Nutrition and Diet Therapy 9th edition DeBruyne Solutions Manual

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Chapter 2 – Carbohydrates

Learning Objectives

Upon completion of this chapter, students should be able to:

2.1 Identify the monosaccharides, disaccharides, and polysaccharides common in nutrition and list their major food sources.
2.2 Explain how hormones control blood glucose concentrations.
2.3 Describe how added sugars can contribute to health problems and how alternative sweeteners may help to limit kcalories and sugar intake.
2.4 Identify the health benefits of, and recommendations for, starches and fibers.
2.5 Describe the glycemic index and explain why its use in disease prevention is controversial.

Chapter Outline/Summary

2.1 The Chemist's View of Carbohydrates
Monosaccharides
Disaccharides
Polysaccharides
2.2 Regulation of Blood Glucose
2.3 Health Effects of Sugars and Alternative Sweeteners
Sugars
Alternative Sweeteners: Sugar Alcohols
Alternative Sweeteners: Nonnutritive Sweeteners
2.4 Health Effects of Starch and Dietary Fibers
Carbohydrates: Disease Prevention and Recommendations
Carbohydrates: Food Sources
Carbohydrates: Food Labels and Health Claims
Nutrition in Practice: The Glycemic Index in Nutrition Practice

Answer Key for Assignment Worksheets (provided at the end of this IM chapter)

Worksheet 2-1: Chapter 2 True/False Practice Quiz

1. False: The amount of carbohydrate in animal foods, with the exception of milk, is insignificant.
2. False: Table sugar is composed of sucrose.
3. False: Excess kcalories from carbohydrates are stored as fat, thus total carbohydrate kcalorie intake is important.
4. True: The main staple food in diets worldwide is some high-starch food, such as wheat, rice, or corn.
5. True: Blood sugar is glucose.
6. False: The RDA for carbohydrate is 130 grams per day.
7. True: Once the glycogen stores are full, carbohydrates in excess of energy needs are stored as fat.
8. False: Honey is a concentrated sweet and contains only trace amounts of vitamins and minerals.
9. True: Humans, unlike cows and other ruminants, lack the enzyme to break down cellulose in the intestine.
10. True: Excessive sugar intakes, however, can displace foods of higher nutrient density, leading to inadequate intake of nutrients and dietary fiber—and excess kcal from sugar or any other source can contribute to weight gain.

Worksheet 2-2: Chapter 2 Review

1. Monosaccharides, disaccharides
2. Starch, glycogen, fibers
3. Glucose, fructose, galactose
4. Sucrose, lactose, maltose

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5. Starch (from plants), glycogen (from animal sources)
6. Soluble fibers, insoluble fibers
7. Composition of the food, how sticky the food is, how often a person eats the food, whether the teeth are brushed after eating the food
8. Any 5 of the following: brown sugar, concentrated fruit juice sweetener, confectioner's sugar, corn sweetener, corn syrup, dextrose, anhydrous dextrose, evaporated cane juice, fructose, galactose, glucose, granulated sugar, high-fructose corn syrup, honey, invert sugar, lactose, maltose, sucrose, levulose, malt syrup, maple syrup, molasses, raw sugar, turbinado sugar, white sugar
9. 2-3
10. 4
11. Any 5 of the following: saccharin, aspartame, acesulfame potassium, sucralose, neotame. Tagatose, stevia, Luo han guo
12. Increasing fecal weight and speeding fecal passage through the large intestine, providing bulk and feelings of fullness
13. Any 3 of the following: lowering blood cholesterol by binding bile, slowing glucose absorption, slowing transit of food through the upper GI tract, increase satiety, holding moisture in stools and hence softening them, yielding small molecules after fermentation that the large intestine can use for energy
14. Answers will vary; see Figure 2-6 on page 51
15. 10
16. starch, fibers, sugars
17. Muscle glycogen, liver glycogen

Worksheet 2-3: Food Examples of Nutrients and Other Food Components – Answers will vary. See Figure 2-5 for sources of insoluble and soluble fibers, pectin, lignin, and cellulose; Table 2-3 for a list of nonnutritive sweeteners.

Worksheet 2-4: Carbohydrate Crossword

1. Artificial
2. sucrose (A); starch (D)
3. glucose
4. insoluble fiber
5. alcohols
6. fructose
7. glucagon
8. disaccharides
9. viscous
10. glycogen
11. caries
12. soluble fibers
13. polysaccharides
14. stevia sweeteners

Answer Key for In-Text Exercises

Clinical Applications
Suggestions that could be offered:

- The client should replace the refined, sugary breads or cereals with whole grains such as cracked wheat, oatmeal, whole wheat, or whole rye. Whole grains are more healthful choices, as they contain more vitamins, minerals, fiber, and other nutrients that enhance health. Most grain choices should be low in fat and sugar.
- Rather than only one serving a day, it would be better to eat a variety of vegetables daily with a mixture of starchy and non-starchy vegetables to ensure that the client gets the nutrients needed. Instead of french fries, which are high in starch and fat, better choices are carrots, tomatoes, cooked greens, or a green salad. French fries could also be replaced with a baked potato with skin with a light margarine or low-fat sour cream.
- The client should eat a variety of fruits and vegetables every day, and healthy choices can include fresh fruits/vegetables, canned vegetables with no salt, canned fruit in it's own juice, frozen fruits and vegetables without sugar or added sauces, and dried fruits. No more than one-half of the day's fruit should come from juice.
- The diet would be improved by exchanging some of the cheese with milk. Although both fat-free milk and some cheeses are excellent choices, fat-free milk offers the same amount of calcium for much less food energy (kcalories) than the cheese. Other options include low-fat yogurt, calcium-fortified soymilk, and low-fat cottage cheese.

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- Smaller servings of low-fat or lean meats should be recommended. The client should also be encouraged to vary protein choices to include more fish, legumes, beans, nuts, and seeds. This will provide a greater range of nutrients that enhance health.
- Instead of candy for a snack, it would be better to choose a fresh nectarine, peach, apple, orange, or banana for a snack. Foods high in added sugar promote tooth decay, contribute to an excess of kcalories in the diet, and can cause overweight and obesity. These foods should be eaten in small amounts only on occasion since they deliver only energy with little protein, vitamins, or minerals.

Critical Thinking Questions

1. How would a lactase deficiency impact someone's carbohydrate intakes, and why? (Lactase is the enzyme in our small intestine that breaks down lactose.) What type of carbohydrate is lactose?

   Answer: If someone has a lactase deficiency, he/she will be lactose intolerant. This means the person will need to limit dietary intake of lactose, which is found in milk and milk products such as ice cream and soft cheeses. Yogurt and hard cheese are typically tolerated. Lactose is a disaccharide that breaks down into the two monosaccharides galactose and glucose.

2. Research has shown that high-fiber, low-fat diets are most effective for long-term weight loss. After reading the section on dietary fiber, how do you think fiber can affect weight loss?

   Answer: Foods that naturally tend to be lower in calories—such as fruits, vegetables, whole grains, and legumes—also tend to be higher in fiber. These foods also contain vitamins and minerals. Foods high in fiber tend to be satiating because they take longer to leave the digestive system. Dietary fiber contains chains of sugars held together by bonds that human digestive enzymes cannot break. Therefore, the dietary fibers tend to pass through the body undigested and do not contribute significantly to caloric intakes.

3. Elizabeth is trying to lose weight. Her typical intake for meals is found below. She is complains of feeling hungry throughout the day and says her meals do not fill her up. Take a look at her carbohydrate choices for breakfast, lunch, and dinner. What changes would you suggest and why?

   24-Hour Intake:
   Breakfast: 2 slices white toast with 2 tbsp jelly, 1 cup orange juice, 1 cup coffee with cream and sugar
   Lunch: turkey wrap sandwich on white tortilla with potato chips and a glass of sweet tea
   Dinner: Stir-fry beef with sweet and sour sauce over white rice, and a slice of cake for dessert

   Answer: Elizabeth is consuming extra calories from sugary foods and choosing low-fiber refined grains. Her diet is also lacking fruits and vegetables. Elizabeth needs to make more nutrient-dense food choices; this would allow her to eat a larger volume to increase satiety while improving adequacy. To add fiber, vitamins, and minerals; increase her consumption of fruits and vegetables; and reduce extra sugar intake I would suggest these changes:

   Breakfast: 2 slices whole-grain toast with 1 tbsp crunchy peanut butter, 1 sliced orange, 1 cup coffee with cream and no-calorie sweetener
   Lunch: turkey wrap sandwich with lettuce, tomato, shredded carrots on a whole-grain tortilla with blue corn tortilla chips and salsa and a glass of unsweet tea
   Dinner: Stir-fry beef with light soy sauce, carrots, broccoli, bok choy over brown rice; for dessert, fresh berries with light vanilla yogurt

4. Matt is an athlete training for a marathon. He is also trying to lose weight. He is currently doing a "low-carb" diet that his trainer recommended to lose weight. He finds himself tired after long runs and struggling to achieve his training goals. What advice would you give Matt regarding his diet?

   Answer: Explain to Matt that carbohydrates are the preferred energy source for many of the body's functions. Also, explain to Matt that carbohydrates are not "fattening" but that excess calories cause weight gain. Review with Matt the best choices from the carbohydrate group, such as low-fat dairy (milk and yogurt), whole grains, legumes, fruits, and vegetables. Also explain that a low-carbohydrate diet is not compatible with training for a marathon.

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Explain that he needs to replenish the carbohydrate consumed by his muscles on long runs by eating a carbohydrate/protein-rich snack, such as a peanut butter sandwich on whole-grain bread and a glass of skim milk, following his workout. Refueling before AND after his workouts will help him have the energy to achieve his training goals.

5. Explain why a growing teenaged boy who plays sports would have more discretionary calories than his aging grandmother.

   Answer: The term "discretionary calories" is used to describe calories that typically come from low-micronutrient, sugary/fatty drinks or foods. A growing teenage boy is going to have high calorie needs due to his muscle mass, growth needs, and calories burned via sports/exercise. His aging grandmother has a much lower BMR and participates in less voluntary activity. Therefore, if she only needs 1500 calories per day to meet her energy needs, there will not be many calories left for sweets or added fats after she eats enough wholesome food to meet her vitamin and mineral needs. However, the growing teenage boy may need 3000 calories per day to meet his calorie needs. He will have more calories left over for sweets without exceeding his calorie needs.

6. Explain the many health benefits of dietary fiber intake as they relate to chronic diseases.

   Answer: Fiber-containing grains, fruits, and vegetables reduce risk of cancer and coronary heart disease. High-fiber diets have also been shown to reduce abdominal obesity and therefore reduce the risk of type 2 diabetes. Insoluble fiber intake lowers the risk of diverticulosis. Soluble fiber intakes also help regulate glucose control by slowing the release of glucose. This is beneficial if you have type 2 diabetes.

Suggested Activities

Activity 2-1: Taste Testing
Bring in samples of fructose from the health food store to compare its sweetness with that of sucrose. To illustrate the differences between the taste of table sugar and alternative sweeteners, assemble samples of cola drinks and other products such as hot chocolate in a regular version or the "diet" version sweetened with aspartame or other sweeteners. Chewing gum with aspartame or sugar alcohol, sugar-free candy, and sugar-free puddings are convenient as illustrations of the uses of alternative sweeteners. Have the students fill in evaluation forms rating the products on flavor, texture or consistency, appearance, and price.

Activity 2-2: Sucrose and Fat Intakes[1]
After students have compiled their personal dietary records and calculated the grams of sucrose and saturated/trans fat, ask them to go into the laboratory and use a canister of sugar and a can of shortening to weigh out the amounts consumed. The visual impact can be startling.

Activity 2-3: Sugar in Popular Beverages[2]
Bring a teaspoon, white sugar, and a glass to class. Ask students how much sugar they put in coffee or tea. Start putting sugar in the glass and have students tell you when they would stop adding sugar. Add sugar to the glass until you have put in 8 teaspoons. Ask if they would drink something with that much sugar. Explain that this is the amount of sugar in one can of soda. A common trend today is the use of "energy" drinks—these really pack in the sugar and can be a great additional visual! For example, an 8-oz. can of Monster Energy® drink contains almost 13 teaspoons (54 g) of sugar.

Activity 2-4: Sugar and Fiber Content of Breakfast Cereals
Packages from dry breakfast cereal are easy to keep on hand to illustrate concepts regarding product labeling regulations and carbohydrates. Show examples of various cereal packages to the class as you talk about types of sugars on product ingredient lists, types of dietary fiber, marketing concepts, and so on. If the students are doing a nutrition labeling assignment, they will find that breakfast cereal labels make good illustrations.

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[1] Thanks to Barbara A. Stettler, Bluffton College.
[2] Source: L. Turner, Instructor's Manual for *Understanding Nutrition*, Eighth Edition (Belmont, CA: West Wadsworth, 1999).

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Ask the students to review the sugar and fiber content of breakfast cereals in their kitchen cupboards before the next class period or visit a supermarket to look at cereal selection and labeling. They could call a food company's toll-free consumer number listed on a cereal package to ask a question about the product or packaging. Have them calculate the % of total kcalories from carbohydrate for a cereal product. In class, divide the students into groups that will compile results and evaluate cereals based on their findings.

Activity 2-5: Dietary Carbohydrate Analysis
Ask the students to bring their 24-hour dietary record prepared using the "Analysis" activity at end of Chapter 1. Have them analyze the 24-hour recall to identify carbohydrate foods, and to classify them into simple sugars, starches, and fibers. Students should identify those high in fiber, those of higher nutrient density, and those rich in "empty-kcalorie" simple sugars.

Activity 2-6: Academy of Nutrition and Dietetics (AND) Resources on Carbohydrates
Have the students review the information AND prepares for the general public on carbohydrate-related topics. It can be found by navigating to www.eatright.org. Ask them to search for an article related to the chapter and summarize it to prepare for a class discussion on the topic.

If you have a more advanced class, have them navigate to www.eatrightpro.org. Ask them to review the AND position papers on carbohydrate-related topics such as use of nutritive and nonnutritive sweeteners or the health implications of dietary fiber. To locate the relevant papers, type a keyword such as sweetener into the search section on the main page of eatrightpro, or click on "Practice" then subtopic "Position and Practice Papers" and browse paper titles.

Activity 2-7: Nutrition Portfolio
Another popular term assignment is a nutrition portfolio or resource file. The students are given a list of items to include in a resource file or portfolio, which each student assembles over a set period of time—usually the first half of the semester or the whole semester. These would include such items as Internet page evaluations, dietary evaluations, and resources that will be of use in later courses or in their professional careers. Usually, the instructor will include an item for each chapter on the list. It might include the answers to the "Clinical Applications" questions at the end of the chapter. The advantage of this assignment is that it is relatively easy to mark while keeping students focused on application of the lecture material. It also provides them with a useful resource file for later use.

Teaching Tips

What is Essential? You have already covered "essential nutrients" in chapter 1, now dig deeper into the meaning of "essential". Glucose is not an "essential nutrient," meaning our body can convert other nutrients into glucose (which will be covered in later chapters). It logically follows that glucose is NOT an essential nutrient, per se.

The Glycemic index. Table NP2-1 shows the glycemic index of selected foods. Foods that have a high GI value tend to be foods high in starch, such as bread and potatoes, whereas many fruits and legumes have low GI values. Discuss the factors that influence the GI value of a food.

The Glycemic Index in practice. Discuss the mixed results of research studies suggesting consuming a low-gi diet may influence chronic disease risk and the current recommendation on the use of the Glycemic index in dietetics practice.

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Worksheet 2-1: Chapter 2 True/False Practice Quiz

Circle the correct answer. If the statement is false, rewrite the statement in a correct form.

T F 1. Carbohydrates are found in all animal foods.

T F 2. The principle carbohydrate in table sugar is lactose.

T F 3. Carbohydrates should be avoided as they are fattening.

T F 4. The main carbohydrate food in the diet is starch.

T F 5. Glucose is the form in which sugar circulates in the blood.

T F 6. The Dietary Reference Intake (DRI) for carbohydrate for adults is 100 grams per day.

T F 7. Excess dietary carbohydrate is converted into fat in the body.

T F 8. Honey is much superior nutritionally to table sugar.

T F 9. Cellulose is a polysaccharide that is not digested in the small intestine.

T F 10. In moderation, sugars pose no major health threat except for an increased risk of dental caries.

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Worksheet 2-2: Chapter 2 Review

1. The two main categories of simple carbohydrates are:

   a. b.

2. The complex carbohydrates (polysaccharides) are:

   a. c.

   b.

3. The monosaccharides (single sugars) are:

   a. c.

   b.

4. The disaccharides (double sugars) are:

   a. c.

   b.

5. The energy-yielding polysaccharides are:

   - _____ (from plants)
   - _____ (from animal sources)

6. Fibers are classified by their solubility in water into:

   a. b.

7. Factors that influence the development of dental caries (by influencing the length of time a cariogenic food is in the mouth) include:

   a. c.

   b. d.

8. Names on ingredient lists of food products which you recognize as sugar include:

   a. d.

   b. e.

   c.

9. Sugar alcohols are nutritive sweeteners with _____ kcalories per gram.

10. Sugars and starches yield _____ kcalories per gram.

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11. Alternative, artificial sweeteners which are nonnutritive include:

    a. d.

    b. e.

    c.

12. Insoluble fibers may benefit health by:

    a. b.

13. Soluble fibers may benefit health by:

    a. c.

    b.

14. Food sources of complex carbohydrate (starch and fiber) are:

    - Grains Group portion example _____
    - Vegetables Group portion example _____
    - Fruits Group portion example _____
    - Meat & Beans Group portion example _____

15. It is recommended that no more than _____% of total kcalories from concentrated sugars (according to the WHO).

16. Food labels must list the amount in grams of the following carbohydrate components:

    a. c.

    b.

17. The body stores glucose in:

    a. b.

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Worksheet 2-3: Food Examples of Nutrients and Other Food Components

Please complete the chart below by listing one good food source for each nutrient, compound, or food element term. Name a food or beverage, not a nutrient or chemical compound. This exercise will test whether you can apply the material on nutritional biochemistry in a practical way. You may use the same food as an example as many times as you wish.

Correct and incorrect examples:

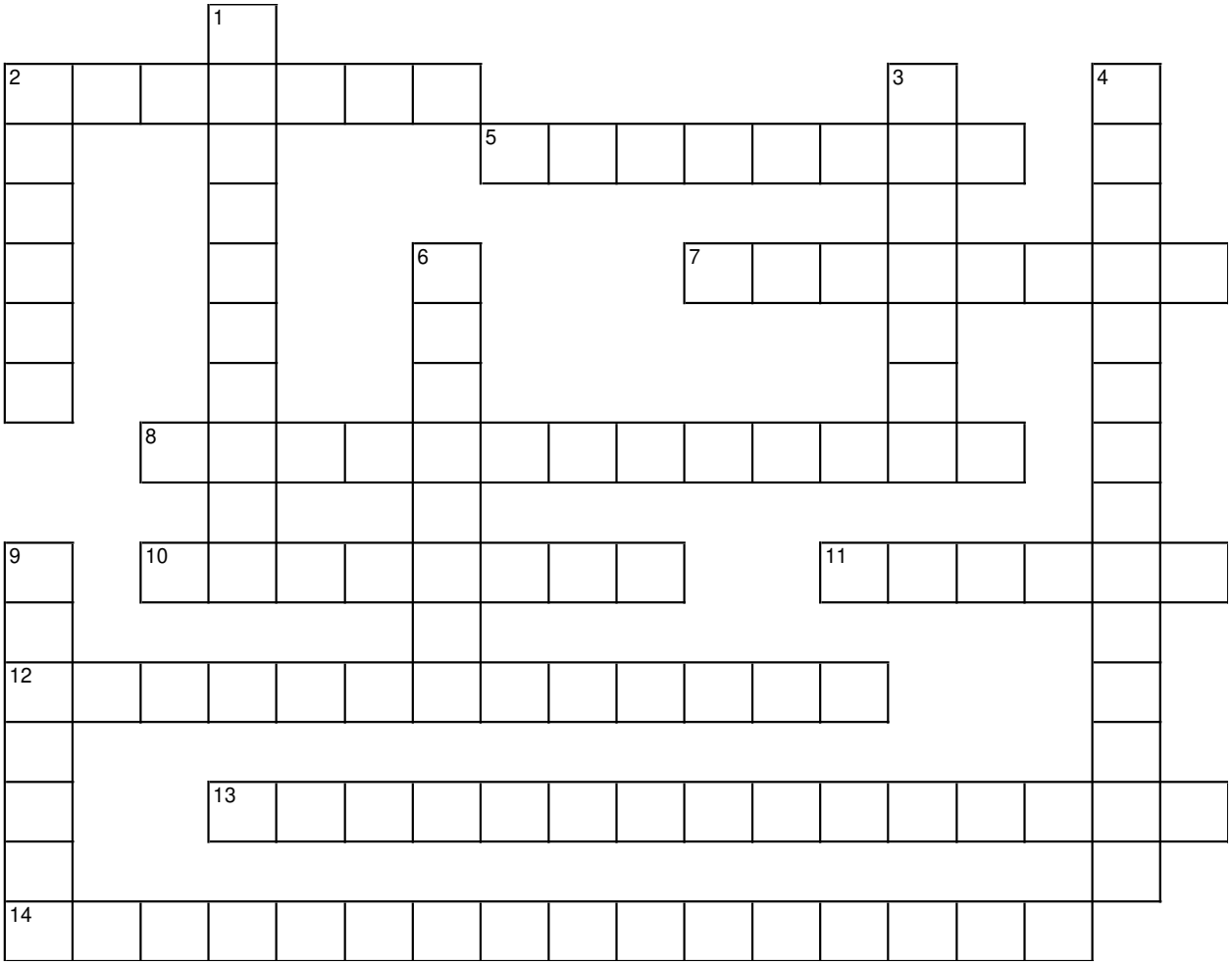
Food term, nutrient, compound or food element	**One good example of a significant food or beverage source**
Simple carbohydrate	brown sugar *(correct)*
Fructose	honey *(correct)*
Fructose	sucrose *(incorrect: not a food name)*

Food term, nutrient, compound, or food element	**One good example of a significant food or beverage source**
monosaccharide	
disaccharide	
polysaccharide	
complex carbohydrate	
starch	
lactose	
sucrose	
insoluble fiber	
soluble fiber	
pectin	
lignin	
cellulose	
sugar alcohol	
nonnutritive sweetener	
cariogenic food	

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Worksheet 2-4: Carbohydrates Crossword



Across:	Down:
2. A disaccharide composed of glucose and fructose 5. Sugar ___ are sugarlike compounds that yield 2 to 3 kcal per gram. 7. A hormone that is secreted by the pancreas and elicits release of glucose from storage 8. Pairs of sugar units bonded together. 10. A polysaccharide composed of glucose that is made and stored by liver and muscle tissues of human beings and animals 11. The gradual decay and disintegration of a tooth is known as dental ___. 12. Indigestible food components that readily dissolve in water and often impart gummy or gel-like characteristics to foods 13. Long chains of monosaccharide units 14. Zero-kcalorie sweeteners derived from the sweetest part of a native South American plant	1. ___ sweeteners are noncarbohydrate, nonkcaloric synthetic sweetening agents. 2. A plant polysaccharide composed of glucose and digestible by human beings 3. A monosaccharide common to all disaccharides and polysaccharides 4. The tough, indigestible, fibrous structures of fruits, vegetables, and grains 6. A monosaccharide abundant in fruits, honey, and saps 9. Having a gel-like consistency

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