)	
	Surface	Interior	Surface	Interior
Before Storage				
After Storage				
After Cooking				

Key Questions:

1. Which of the samples, after cooking, most closely resembles sausage?

2. Which of the cooked samples looks the most appetizing?

3. Would you purchase meats processed with nitrates? Explain your answer.

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

UNIT III - THE BIOCHEMISTRY OF FOODS AS 1.2

Lesson 1: Factors That Affect Food Safety and Quality Name __________________

Food Safety and Issues

Objective: Examine an issue regarding food safety.

Directions: Select a food safety issue. Research the topic and prepare a report to answer the following questions:

1. Why is this issue important?
2. What effect does this issue have on people?
3. What is the history behind the issue?
4. What are the risks caused by the issue?
5. Is there a definite right and wrong side to the issue?
6. What are possible solutions?
7. What is my opinion of the issue?

Topic Ideas:

• Are hormones given to beef cattle present in the meat eaten by humans?

• Do pesticides affect the quality of food in the U.S.?

• Is organically grown food <u>more</u> nutritious than foods grown with pesticides and fertilizers?

• Does food coloring affect food quality?

UNIT III - THE BIOCHEMISTRY OF FOODS AS 1.3

Lesson 1: Factors That Affect Food Safety and Quality

Food Safety Concerns Survey

Please rank your greatest food safety concern #1 and your least concern #6, and rank all of the numbers in between in a similar manner. Do not put your name on this paper. The purpose of this exercise is to see how your answers compare with others.

The following food safety concerns are listed in alphabetical order.

___Disease--causing microorganisms

___Environmental contaminants (lead poisoning for example)

___Food additives

___Naturally occurring toxins (poisonous plants for example)

___Pesticide residue

___Poor nutrition

UNIT III - THE BIOCHEMISTRY OF FOODS

Lesson 2: Problems with Food Deterioration

Objective

The student will be able to describe problems resulting from food deterioration.

I. Study Questions

   A. What physical changes result from food deterioration?

   B. What chemical changes result from food deterioration?

   C. What environmental conditions favor bacterial growth in foods?

   D. What organisms contribute to food deterioration?

   E What are some of the organisms found in food that can cause human diseases?

II. Reference

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

UNIT III - THE BIOCHEMISTRY OF FOODS

Lesson 2: Problems with Food Deterioration

TEACHING PROCEDURES

A. Review

Review the factors that contribute to food deterioration. They are: microorganisms, natural enzymes, insects, parasites, rodents, temperature, moisture, air, light, and time.

B. Motivation

Imagine you are in the military overseas and it is your birthday. You have anticipated receiving food packages from family back home. You can taste the chocolate chip cookies, caramel popcorn, homemade apple cider and dinner rolls.

Unfortunately, your platoon is involved in field exercises and it will be two weeks before you get back to base. You can only hope the birthday box will still be there when you get back. You are looking forward to the goodies more than ever. Hopefully, the box will be refrigerated until you get back.

The last day of field exercise has passed as you tiredly return to the base. Your hunger pains can only be satisfied with the contents of your birthday box.

To your surprise, the box is resting on your bunk. Unopened, but also unrefrigerated. You can only hope the food has not molded nor grown stale. You quickly cut the strings and dig into the box where you find four packages, individually wrapped in tin foil. In just a few seconds you will satisfy your taste buds. In fact, your mouth is watering.

The first package is chocolate chip cookies, but they are all green with mold. You decide the next package will surely be all right, but the rolls have circular molds on them, and are as hard as hockey pucks. Your disappointment grows deeper as you taste the apple cider's bitter flavor and the caramel corn's staleness. What caused all of this?

C. Assignment

D. Supervised study

E. Discussion

1. Discuss the physical changes from food deterioration.

   What physical changes result from food deterioration?

   a. Dehydration - excessive heat, cold, or exposure to air
   b. Cracked skin - fruit frozen then thawed
   c. Broken emulsion - liquid foods frozen then thawed
   d. Texture degradation - frozen milk will curdle
   e. Off-color (surface)
      1. Fruits and vegetables stored at too low a temperature
      2. Light causes surface discoloration of meat pigments
      3. Insufficient oxygen to cut meat surfaces reduces oxymyoglobin to metmyoglobin (brownish-red color)
      4. Mold growth causes a variety of color development
   f. Internal browning - apples stored at too low a temperature
   g. Lumping/caking/crystallization - excessive moisture
   h. Surface pitting - fruit stored at too low a temperature

2. Discuss the chemical changes that result from food deterioration.

   What chemical changes result from food deterioration?

   a. Sugars ferment
   b. Starches hydrolyze
   c. Fats hydrolyze (lipolysis) - causes rancidity
   d. Proteins are denatured or digested - ammonia-like odors
   e. Toxin production
   f. Enzymatic reactions
   g. Pigment conversion

3. Discuss what environmental conditions favor bacterial growth.

   What environmental conditions favor bacterial growth in foods?

   a. Warm temperature; although some bacteria grow at very high or at very low temperatures
      1. Psychrophilic - grow in temperatures as low as 32°F
      2. Mesophilic - 60°-100°F, most bacteria are this type
      3. Thermophilic - grow in temperatures as high as 180°F
   b. Moist conditions

4. Discuss what organisms contribute to food deterioration.

   What organisms contribute to food deterioration?

a. Bacteria
b. Fungi - yeasts and molds

5. Discuss what human diseases may be caused by unsafe food.

What are some of the organisms found in food that can cause human diseases?

a. Campylobacteri
b. Clostridium botulism
c. Escherichia coli (E. coli)
d. Hepatitis A Virus
e. Listeria
f. Salmonella
g. Staphylococcus
h. Toxoplasma
i. Trichinella
j. Vibrio parahaemolyticus
k. Yersinia

F. Other activities

1. Make kimchee to study lactic acid fermentation. A detailed procedure can be obtained from Bottle Biology Program, University of Wisconsin-Madison, (608) 263-5645.

2. Invite a health department official to present a program on food-borne diseases.

G. Conclusion

Food deterioration is a continual problem for the food industry. Physical and chemical deterioration result from microbial and environmental influences. Unsafe food can thus cause a multitude of human diseases.

H. Competency

Describe problems resulting from food deterioration.

Related Missouri Core Competencies and Key Skills: None

I. Answers to Evaluation

1. a
2. b

3. a
4. a
5. b
6. a
7. a
8. b
9. b
10. b
11. Warm temperatures, moisture
12. b
13. a
14. a
15. b
16. b
17. a
18. b
19. d
20. a
21. c
22. e

UNIT III - THE BIOCHEMISTRY OF FOODS Name ____________________

Lesson 2: Problems with Food Deterioration Date____________________

EVALUATION

Is the type of deterioration on the left a physical change or chemical change? Write the correct letter in the blank.

1.____Dehydration	a. Physical change
2.____Starches hydrolyze	b. Chemical change
3.____Off-color	
4.____Internal browning	
5.____Acid production	
6.____Surface pitting	
7.____Lumping, caking	
8.____Pigment conversion	
9.____Lipolysis	
10.____Toxin production	

11. List the 2 environmental conditions needed for most microbes to grow.

Match the microbial characteristic on the left with the appropriate type of microbe on the right.

12.____Used to ripen certain types of cheese	a. Bacteria
13.____Unicellular	b. Fungi (molds, yeasts)

14.____Procaryote

15.____Grow by mycelia

16.____Require oxygen

17.____Classified based on shape

Match the disease on the right with the description on the left.

18.____Transmitted by improperly processed or unrefrigerated low acid foods	a.	Salmonellosis
	b.	Botulism
19.____Leading cause of gastroenteritis in humans	c.	Trichinosis
20.____Caused by salmonella bacteria	d.	Camphyolbacteriosis
21.____Raw pork from hogs fed uncooked garbage	e.	Toxoplasmosis
22.____Meat animals can be infected by cats, which are a common host of this disease		

UNIT III - THE BIOCHEMISTRY OF FOODS

Lesson 3: Nutritional Properties of Foods

Objective

The student will be able to describe the nutritional properties of foods.

I. Study Questions

   A. What are the major food groups?

   B. What are the six classes of nutrients?

   C. What are the nutritional characteristics of each food group?

   D. What are the functions for each nutrient class?

   E. What are the sources for each nutrient class?

II. References

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

   B. Activity Sheet

      AS 3.1: Identify Basic Food Nutrients

UNIT III - THE BIOCHEMISTRY OF FOODS

Lesson 3: Nutritional Properties of Foods

TEACHING PROCEDURES

A. Review

The previous lesson discussed the physical and chemical changes from food deterioration and food-borne diseases and their causes. This lesson takes a look at the nutritional properties of food, including diseases caused by a nutrient deficiency.

B. Motivation

Bring a baked potato and french fries to class. Poll the class on their preferences, then compare french fries to a baked potato. Analyze nutritional data using the table below.

Nutrition of French Fries versus Baked Potato								
				% Daily Values				
	Grams	#Calories Food Energy	Calories from fat	Protein	Vit. A	Vit. C	Calcium	Iron
French Fries	70	220	100	3	0	10	2	2
Baked Potato	70	80	1	2	0	15	0	6

C. Assignment

D. Supervised study

E. Discussion

1. Discuss the major food groups. Use the new Food Pyramid. Discuss where fats and sweets fit into the Food Pyramid.

   What are the major food groups?

   a. Meats
   b. Breads & cereals
   c. Fruits
   d. Vegetables

e. Dairy products

2. Discuss the six classes of nutrients.

What are the six classes of nutrients?

a. Carbohydrates
b. Proteins
c. Fats
d. Vitamins
e. Minerals
f. Water

3. Discuss the nutritional characteristics of each food group.

What are the nutritional characteristics of each food group?

a. Meats - protein primarily, also carbohydrates, fats, vitamins, and minerals
b. Breads and cereals - carbohydrates primarily, also protein, fat, vitamins, and minerals
c. Fruits - vitamins and minerals, also protein and carbohydrates
d. Vegetables - minerals and vitamins primarily, also protein, and carbohydrates
e. Dairy foods - excellent source for all five nutrient categories

4. Discuss the functions of each nutrient class.

What are the functions for each nutrient class?

a. Carbohydrates - 4 Calories per gram of energy; 98 percent are digested and completely oxidized
   1. Needed for body heat
   2. Synthesis of tissue
   3. Energy to work and play
   4. Increase fat utilization efficiency
   5. Spare proteins from being converted to a major energy source
   6. Provide fiber
   7. Promote vitamin B synthesis
b. Proteins - 4 Calories per gram of energy; 70 percent are digested and completely oxidized
   1. Primary role is to supply nitrogen-based molecules necessary for tissue synthesis and provide essential amino acids

2. Source of essential amino acids: leucine, isoleucine, lysine, methionine, phenylerlanine, threonine, tryptophan, valine plus histidine for childhood growth
3. Secondary role is to supply energy

c. Fats - 9 Calories per gram of energy; 95 percent are digested and completely oxidized
    1. Supply necessary polyunsaturated fatty acids
    2. Aid in absorption of fat-soluble vitamins A, D, E, and K
    3. Source of phospholipids
    4. Insulate and protect body
    5. Reserve source of energy

d. Vitamins - needed for enzyme systems which are required for protein, fat, and carbohydrate metabolism, needed in relatively small amounts except vitamin D.
    1. Vitamin A - needed to prevent: night blindness, abnormal bone and tooth development, diseases of skin, fat-soluble
    2. Vitamin D - increase Ca & P absorption, reduces bone defects, fat-soluble
    3. Vitamin E - favors Fe absorption; antioxidant, fat-soluble
    4. Vitamin K - essential for normal blood clotting, fat-soluble
    5. Vitamin C - prevents scurvy, bone joint disease, teeth loosening, and fragile capillary walls; needed for normal protein collagen formation, water-soluble
    6. Vitamin B complex - water-soluble
        a. B_1 (thiamine) - needed to oxidize glucose
        b. B_2 (riboflavin) - needed for cellular growth and tissue maintenance
        c. Niacin - needed for tissue respiration and glucose oxidation
        d. B_6 - needed for enzyme systems
        e. Pantothenic acid - needed for mental health
        f. B_{12} - needed for nucleic acid formation; helps prevent anemia
        g. Folacin - helps prevent anemia; used for nucleic acid production
        h. Biotin - helps metabolize fatty acids & amino acids

e. Minerals - needed in relatively small amounts.
    1. Ca - needed for blood clotting, bone & tooth development, enzyme function; control of fluid through membranes
    2. P - needed for metabolism, controls acid-alkaline reactions in blood, phospho-lipid production
    3. Mg - needed for enzyme systems, electrical potential in nerves; muscle contraction, Ca & P metabolism
    4. Fe - needed for blood hemoglobin & muscle myoglobin
    5. Cu - helps utilize Fe & synthesis of hemoglobin

6. Co - part of vitamin B_{12}
7. Zn - needed for enzyme production
8. Na - needed for osmotic equilibrium and body fluid volume
9. Cl - exists in chloride form; helps produce hydrochloric acid
10. K - helps regulate osmotic pressure, equilibrium, and pH; enzyme production
11. I - needed for thyroid hormone
12 F - needed for sound teeth
13. Mn - bone structure, central nervous system function, reproduction
14. Cr - glucose metabolism
15. Mo - protein metabolism

f. Water - 60 percent of body weight
1. Solvent for chemical reactions in body
2. Transport media to cells
3. Removes body waste
4. Regulates body temperature and metabolism rate

5. Discuss the sources for each nutrient. Point out that each nutrient comes from other sources as well. Divide class into small groups to complete AS 3.1. The instructor should demonstrate the tests before students complete the activities.

What are the sources for each nutrient class?

a. Carbohydrates - potatoes, rice, flour, dairy products
b. Proteins - meat, poultry, fish, eggs, dairy products, legumes
c. Fats - meat, poultry, grain oils, nuts, dairy products
d. Vitamins - fruits, vegetables, dairy products
e. Minerals - meat, fruits, vegetables, dairy products
f. Water - beverages, high water-content foods

F. Other activities

1. Assign each student to plan a complete meal. This meal must contain 2 servings of breads/cereals, 1 serving of fruits, 1 serving of vegetables, 1 serving of meat, 1 serving of dairy products, and 1 serving of a beverage. They are to research what nutrition is provided per serving and then complete the following chart.

% Daily Value Nutrition/ Serving	Breads/ Cereals	Meats	Fruits	Vegetables	Dairy Products	Beverage
Protein						
Vitamin A						
Vitamin C						
Calcium						
Dietary Fiber						
Fat						
Iron						
Sodium						
# Servings	2	1	1	1	1	1
Total % Achieved						

2. Assign oral reports on: Iron in diet, zinc in diet, types of iron, types of cholesterol, fiber value in diet, calcium in diet, vegetarian diet, nutrient density.

   For information on Activity 2, write: National Live Stock and Meat Board, 444 North Michigan Ave., Chicago, IL 60611. Ask for: <u>Percent U.S. R.D.A. Chart Exploring Meat and Heath, Zinc, Iron</u>

3. Students are to select a balanced meal from items on the menu at a local McDonald's. Students can only spend $5.00. Students will need to get nutrient information from local McDonald's restaurants.

G. Conclusion

Foods are divided into meats, breads/cereals, fruits, vegetables, and dairy products. These food groups supply carbohydrates, proteins, fats, vitamins, and minerals. Water is also a necessary nutrient. A healthy diet consists of items from all food groups.

H. Competency

Describe the nutritional properties of foods

Related Missouri Core Competencies and Key Skills: None

I. Answers to Evaluation

1. a
2. b
3. d
4. e
5. a
6. b
7. e
8. c
9. f
10. f
11. e
12. c
13. b
14. b
15. c
16. c
17. b
18. d
19. a
20. Teacher's discretion

J. Answers to Activity Sheets

AS 3.1

1. Answers will depend on types of food tested. Answers for foods listed in materials list follow:

    a. raw potato, rice kernels, croutons, milk
    b. sucrose, honey, jam
    c. cheese, milk, chicken, beef or pork, bacon, hamburger, dry beans, egg white
    d. cheese, whole milk, egg white, bacon, hamburger, mayonnaise, butter, margarine
    e. potato, rice, cheese, croutons, milk, meat, beans
    f. orange

2. Answers will vary.

3. By determining the nutrients (components) in various foods, we can become more aware of how well we are feeding our bodies.

UNIT III - THE BIOCHEMISTRY OF FOODS Name ________________________

Lesson 3: Nutritional Properties of Foods Date ________________________

EVALUATION

Match the nutrient class on the right with its role on the left.

____1. Supply the majority of your energy	a.	Carbohydrates
____2. Protein synthesis	b.	Proteins
____3. Regulates body temperature	c.	Vitamins
____4. Provide fatty acids	d.	Water
____5. Major source of fiber	e.	Fats
____6. Source of nitrogen	f.	Minerals
____7. Insulate body		
____8. Prevent scurvy; night blindness		
____9. Major source for blood hemoglobin, bone development, osmotic equilibria		

Match the nutrient class on the right with the examples on the left.

____10. Ca, P, K, Mg, Zn, Fe	a.	Carbohydrates
____11. Riboflavin	b.	Proteins
____12. A, B complex, C, D, E, K	c.	Vitamins
____13. Lysine	d.	Water
____14. Threonine	e.	Fats
____15. Thiamine, niacin, folacin	f.	Minerals

Circle the letter that corresponds to the best answer.

16. Which nutrient is the most energy rich compound?

    a. Proteins
    b. Vitamins
    c. Fats
    d. Minerals

17. Which nutrient class is divided into fat-soluble and water-soluble?

    a. Proteins
    b. Vitamins
    c. Fats
    d. Minerals

18. Which nutrient class makes 60 percent of the human body's weight?

    a. Carbohydrates
    b. Proteins
    c. Minerals
    d. Water

19. Which nutrient class is 98 percent digested and utilized in the body?

    a. Carbohydrates
    b. Proteins
    c. Minerals
    d. Water

20. List two reliable sources for each of the six nutrient classes.

UNIT III - THE BIOCHEMISTRY OF FOODS AS 3.1

Lesson 3: Nutritional Properties of Foods Name________________________

Identifying Basic Food Nutrients

Objective: To determine the presence of complex carbohydrates, simple carbohydrates, protein, fat, minerals, and vitamin C in common foods.

Activity Length: 2 days

Materials and Equipment (for each group):

Lab apron (1 per student)
Safety glasses (1 per student)
15 foods divided into 6 small amounts (suggestions below)
- ½ small raw potato
- 60-90 rice kernels
- 1-inch cube cheese
- 6 croutons
- 1 tablespoon sucrose (table sugar)
- 1 tablespoon honey
- 1 tablespoon whole or skim milk
- 1 tablespoon jam or jelly
- 1 tablespoon cooked chicken (no skin), beef or pork
- 1 cooked egg yoke or white (note which)
- 1 small leaf of lettuce
- 1 tablespoon raw bacon or hamburger
- 1 tablespoon mayonnaise
- ¼ orange or 2 tablespoons orange juice
- 1 tablespoon butter or margarine
- Pulverized dry beans or any pulverized food
- 1 tablespoon water

Lugol's iodine with dropper
Biuret solution
Benedict's solution
Source of gas flame
Eyedropper
Paring knife
Cutting board
Heavy duty aluminum foil
Brown paper

Paper cups
2 small paper plates
Tongs or tweezers
Graduated cylinder
100-ml beakers
Stirring rod
Pipette
Test tubes
Test tube holder
Distilled water
Cornstarch
Aluminum foil pie tin or shaped foil container

Procedure:

1. Since you will be working in small groups for this activity, read the instructions for each experiment and determine who will assume responsibility for each part.

2. Assemble foods (only small amounts are needed) to be tested on small paper plates and label as needed.

3. Carefully follow instructions for each test.

4. Record observations for each experiment.

5. Analyze data, determine conclusion, and complete laboratory report.

CAUTION: Do not eat any of the foods being tested.

TEST #1 for COMPLEX CARBOHYDRATE (starch)

1. Supplies:

   Aluminum foil
   Eyedropper
   Lugol's iodine
   Foods to test

2. Procedure:

   a. Cut the aluminum foil into squares 4 cm on each side (one square for each food type). Place the 4-cm squares of aluminum foil on the table, and place a small amount of each food sample on a square.

b. In the data table indicate the test results you expect for each food in this test.

c. With an eyedropper, add one drop of iodine test solution onto each sample. A blue-black color indicates the presence of a complex carbohydrate.

CAUTION: Handle iodine very carefully, it stains if dropped on skin, clothes, or surfaces.

d. Record results for the test as positive (turns blue-black) or negative in the data table.

TEST #2 for SIMPLE CARBOHYDRATE (sugar)

1. Supplies:

   Safety glasses
   A rack test tube holder
   1 test tube for each food to be tested
   1 oz. Benedict's Solution for each test tube
   Foods to test

2. Procedure:

   a. PUT ON YOUR SAFETY GLASSES.

   b. Place a small amount of a food in separate test tubes and label each with the name of the food.

   c. In the data table, indicate the test results you expect for each of the foods in this test.

   d. Add 1 oz. Benedict's Solution to each test tube and heat in a water bath. If solution changes from blue to red-orange, a simple carbohydrate is present.

   e. Record results as positive (turns red-orange) or negative in the data table.

TEST #3 for PROTEIN

1. Supplies:
   Safety Glasses

Tongs or tweezers
15 100-ml beakers
Distilled water
Stirring rod
Pipette
Test tubes
Biuret solution
Foods to test

2. Procedure:

   a. PUT ON YOUR SAFETY GLASSES.

   b. Using tongs, put a piece of each food into separate 100-ml beakers and label. (Some foods might need to be ground or chopped before being added to the beaker.)

   c. Add enough distilled water to each beaker to just cover the pieces of food. Mix with a clean stirring rod until food is thoroughly moistened.

   d. Allow the solutions to stand for at least three (3) minutes.

   e. In the data table, indicate the test results you expect for each food for this test.

   f. Pipette 1 ml of each food solution into a test tube. Add five (5) drops of Biuret solution to each tube. The appearance of a pink or violet color will indicate the presence of protein (amino acids).

   CAUTION: Do not handle the bottle containing Biuret solution. Only touch the rubber bulb of the eyedropper. Biuret can burn your skin and eyes.

   g. Record results of the test for protein as positive (turns pink or violet) or negative in the data table.

TEST #4 for FAT

1. Supplies:

4-cm squares of brown paper
Foods to test

2. Procedure:

   a. Cut the brown paper into squares 4 cm on each side (1 square for each food.) Lay the pieces of paper on the table.

   b. In the data table, indicate the test you expect for each food for this test.

   c. Place and rub a small amount of each food on a square and label.

   d. Remove food from square and discard.

   e. After 10 minutes, examine each square by holding it up to a light source. A grease spot will indicate the presence of fat.

   f. Record results for the test for fat as positive (grease spot appears) or negative in the data table.

TEST #5 for MINERALS

1. Supplies:

   Aluminum foil pie tin or shaped foil container
   Tweezers
   Foods to test

2. Procedure:

   a. Place a small amount of one food on the tin or shaped container.

   b. In the data table, indicate the test result you expect from the test.

   c. Heat the food on the tin over a gas flame until burned. If gray powdery ash remains, minerals are present. (Minerals do not burn.)

   CAUTION: Tin will become hot, handle carefully.

   d. Repeat steps a-c for the other foods.

   e. Record results for the test as positive (gray powdery ash remains) or negative in the data table.

TEST #6 for VITAMIN C

1. Supplies:

   2 cups water and
   2 tablespoons cornstarch boiled together for 3 minutes and cooled (this may be done in advance by teacher)
   Paper cups
   Iodine with dropper
   Foods to test

2. Procedure:

   a. Chop or grate a small amount of one of the foods into a clean paper cup.

   b. In the data table, indicate the test result you expect from this test.

   c. Place 1 teaspoon of cornstarch mixture into the same cut. Add 1 drop iodine at a time, swirling to mix between each addition. If the solution turns clear, vitamin C is present. The more drops of iodine needed to clear the solution, the less vitamin C there is in the food.

   d. Record results for the test as positive (solution turns clear) or negative in data table.

   e. Repeat steps a, b, c, and d for other foods to be tested.

Food	Test for Complex Carbohydrate (+/-)		Test for Simple Carbohydrate (+/-)		Test for Protein (+/-)		Test for Fat (+/-)		Test for Minerals (+/-)		Test for Vit. C (+/-)	
	Pred	Result	Pred	Result	Pred	Result	Pred	Result	Pred	Result	Pred	Result

Key Questions:

1. Based on your tests and observations, which foods are sources of the following nutrients:

   a. Complex carbohydrates

   b. Simple carbohydrates

   c. Protein

d. Fat

e. Minerals

f. Vitamin C

2. How accurate were your predictions compared to your tests?

3. How can you apply the things you learned in this lab to your own eating habits?

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

UNIT III - THE BIOCHEMISTRY OF FOODS

Lesson 4: Processing Influences Nutritional Value

Objective

The student will be able to describe how processing techniques influence the nutritional value of food.

I. Study Questions

   A. How does temperature affect nutrient availability in foods?

   B. How does light affect nutrient availability in foods?

   C. How does water content affect nutrient availability in foods?

   D. How does oxidation affect nutrient availability in foods?

   E. What process can be used to maintain or enhance the nutritional value of foods?

II. References

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

   B. Activity Sheet

   AS 4.1: How Processing Affects Vitamin C

UNIT III - THE BIOCHEMISTRY OF FOODS

Lesson 4: Processing Influences Nutritional Value

TEACHING PROCEDURES

A. Review

Review the six classes of nutrients and their functions in the human body.

B. Motivation

Compare nutritional values of fresh (posted at the grocery store), frozen (on the container), and canned (on the container) fruits and vegetables. Check the list of ingredients to see if Vitamin C (Ascorbic Acid) was added.

C. Assignment

D. Supervised study

E. Discussion

1. Discuss how temperature affects nutrient availability in foods.

   How does temperature affect nutrient availability in foods?

   a. Room or elevated temperatures allow enzymes to degrade tissue and break down vitamins.
   b. Blanching stops enzyme activity.
   c. Proteins toughen when exposed to high cooking temperatures.
   d. High cooking temperatures and long cooking times destroy vitamins.

2. Discuss how light affects nutrient availability.

   How does light affect nutrient availability in foods?

   a. Fluorescent and ultraviolet light can destroy riboflavin.
   b. Vitamins, in general, break down in the presence of light.

3. Discuss how water content affects nutrient availability in foods.

   How does water content affect nutrient availability in foods?

   Water-soluble vitamins are a part of a food's juice and are easily lost.

4. Discuss how oxidation affects nutrient availability. Oxidation is the breakdown of nutrients in the presence of oxygen. BHA and BHT are antioxidants.

   How does oxidation affect nutrient availability in foods?

   a. Overcooked or burned foods have been partially oxidized to carbon and oxygen gas and are not useful to the body.
   b. Protein molecules release their nitrogen as nitrous oxide.

5. Discuss what processes are used to enhance the nutritional value of foods.

   What processes can be used to maintain or enhance the nutritional value of foods?

   a. Enrichment - nutrient levels are increased
   b. Fortification - add nutrients that may not have originally been found in foodstuff
   c. Supplements - nutrients added to a level in excess of 50 percent RDA
   d. Cooking method and length
   e. Quick cooling post harvest
   f. Waxing/packaging

F. Other activities

Have students bring food labels from home that indicate enriched or fortified foods. Compare the labels.

G. Conclusion

Processing does influence the nutritional value of foods. Critical aspects are: temperature, light, water content, and exposure to the air or oxidation. There are several processes that are used to maintain or even enhance a foods nutritional value.

H. Competency

Describe how processing techniques influence the nutritional value of food.

Related Missouri Core Competencies and Key Skills: None

I. Answers to Evaluation

1. d
2. d

3. a
4. b
5. b
6. c
7. a

J. Answers to Activity Sheet

AS 4.1

1. Vitamin C is lost when foods are heated.
2. There is a time dependant relationship between heating and Vitamin C destruction.
3. Answers will vary but should indicate that most of the Vitamin C will

UNIT III - THE BIOCHEMISTRY OF FOODS Name ______________________

Lesson 4:Processing Influences Nutritional Value Date ______________________

EVALUATION

Circle the letter that corresponds to the best answer.

1. Which of the following can cause nutrient loss in foods?

   a. Light
   b. Heat
   c. Boiling in a water bath
   d. All of the above

2. Light, especially fluorescent and ultraviolet, promotes the breakdown of:

   a. Vitamin C
   b. Water
   c. Carbohydrates
   d. Riboflavin

3. Cooking food in a water bath would increase the loss of:

   a. Water-soluble vitamins
   b. Fat-soluble vitamins
   c. Minerals
   d. Proteins

4. Oxidation is defined as:

   a. The binding of protein molecules in the presence of O2
   b. The chemical reaction in the presence of O2
   c. The addition of a carbon atom
   d. Inhaling oxygen

Match the word on the right with the definition of the left.

____5. Nutrients added to a level that exceeds 50 percent of the RDA

____6 .Nutrient levels returned to levels present before processing

____7. Nutrients are added to a food that may or may not have been there originally

a. Enrich

b. Fortify

c. Supplement

UNIT III - THE BIOCHEMISTRY OF FOODS AS 4.1

Lesson 4:Processing Influences Nutritional Value Name________________________

How Processing Affects Vitamin C

Objective: The student will be able to identify how processing affects Vitamin C retention in vegetables.

Activity Length: One class period

Materials and Equipment:

Blender
Knife
Scale
Cheesecloth or filter paper (a coffee filter will work, but may be a little slow)
Hot plate or stove
Microwave
1 - 200-ml beaker or other heat-resistant container (1 cup Pyrex measuring cup will work in the microwave)
6 - 150-ml beakers (clear disposable plastic drink cups work well)
60 grams of 2 different kinds of fresh vegetables (green beans, broccoli, potato, tomato, etc.)
Water
6 test tubes
Eyedropper
Indolphenol blue dye
Test tube rack
Labels (masking tape will work)
Hotpads

Procedure:

1. Cut the vegetables into uniform pieces, no larger than 3 cm in any dimension.
2. Weigh out 3 portions of each vegetable (total of 6 portions). A portion should weigh about 20 grams.
3. Label the 150-ml beakers with A, B, C (control first vegetable), D, E, and F (control second vegetable).
4. Place 20 grams of one vegetable in beakers A, B, and C.
5. Place 20 grams of the other vegetable in beakers D, E, and F.
6. Add 100 ml water to each beaker.

7. Pour the contents of beaker A into the 200-ml beaker. Heat in the microwave until the water boils. Pour the contents back into beaker A.
   CAUTION: Use hotpads when handling the hot beakers.
8. Wash the 200-ml beaker. Then repeat step 7 with beaker D.
9. Heat beaker B on stove or hot plate for about 30 minutes.
10. Heat beaker E on stove or hot plate for about 30 minutes.
11. Allow beakers to cool.
12. Transfer the contents of beaker A to the blender. Process at high speed until the sample is well blended.
13. Pour the contents of the blender through cheesecloth or filter paper to filter out the liquid. (If you have access to a centrifuge, centrifuge sample for 10-15 minutes.) The sample does not have to be clear. (With some vegetables this step can be eliminated, as long as the sample is liquid enough to pour easily into a test tube.)
14. Measure 60 ml of the filtrate back into beaker A.
15. Rinse the blender thoroughly after filtering the liquid.
16. Repeat Steps 12 -15 for the contents of beakers B, C, D, E, and F.
17. Using the eyedropper, measure 10 drops of indophenol blue dye into 6 <u>test tubes</u>. Label test tubes A, B, C, D, E, and F. Clean eyedropper.
18. Using the eyedropper, carefully add contents of <u>beaker</u> A into <u>test tube</u> A one drop at a time, counting the number of drops needed to make the blue color disappear. Stop adding drops when the color disappears. Record the number of drops added to the test tube.
19. Clean eyedropper before moving to next beaker.
20. Repeat steps 18 and 19, using beaker B with test tube B, so on, with beakers C, D, E, and F.
21. Vitamin C bleaches the blue color out of indophenol blue. This lab will make qualitative distinctions between the different processing techniques based on the amount of vitamin C they possess. The fewer the number of drops needed to make the blue color disappear, the greater the percentage of vitamin C in that sample. If the blue color does not disappear, the beverage is said to contain no vitamin C.

Key Questions:

1. What is the effect of heating on the vitamin C content of vegetables?

2. Why is there a difference between the microwaved vegetables and the vegetables cooked for 30 minutes on the stove.

3. What would you predict would happen if the vegetables were roasted at 350 F for 3 hours (like being cooked in a pot roast)?

Variations:
All kinds of processing treatments could be evaluated using this procedure. For example:

What is the effect of peeling on vitamin C levels?
What about adding salt or vinegar to the liquid?
Freeze the vegetables
Store vegetables for a week at different temperatures

This procedure would also work using fruits, but the amount of material titrated in step seven may have to be adjusted (vitamin C levels in fresh fruit is much higher than in processed juices.)

UNIT III - THE BIOCHEMISTRY OF FOODS

Lesson 5: Biotechnology in the Food Industry

Objective

The student will be able to describe the role of biotechnology in the food industry.

I. Study Questions

   A. What is biotechnology?

   B. How has biotechnology affected food production?

   C. What are examples of bioengineered foods?

   D. What business enterprises are involved in biotechnology research?

   E. How will biotechnology influence the food industry in the future?

   F. What factors influence new developments in food biotechnology?

II. References

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

   B. Activity Sheet

   AS 5.1: A Bioengineered Food Product

UNIT III - THE BIOCHEMISTRY OF FOODS

Lesson 5: Biotechnology in the Food Industry

TEACHING PROCEDURES

A. Review

In Unit 2, Lesson 2, you studied new food product development. It was stated that new products are developed to enhance the food's convenience and nutritional value. Unit 3, Lesson 1, examined the use of food additives in regard to food safety. Biotechnology in food science encompasses all of these ideas, from bioengineered new food products to bio-designed additives. This lesson looks at biotechnology, specifically in the food industry.

B. Motivation

A package of cheese is a good example of biotechnology in food. The rennet was developed using biotechnology. Begin class with the students writing the many ways technology has worked to produce other products. A visual example would be helpful. Examples - chicken sticks, Miracle Whip®, Cool-Whip®.

C. Assignment

D. Supervised study

E. Discussion

1. Discuss what biotechnology is.

   What is biotechnology?

   a. The use of living organisms to make commercial products
   b. The use of microorganisms, animal cells, plant cells, or components of cells such as enzymes to produce products or carry out processes for human benefit

2. Discuss how biotechnology has affected food production.

   How has biotechnology affected food production?

   a. Greater variety of foods
   b. Increased shelf life/safety of food
   c. Greater efficiency in production of food

3. Discuss examples of bio-engineered foods.

What are examples of bioengineered foods?

a. Enzymes
    1. Rennet - naturally found in a calf stomach, can be synthetically produced and immobilized
    2. Lactase - cleaves lactose to glucose and galactose, can be immobilized
    3. Low-calorie foods - Non-nutritive sweeteners - aspartame, thaumatin, and monellin are taste active proteins. The genes that code for these proteins may be isolated and transferred to bacteria and produced through fermentation.
    4. Waste management - certain yeast strains can produce a grape aroma when they consume whey, a cheese-making by-product. This could be used as a flavor component for the wine and food industries.
    5. Biological monitoring - DNA fragments from disease-causing microorganisms have been coded and hybridized to probe for the presence of these organisms in food.
    6. Cellulose and collagen casings and co-extruded casings

4. Discuss the types of businesses involved in biotechnology research.

What business enterprises are involved in biotechnology research?

a. USDA
b. Universities
c. Food processing companies
d. Commodity organizations
e. National Live Stock and Meat Board
f. Other food/agricultural related companies

5. Discuss how biotechnology will influence the food industry in the future.

How will biotechnology influence the food industry in the future?

a. A growing population will necessitate a growing food supply on less acres.
b. Greater weed control, less insect damage, enhanced nutritional quality and safety, greater disease resistance, improved genetics
c. Longer shelf life, new vaccines, less dependence on petroleum oil, soy- and corn-based product expansion, biological insect control, resistant varieties, more hydroponic-grown food

d. Round-up resistant corn, non-fixing grasses, soy coatings, natural antifreeze

6. Discuss what factors influence new developments.

   What factors influence new developments in food biotechnology?

   a. Needs of the people
   b. Finances
   c. Talent pool of researchers
   d. Facilities/equipment
   e. Weather
   f. Time

F. Other activities

1. Have students complete a report on George Washington Carver's advances with the peanut.

2. Show the video, "The Nature of Change," from Monsanto Company, 800 N. Lindberg Blvd., St. Louis, MO 63167, (314) 694-1000.

3. Read and report on "Of the Earth: Agriculture and the New Biology," from the Monsanto Company, 800 N. Lindberg Blvd, St. Louis, MO 63169, (314) 694-1000.

4. Evaluate a news article on biotechnology.

5. Prepare a tissue culture using the Wisconsin fast plants tissue cultures, available from Carolina Biological Supplies.

G. Conclusion

Biotechnology is changing the production and processing of foods. New foods are routinely being developed like the non-nutritive sweeteners: aspartame, thaumatin, and monellin. Biotechnology is also being used to develop synthetic nonfood products like insulin.

H. Competency

Describe the role of biotechnology in the food industry.

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.

10D-1: Describe general ways in which human activities affect environmental quality.

I. Answers to Evaluation

1. a
2. c
3. d

4. The use of microorganisms, animal cells, plant cells, or components of cells to produce products or carry out processes for human benefit.

5. Two of the following: greater variety, increased shelf life/safety, greater efficiency in food production.

6. USDA
   Universities
   Food processing companies
   Commodity organizations
   National Live Stock and Meat Board
   Other food/agricultural related companies

7. Teacher's discretion.

J. Answers to Activity Sheets

AS 5.1

1. Too high or low a temperature will render the enzyme inactive or it will not coagulate the curd. (You may want to allow some groups to form curd using high and low temperatures.)

2.

Function	Enzyme
hydrolysis of starch to glucose	glucoamylase
coagulation of milk for cheese production	rennet
clarification and production of fruit juices	pectinase

UNIT III - THE BIOCHEMISTRY OF FOODS Name ________________________

Lesson 5: Biotechnology in the Food Industry Date ______________________

EVALUATION

Circle the letter that corresponds to the best answer.

1. Which of the following is a non-nutritive sweetener that has been bioengineered?

   a. Aspartame
   b. Corn syrup
   c. Cane sugar
   d. Beet sugar

2. What enzyme is used during cheese making?

   a. Glucose
   b. Lactose
   c. Rennet
   d. Thaumatin

3. What type of casing has been bioengineered to replace natural casings?

   a. Biocasings
   b. Digestive tract casings
   c. Fatty casings
   d. Cellulose casings

Complete the following short answer questions.

4. Define biotechnology.

5. Name two ways biotechnology has affected food production.

6. What are two business enterprises involved in biotechnology research?

7. Use the terms: biotechnology, herbicide-resistant varieties, shelf life, soy coatings, food safety, increased efficiency, in an essay that discusses biotechnology's future role in food production.

UNIT III - THE BIOCHEMISTRY OF FOODS AS 5.1

Lesson 5: Biotechnology in the Food Industry Name________________________

A Bioengineered Food Product

Objective: Process hard curd (the primary step in cheese production) using rennin.

Activity Length: 1 class period

Background Information: Chymosin, also known as rennin, is an enzyme that is used in cheese making. When added to milk at the beginning of the cheese-making procedure, it causes the milk to coagulate, or "set," within 30 minutes so that it can be separated into curds and whey. The only source of chymosin for many years was from calf rennet, the extract from stomachs of calves which were slaughtered for veal production. The extract contained, besides chymosin, many impurities. The supply of chymosin also depended on the supply of veal calves (as the cow gets older, its stomach stops producing chymosin). The gene for chymosin has been isolated from cells of calves and inserted into a bacterium. The resultant product, recombinant chymosin, is produced by bacterial cultures in large and controllable quantities. Also, because its production can be highly controlled, it can be easily purified and therefore used without impurities. Chymosin is the first recombinant product to be approved by the FDA for use in food and is now being produced and sold commercially. This procedure demonstrates hard curd production. Hard curds are used in the production of many cheeses, such as, cheddar, Swiss, and Gouda. (Purdue University Cooperative Extension Service, 1992)

Materials and Equipment:

Thermometer
Skim milk - 1 c.
Double boiler
Hot plate
Cups
Plastic spoons and knives
Safety glasses
Rennet solution*
Water

*rennin (rennet solution: crush one junket tablet and dissolve in a tablespoon of water. If material does not dissolve completely, be sure that it is thoroughly dispersed immediately before adding to milk. Junket tablets can be purchased in most grocery stores.)

Procedure:

1. Put on your safety glasses.

2. Place 1 cup of skim milk into the top half of the double boiler.

3. Place water in the bottom of the double boiler on a hot plate. Heat the milk to 95°F-113°F (do not allow the thermometer to rest on the bottom of the pan).

4. With constant stirring, slowly add the rennet solution.

5. Allow the milk to remain at 95-113°F for 15-20 minutes, until a firm gel is formed.

6. Cut the gel into small pieces with a plastic knife.

7. Increase the heat slowly to 113-122°F to firm the curd.

8. Allow the curd to settle.

9. The liquid in the boiler pan is called sweet whey. Pour the sweet whey into a clean cup. Taste when cooled.

10. Examine the curd. Determine the texture/consistency of the curd by squeezing it between your thumb and fingers. You may place a small piece of curd in your mouth and chew it.

Key Questions:

1. What effect does temperature have on this process?

2. What are some major industrial uses of enzymes to produce and process food?

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

UNIT IV - FOOD SELECTION AND CONSUMER HEALTH

Lesson 1: Factors that Affect Consumer Choice

Objective

The student will be able to describe the factors that affect consumer choices of food.

I. Study Questions

   A. What factors affect consumer choice of foods?

   B. What sensory attributes influence consumer choice?

   C. How does convenience influence consumer selection?

   D. How does price affect consumer selection?

   E. How does packaging affect consumer selection?

   F. How does shelf life affect consumer choice?

   G. How do consumer concerns about safety affect food product selection?

   H. What nutritional concerns affect food product selection?

II. References

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

   b. Activity Sheet

      AS 1.1: Comparing Snack Foods

UNIT IV - FOOD SELECTION AND CONSUMER HEALTH

Lesson 1: Factors that Affect Consumer Choice

TEACHING PROCEDURES

A. Introduction

This unit will look at food science and technology through the eyes of the consumer. Consumer choices, food labels, beverage nutrition, and the link between diet and health will be covered.

B. Motivation

1. Video tape a TV food advertisement. Show it to your class and have them answer the following questions: Is the food healthy? Does it appeal to your emotions? Does it make you hungry/thirsty? What age group does the ad target? Does it list the price?

2. Bring several different pieces of hard candy to class. Have each student select a piece of candy without looking at it. Have students pinch their nostrils closed while they put the candy in their mouths. They should not be able to taste the candy nor should they know what flavor of candy they are eating. Discuss how the senses are dependent on each other. Ask, "Do you eat with your mouth, your nose, or your eyes?" An onion and an apple work well for this activity.

C. Assignment

D. Supervised study

E. Discussion

1. Discuss what factors affect a consumer's choice of foods. Remind the students that everyone is a consumer.

   What factors affect consumer choice of foods?

   a. Location/supply
   b. Cost
   c. Time
   d. Knowledge/skill
   e. Energy
   f. Other people

g. Emotions
h. Tools
i. Culture
j. Religion
k. Advertising
l. Lifestyle
m. Values

2. Discuss what sensory attributes influence the consumer's choice.

What sensory attributes influence consumer choice?

a. Eyesight
    1. Color
    2. Size/shape
b. Odor/smell
c. Sense of taste
    1. Sweet
    2. Sour
    3. Salty
    4. Bitter
d. Feel/touch

3. Discuss how convenience affects consumer selection.

How does convenience influence consumer selection?

a. Why convenience foods are purchased:
    1. Less time required
    2. Less energy required
    3. Less clean-up needed
    4. More variety
    5. Less equipment needed
b. Why convenience foods are not purchased:
    1. Desire to prepare their own food
    2. More costly to purchase convenience foods
    3. More packaging to dispose of

4. Discuss how the price affects consumer selection.

How does the price affect consumer selection?

a. Smart shoppers are influenced
b. Impulse buyers are influenced less

5. Discuss how packaging affects consumer selection. Have students complete AS 1.1.

   How does packaging affect consumer selection?

   a. Labeling
   b. Environmentally friendly
   c. Size
   d. Cost

6. Discuss how shelf life affects consumer choice.

   How does shelf life affect consumer choice?

   a. Longer shelf life is desired
   b. May cost more

7. Discuss how consumer safety concerns affect food selection.

   How do consumer concerns about safety affect food product selection?

   a. Many consumers show no concern
   b. Others examine food carefully

8. Discuss what nutritional concerns affect food product selection.

   What nutritional concerns affect food product selection?

   a. Fat content
   b. Calories
   c. Additives
   d. Vitamins and minerals present
   e. Fiber
   f. Cholesterol

F. Other activities

1. Have students examine at least two newspaper advertisements for food. Compare the products they are advertising, their price, their pictures, the seasonality of the specials, the percentage of food to non-food items, etc.

2. Tour a grocery store and locate the items targeted at impulse buyers.

3. Invite a grocer to speak to the class on how they manage shelf-life on perishable items and what part advertisement plays in sales.

4. Acquire copies of A Guide to the Meat Department from the Beef Industry Council, 444 N. Michigan Ave., Chicago, IL 60611, (312)467-5520. Have students survey the class, their families, or the school using pp. 4-10, 36-40, compare the results to comparable statistics in A guide to the Meat Department.

5. Acquire copies of A Legitimate Beef, Pitman-Moore, Inc. 421 E. Hawley St., Mundelein, IL 60060, (800)541-7459. Have students ask two other people questions, at least one outside of their household. Have questionees write a brief statement on their reactions.

G. Conclusion

Consumers are influenced by a myriad of factors that affect their food selections. Location, time, cost, and religion are a few of these factors. In addition, sensory appeal, convenience, price, packaging, shelf life, safety risk, and nutritional content are all factors that play a major role in consumer selection.

H. Competency

Describe the factors that affect consumer choices of food.
Related Missouri Core Competencies and Key Skills: None

I. Answers to Evaluation

1. c
2. b
3. Advantages:
   less time required
   less energy required
   less clean-up
   more variety is possible
   requires less equipment

   Disadvantages:
   more costly
   consumers desire to prepare their own food
   more packaging to dispose of

4. They are making decisions based on emotions, not necessarily intellect.
5. Fat content, calories, additives, vitamins and minerals present, fiber, cholesterol

6. Teacher's discretion

J. Answers to Activity Sheet

AS 1.1 - Teacher's discretion

UNIT IV - FOOD SELECTION AND CONSUMER HEALTH Name ________________

Lesson 1:Factors that Affect Consumer Choice Date ___________________

EVALUATION

Circle the letter that corresponds to the best answer

1. Which of the following is the most economical choice when purchasing for a large family?

   a. Large packages, extended shelf life, low cost, blemished cans
   b. Small packages, short shelf life, high cost, no blemishes
   c. Large packages, average shelf life, low cost, no blemishes
   d. Large packages, short shelf life, high cost, no blemishes

2. A one-person family usually shops for:

   a. Large packages, short shelf life, bright packages, low value
   b. Small packages, long shelf life, fresh to touch, low cost
   c. Small packages, short shelf life, attractive odor, low cost
   d. Large packages, long shelf life, dull package color, high cost

Complete the following short answer questions.

3. Compare/contrast the advantages and disadvantages of convenience foods.

4. Why are impulse buyers less price influenced than shoppers who have planned ahead?

5. List five nutritional concerns consumers exhibit.

6. Use these words in an essay describing a consumer's choice of foods: energy, knowledge/skill, cost, time, location, family size, advertising, religion, values, emotions, tools. (Use the back of this page if necessary.)

UNIT IV - FOOD SELECTION AND CONSUMER HEALTH AS 1.1

Lesson 1:Factors that Affect Consumer Choice Name ______________________

Comparing Snack Foods

Objective: To compare different brands of snack foods

Activity Length: 20 minutes

Materials and Equipment:

*4 different snack foods in individual packages (potato chips, pretzels, banana chips, sunchips, corn chips, etc.)
Bowls
Scale

*If snack foods are not in individual packages, put a serving size for each food into a separate bowl.

Procedure:

1. Record the type of snack food in the top row in the columns under "Types of Snack Foods."

2. Compare the "Nutrition Facts" on the label of each snack food. Record your findings in Table 1.1.

3. Taste each snack food and record your preferences in Table 1.1.

Table 1.1

	Types of Snack Foods			
Serving size				
Weight of product in bag				
Fat				
Saturated Fat				
Calories				
Carbohydrates				
Fiber				
Protein				
Sugar (g)				
Sodium (mg)				
Vitamin C				
Taste preference*				

*(for taste preference, rank 1 thru 4 with 1 being the most preferred.)

Key Questions:

1. Which snack food is the most nutritious? Which do you prefer?

2. Which contains the most salt?

3. Which contains the most fat?

4. Which one did you think tasted the best?

UNIT IV - FOOD SELECTION AND CONSUMER HEALTH

Lesson 2: Interpreting Food Labels

Objective

The student will be able to interpret a food label.

I. Study Questions

   A. What are the parts of a food label?

   B. What are the daily dietary requirements for people?

   C. How does the food label reflect the nutritional content of foods?

   D. What is the significance of "nutrient content claims" and "health claims"?

II. References

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

   B. Transparency Master

      TM 2.1: Nutrition Labels

   C. Activity Sheets

      AS 2.1: Nutritional Status
      AS 2.2: Identifying Information on a Food Label

UNIT IV - FOOD SELECTION AND CONSUMER HEALTH

Lesson 2: Interpreting Food Label

TEACHING PROCEDURES

A. Review

Lesson 1 of Unit IV discussed how sensory attributes of a package can influence consumer choice. This lesson looks specifically at one part of the package, the label. How does the label, its location or its contents, affect consumer selection?

B. Motivation

Bring to class labels from a cereal box, mayonnaise jar, orange juice container, and lunch meat package. Copy all labels so that the product name is covered up. Ask students to guess what these labels came from. Follow with a listing of what information is common for each product.

C. Assignment

D. Supervised study

E. Discussion

1. Discuss the parts of a food label.

   What are the parts of a food label?

   a. Principal display panel (PDP)
      1. It must identify the food, either by real name (e.g., green beans) or a made-up name (e.g., Cheerios®).
      2. If picture appears, it must look like the food.
      3. Net contents or net weight must be included.

   b. Information panel (IP)
      1. The IP must include the name and address of the manufacturer.
      2. A list of ingredients must be in order by descending weight.
      3. Nutritional facts panel must be included except in a few instances.

2. Discuss the daily dietary requirements for people. The human body is composed of 60 percent water, 20 percent fat, and 20 percent carbohydrates, proteins, vitamins, and minerals.

   What are the daily dietary requirements for people?

a. Bread, Cereal, Rice, Pasta Group - 6-11 servings
b. Fruit Group - 2-4 servings
c. Vegetable Group - 3-5 servings
d. Meat, Poultry, Fish, Dry Beans, Eggs, Nuts Group - 2-3 servings
e. Milk, Yogurt, Cheese Group - 2-3 servings
f. Fats, Oils, Sweets - use sparingly

3. Discuss how food labels reflect the nutritional content of foods.

How does the food label reflect the nutritional content of foods?

a. Total calories
b. Calories from fat
c. Total fat - grams and percent daily value
d. Saturated fat - grams and percent daily value
e. Cholesterol - grams and percent daily value
f. Sodium - grams and percent daily value
g. Total carbohydrate - grams and percent daily value
h. Dietary fiber - grams and percent daily value
i. Sugars - grams
j. Protein - grams
k. Vitamin A - percent daily value
l. Vitamin C - percent daily value
m. Calcium - percent daily value
n. Iron - percent daily value
o. Serving size - determined by comparison to a standard serving size; not necessarily the same serving size that is used in the "Food Pyramid"

4. Discuss with students the significance of nutrient content claims and health claims. Point out that before 1990 there were no standards for what the terms meant.

What is the significance of "nutrient content claims" and "health claims"?

In 1990 standards were established to define 'nutrient content claims' and 'health claims.'

a. Nutrient content claims - Words such as "lite," "high," and "low" are clearly defined.
b. Health claims
    1. phrases that remind consumers that certain nutrients are important
    2. monitored by government scientists
    3. currently only seven different types of claims are allowed

F. Other activities

Collect several food labels. Make an answer key for each label based on its identity statement, net contents, and manufacturer's name and address. List on key, the product's ingredients and its nutritional information. Students then select a label and complete AS 2.1.

G. Conclusion

The daily dietary requirements include servings from the groups of bread, fruit, vegetables, meat, and milk. Fats and sweets should be consumed sparingly. While the number of servings may vary, all groups are necessary for a balanced diet. Food labels reflect the nutritional content of foods. Food labels contain the principal display panel and the information panel.

H. Competency

Interpret a food label.

Related Missouri Core Competencies and Key Skills: None

I. Answers to Evaluation

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

J. Answers to Activity Sheets

AS 2.1 - Instructor's discretion
AS 2.2 - Instructor's discretion

UNIT IV - FOOD SELECTION AND CONSUMER HEALTH Name__________________

Lesson 2: Interpreting Food Labels Date __________________

EVALUATION

Circle the letter of the best answer.

1. What are the two major parts of the food label?

   a. Ingredients and net weight
   b. Nutrition facts and percent daily value
   c. Principal display panel and information panel
   d. Weight and manufacturer's name

2. The net weight and name of the food appear on what location?

   a. Side panel
   b. Nutritional facts panel
   c. Information panel
   d. Principal display panel

3. On which panel do nutritional facts, ingredients, and name and address of manufacturer appear?

   a. Side panel
   b. Nutritional facts panel
   c. Information panel
   d. Principal display panel

4. What types of information are included on the nutritional facts panel?

   a. Percent daily value and grams
   b. Weight and manufacturer's name
   b. Ingredients and net weight
   c. Ingredients and grams

5. Of the food groups listed, which has the highest number of recommended servings?

   a. Fruit group
   b. Breads, cereal, rice, pasta group

c. Meat group
d. Vegetable group

6. Which ingredient is listed first on the food label?

a. The ingredient that weighs the most
b. The ingredient with the largest volume
c. The primary ingredient
d. The order of the listing of ingredients doesn't matter.

7. The Nutritional Labeling and Education Act of 1990 made changes in the food label. Which of the following statements is not correct?

a. The types of information included on the nutritional panel was changed.
b. Terms such as "lite" and "low fat" can only be used if the food product meets certain guidelines.
c. Guidelines for health claims were defined.
d. The food label must give the cost of the food product.

Match the group on the left with the correct number of servings on the right. One answer is used twice.

Food Group	Daily Servings (number of)
____8. Dairy group	a. 3-5
____9. Bread group	b. 6-11
____10. Fruit group	c. Sparingly
____11. Vegetable group	d. 2-4
____12. Meat group	e. 2-3
____13. Fats group	

TM 2.1

Nutrition Labels

Spaghetti Noodle Pasta-Enriched-Dry

MANDATORY LABEL

Nutrition Facts

Serving Size 2 oz. (60 g)
Servings Per Container 8

Amount Per Serving

Calories 220 Calories from Fat 10

	% Daily Value*
Total Fat 1g	**1%**
Saturated Fat 0g	**0%**
Cholesterol 0mg	**0%**
Sodium 0mg	**0%**
Total Carbohydrate 45g	**15%**
Dietary Fiber 1g	**6%**
Sugars 2g	
Protein 8g	

Vitamin A 0%	•	Vitamin C 0%
Calcium 2%	•	Iron 15%

* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower based on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65 g	80 g
Sat Fat	Less than	20 g	25 g
Cholesterol	Less than	300 mg	300 mg
Sodium	Less than	2,400 mg	2,400 mg
Total Carbohydrate		300 g	375 g
Dietary Fiber		25 g	30 g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

Spaghetti Noodle Pasta-Enriched-Dry

VOLUNTARY LABEL

Nutrition Facts

Serving Size 2 oz. (60 g)
Servings Per Container 8

Amount Per Serving

Calories 220 Calories from Fat 10

	% Daily Value*
Total Fat 1g	**1%**
Saturated Fat 0g	**0%**
Cholesterol 0mg	**0%**
Sodium 0mg	**0%**
Total Carbohydrate 45g	**15%**
Dietary Fiber 1g	**6%**
Sugars 2g	
Protein 8g	

Vitamin A 0%	•	Vitamin C 0%
Calcium 2%	•	Iron 15%
Thiamin 40%	•	Riboflavin 15%
Niacin 25%	•	Vitamin B6 4%
Folate 2%	•	Vitamin B12 0%

* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower based on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65 g	80 g
Sat Fat	Less than	20 g	25 g
Cholesterol	Less than	300 mg	300 mg
Sodium	Less than	2,400 mg	2,400 mg
Total Carbohydrate		300 g	375 g
Dietary Fiber		25 g	30 g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

Unit IV - FOOD SELECTION AND CONSUMER HEALTH AS 2.1

Lesson 2: Interpreting Food Labels Name________________________

Nutritional Status

Objective: To illustrate the differences between a single day's diet and a five-day diet on overall nutritional status.

Activity Length: 30 minutes of class time to tabulate results

Materials and Equipment:

Nutritional labels from food consumed in one day
This should be gathered out of class. Each student should collect the "Nutrition Facts" panel from foods that would be eaten at breakfast, lunch, dinner and a snack (or two).
Calculator
Copy of USDA Handbook 8 (*Composition of foods: raw, processed, prepared*) or a nutrition textbook with food composition charts. Several fast food companies also have nutritional information on their products available at each store.

Procedure:

1. Fill in the blanks for chart 1 from the nutritional labels, information from Handbook 8, nutrition textbook, or other sources.
2. Fill in the information from labels for one day. Total the percentages for each nutrient. Determine the percentage of calories by dividing your number by 2000, and multiply the result by 100.
3. Get the nutritional information from five to seven other students. Fill in chart 2. Total the columns and average the percentages for each nutrient.

Key Questions:

1. In the single day analysis, what nutrients did you consume in excess amounts? What nutrients did you need to consume more of?

2. What happened when you combined the data from other students with yours? If you had eaten all of these meals, would your nutritional status be better or worse?

3. Using your single day analysis, choose one nutrient you consumed in excess amounts? What foods should you avoid in order to decrease your consumption of this nutrient?

4. Still using the single day analysis, choose one nutrient that you did not get enough of. What foods are good sources of this nutrient. (Use other nutritional labels or handbooks to get this information.)

Chart 1 - Your Values

Food	Calories	Total Fat	Cholesterol	Sodium	Total Carbohydrates	Dietary Fiber
Total						

Chart 2 - Nutrient Percentages From Other Students

	Calories	Total Fat	Cholesterol	Sodium	Total Carbohydrates	Dietary Fiber
Your values						
Total						
Average						

Developed by Douglas L. Holt, Assistant Professor, Food Science and Human Nutrition, University of Missouri-Columbia

UNIT IV - FOOD SELECTION AND CONSUMER HEALTH AS 2.2

Lesson 2: Interpreting Food Label Name ________________________

Identifying Information on a Food Label

Objective: To identify information on a food label.

Product Name: ___________________________

List the following information obtained from your food label.

1. Identification statement:____
2. Net contents:____
3. Name and address of manufacturer:_______________________________________
4. List of ingredients:____
5. Nutritional information:____
6. Which ingredient occurs in the greatest amount? ___________________________
7. If additives are used, what are they?_______________________________________
8. List any artificial flavor(s).____

UNIT IV - FOOD SELECTION AND CONSUMER HEALTH

Lesson 3: Nutritional Value of Beverages

Objective

The student will be able to compare the nutritional value of beverages.

I. Study Questions

   A. What are the nutritional benefits of beverages in the human diet?

   B. How does the body utilize the fluids consumed?

   C. What are the nutritional qualities of common beverages?

   D. Why is milk considered nature's most nearly perfect food?

II. References

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

   B. Activity Sheet

      AS 3.1: A Test for Vitamin C

UNIT IV - FOOD SELECTION AND CONSUMER HEALTH

Lesson 3: Nutritional Value of Beverages

TEACHING PROCEDURES

A. Review

Review what can be learned from a food label. Re-emphasize the information that is required on a label: the identity statement, net contents, and the manufacturer's name and address. Relate how beverages have labels on them too. What are differences on the labels for milk, orange juice, coffee, and soda?

B. Motivation

1. Explain the origin of soda pop. Soda pop goes back to Greek and Roman times. "Medicinal" or natural mineral waters were valued for their refreshing qualities. In 1767, British scientist Joseph Priestly artificially carbonated water. An early method of obtaining the carbon dioxide was by acidification of sodium bicarbonate or sodium carbonate. From the use of these sodium salts, the name "soda" was given to these drinks. Gradually, fruit juices and extracts were added for flavor.

2. Bring a variety of soda cans, juice bottles, etc., to class. Examine the nutrients and ingredients.

C. Assignment

D. Supervised study

E. Discussion

1. Discuss the nutritional benefits of beverages.

   What are the nutritional benefits of beverages in the human diet?

   a. Water source/fluid source
   b. Protein, carbohydrates
   c. Fat and minerals
   d. Vitamins

2. Discuss how the body utilizes the fluids people consume.

   How does the body utilize the fluids consumed?

a. Medium for carrying nutrients via body fluids
b. Solvent for organic and inorganic chemicals essential for life
c. Carries nitrogenous waste products
d. Controls and maintains body temperature

3. Discuss the nutritional qualities of some common beverages.

What are the nutritional qualities of common beverages?

a. Milk - fat, protein, carbohydrates, minerals, vitamins, water
b. Carbonated soft drinks - water, carbohydrates, some provide Na and /or vitamins
c. Coffee/tea - water and very little else
d. Juices - water, vitamins, carbohydrates, minerals, and some proteins

4. Discuss why milk is considered nature's most nearly perfect food.

Why is milk considered nature's most nearly perfect food?

a. Premium quality protein - containing all essential amino acids
b. Carbohydrate - only natural source of lactose
c. Milk fat - easily digested
d. Calcium and phosphorus
e. Vitamins - milk contains all vitamins known to man

F. Other activities

Complete one or more of the following labs from The Chemistry of Beverages, Flinn Scientific, Inc., P.O. Box 219, Batavia, IL 60510, (708) 879-6900.

a. Lab #1: Testing Milk for Calcium
b. Lab #2: Density and Carbonated Beverages
c. Lab #3: Caffeine Drinks
d. Lab #4: The Juices

G. Conclusion

Beverages are a necessary part of a healthy diet. Because the human body is 60-65 percent water, water intake is vital. Water comes disguised in other beverages that may supply food nutrients as well. Milk is the most complete beverage.

H. Competency

Compare the nutritional value of beverages

Related Missouri Core Competencies and Key Skills: None

I. Answers to Evaluation

1. b
2. a
3. c
4. b
5. Medium for nutrient transport, solvent for chemicals, carry waste products, controls body temperature

6. Alcohol is a toxic substance that, when broken down by the liver, produces extra hydrogen atoms. These in turn allow normal breakdown of sugars, amino acids and fatty acids to be incomplete. These incompletely digestive molecules are converted to fat globules which swell the liver and cause cirrhosis

UNIT IV - FOOD SELECTION AND CONSUMER HEALTH Name__________________

Lesson 3:Nutritional Value of Beverages Date ___________________

EVALUATION

Circle the letter that corresponds to the best answer.

1. Which common beverage contains the least nutrition?

    a. Soda
    b. Coffee
    c. Milk
    d. Apple juice

2. Which minerals are not found in milk?

    a. Iron and copper
    b. Calcium and phosphorus
    c. Potassium and chlorine
    d. Sodium and sulfur

3. What percentage of your body is water?

    a. 40 percent
    b. 50 percent
    c. 60 percent
    d. 75 percent

4. Which statement is NOT true about milk, nature's most perfect food?

    a. Milk contains all essential amino acids.
    b. Milk contains all necessary minerals.
    c. Milk contains all vitamins.
    d. Milk is the only food in nature that contains lactose.

Complete the following short answer questions.

5. List three functions of fluids in your body.

6. Describe how alcohol negatively affects your health.

UNIT IV - FOOD SELECTION AND CONSUMER HEALTH AS 3.1

Lesson 3:Nutritional Value of Beverages Name ________________________

A Test for Vitamin C

Objective: To identify beverages that contain vitamin C and to determine the relative amount of vitamin C in a beverage when compared to another beverage or another brand.

Activity Length: One class period

Materials and Equipment:

Milk - 2 different milk fat percentages - whole and skim
Orange juice - 2 brands - Brand A and Brand B
Soda pop - 2 brands - Brand X and Brand Y
Coffee - 2 brands - Brand P and Brand Q
Calibrated measuring beaker
4 beakers
120 ml distilled water
Indophenol blue dye
Eyedropper
4 test tubes
Test tube rack
Labels (masking tape will work)

Procedure:

Part 1

1. Label beakers A, B, C, and D
2. Measure 30 ml of whole milk into beaker A.
3. Measure 30 ml of brand A orange juice into beaker B.
4. Measure 30 ml of brand X soda into beaker C.
5. Measure 30 ml of brand P coffee into beaker C.
6. Add 30 ml distilled H_2O to each beaker (A, B, C, and D).
7. Gently swirl each beaker to mix liquids.
8. Using the eyedropper, measure 10 drops of indophenol blue dye into 4 test tubes. Label test tubes A, B, C, and D.
9. Carefully add contents of beaker A into test tube A one drop at a time, counting the number of drops needed to make the blue color disappear. Stop adding

drops when the color disappears. Record the number of drops added to the test tube.

10. Clean eyedropper before moving to next beaker.
11. Repeat steps 8 and 9, using beaker B with test tube B, so on, with beakers C and D.
12. Vitamin C bleaches the blue color out of indophenol blue. This lab will make qualitative distinctions between beverages based on the amount of vitamin C they possess. The fewer the number of drops needed to make the blue color disappear, the greater the percentage of vitamin C in that beverage. If the blue color does not disappear, the beverage is said to contain no vitamin C.

Part 2

1. Choose to test either the two types of milk, or the two brands of orange juice, soda, or coffee.
2. Clean beakers and test tubes.
3. Repeat steps 1-12 of part 1, using only 2 beakers and 2 test tubes.

Part 1	# drops	rank in order of vit. C content
beaker A ______		
beaker B ______		
beaker C ______		
beaker D ______		
Part 2		
beaker A ______		
beaker B ______		

Key Questions:

1. Which beverage contains the most Vitamin C?

2. In Part 2, was there a difference in Vitamin C levels?

UNIT IV - FOOD SELECTION AND CONSUMER HEALTH

Lesson 4: Relationship Between Diet and Health

Objective

The student will be able to describe the relationship between diet and health.

I. Study Questions

   A. How does cholesterol affect human health?

   B. Why is the composition of fat in food important?

   C. What is the relationship between dietary fiber and health?

   D. What are major health issues affected by nutrition?

   E. How can health problems be minimized through proper nutrition?

II. Reference

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

UNIT IV - FOOD SELECTION AND CONSUMER HEALTH

Lesson 4: Relationship Between Diet and Health

TEACHING PROCEDURES

A. Review

Review the value of beverages to a person's diet. Concentrate on milk. You may want to briefly discuss the fact that calcium is a necessary mineral which is readily available in dairy products. Research indicates that calcium uptake from a person's diet is significantly reduced around age 30-35.

B. Motivation

1. Fry potatoes with saturated (coconut, palm, lard), monounsaturated (canola, olive, peanut), and polyunsaturated (sunflower, safflower, corn, soybean, sesame) fats. Do a taste test. Question students about different fat types to determine how much they know about fat.

2. Have students keep a weekly diet journal. At the end of the week, discuss whether their diets were balanced.

C. Assignment

D. Supervised study

E. Discussion

1. Discuss how cholesterol affects human health.

   How does cholesterol affect human health?

   a. Necessary for building membranes, manufacture of hormones and vitamin D, and other body functions. The liver produces cholesterol when diet intake is insufficient.
   b. High total blood cholesterol level is a major risk factor in the development of coronary heart disease
   c. Low-Density Lipoprotein is called bad cholesterol
   d. High-Density Lipoprotein is called good cholesterol

2. Discuss why the composition of fat is important.

   Why is the composition of fat in food important?

a. Fats add flavor, aroma, texture, and satisfaction (satiety) to a meal
b. High energy source - 9 calories/gram
c. Transport and absorb fat-soluble vitamins A, D, E, and K
d. Composed of fatty acids - a fat may contain two or more types of fatty acids. Classification is based on the predominant type of acid structure.
   1. Saturated fatty acids
      a. Come from animal sources and coconut, palm, palm kernel, and vegetable oils
      b. Should compose 1/3 or less of total fat intake
      c. Can raise blood cholesterol
   2. Monounsaturated fatty acids
      a. Found in animal and plant fats especially olive, canola, and peanut oils
      b. Should compose 1/3 or less of total fat intake
      c. May help lower blood cholesterol
   3. Polyunsaturated fatty acids
      a. Come from sunflower, safflower, corn, sesame, and soybean oils
      b. Can help lower blood cholesterol
      c. Linoleic acid is an essential fatty acid needed for normal growth
e. Should contribute no more than 30 percent of caloric intake
f. Triglycerides - edible oils and fats composed of three fatty acids attached to glycerol

3. Discuss the relationship between dietary fiber and health.

What is the relationship between dietary fiber and health?

a. Fiber provides bulk and roughage which contribute to a healthy intestine.
b. Fiber holds water, loosens stool, and decreases transit time through colon.
c. It can lower serum cholesterol, decrease incidence of colon cancer, and lower the insulin requirements of diabetics.
d. Excessive fiber can bind minerals making them unavailable for absorption.

4. Discuss the major health issues affected by nutrition.

What are major health issues affected by nutrition?

a. Starvation
b. Obesity

c. Heart disease
d. Bulimia and anorexia
e. Cancer
f. Malnourishment - osteoporosis, night blindness, dermatitis, beri-beri, neuritis, photophobia, anemia, pellagra, scurvy, rickets, hemophilia
g. Diverticulitis
h. Ulcers
i. Decreased recovery time after illness or surgery

5. Discuss how health problems can be minimized through proper nutrition.

   How can health problems be minimized through proper nutrition?

   a. Balanced diet plus exercise
   b. Meet RDA's
   c. Remain in weight range/caloric intake
   d. Diet modification if necessary

F. Other activities

1. Have a Red Cross employee or school nurse speak about or demonstrate a blood iron and cholesterol test.

2. Invite a dietician to speak about his/her job.

3. Each student should monitor food intake for one day and determine if daily values were met, at what level, and what the caloric intake was.

4. Assign students to examine the type of cooking oil(s) used at school, their home, and a local cafe or restaurant. Determine if oils are saturated, monounsaturated, or polyunsaturated fats.

G. Conclusion

This lesson should remind students that their health is directly related to their diet. Issues such as cholesterol, fat, fiber, and dietary diseases are very prevalent. A closer examination of one's diet is always a desirable action.

H. Competency

Describe the relationship between diet and health.

Related Missouri Core Competencies and Key Skills: None

I. Answers to Evaluation

1. natural
2. necessary
3. different than
4. LDL
5. increase
6. c
7. b
8. a
9. age, heredity, gender
10. Retains water, loosens stool, and decreases transit time through colon. Possibly lowers serum cholesterol, decreases colon cancer, and lowers diabetic insulin requirements.
11. Three of the following: starvation, obesity, heart disease, bulimia and anorexia, cancer, malnourishment
12. Three of the following: balanced diet, follow RDA's, exercise, appropriate caloric intake, proper diet modification

UNIT IV - FOOD SELECTION AND CONSUMER HEALTH Name ___________________

Lesson 4:Relationship Between Diet and Health Date ___________________

EVALUATION

Circle the word in parentheses to complete the sentence correctly.

1. Cholesterol is a (synthetic, natural) compound.

2. Cholesterol is a (necessary, unnecessary) component of cell membranes, and hormone and bile production.

3. Blood cholesterol is (identical to, different than) dietary cholesterol.

4. (High-Density Lipoprotein, Low-Density Lipoprotein) is referred to as "bad" cholesterol.

5. Diets high in total and saturated fats tend to (increase, decrease) cholesterol levels.

Match the types of oil with their appropriate molecular structure description.

____6.Palm and coconut oils	a. Polyunsaturated
____7.Olive, peanut, and canola oils	b. Monounsaturated
____8.Soybean and sunflower oils	c. Saturated

Complete the following short answer questions.

9. Name two factors, other than diet, that affect a person's cholesterol level.

10. How can dietary fiber aid nutrition?

11. List three diseases/disorders caused by poor nutrition.

12. What are three keys to minimizing health problems?