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.