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: Percent U.S. R.D.A. Chart Exploring Meat and Heath, Zinc, Iron

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.