

# Chapter 2 :

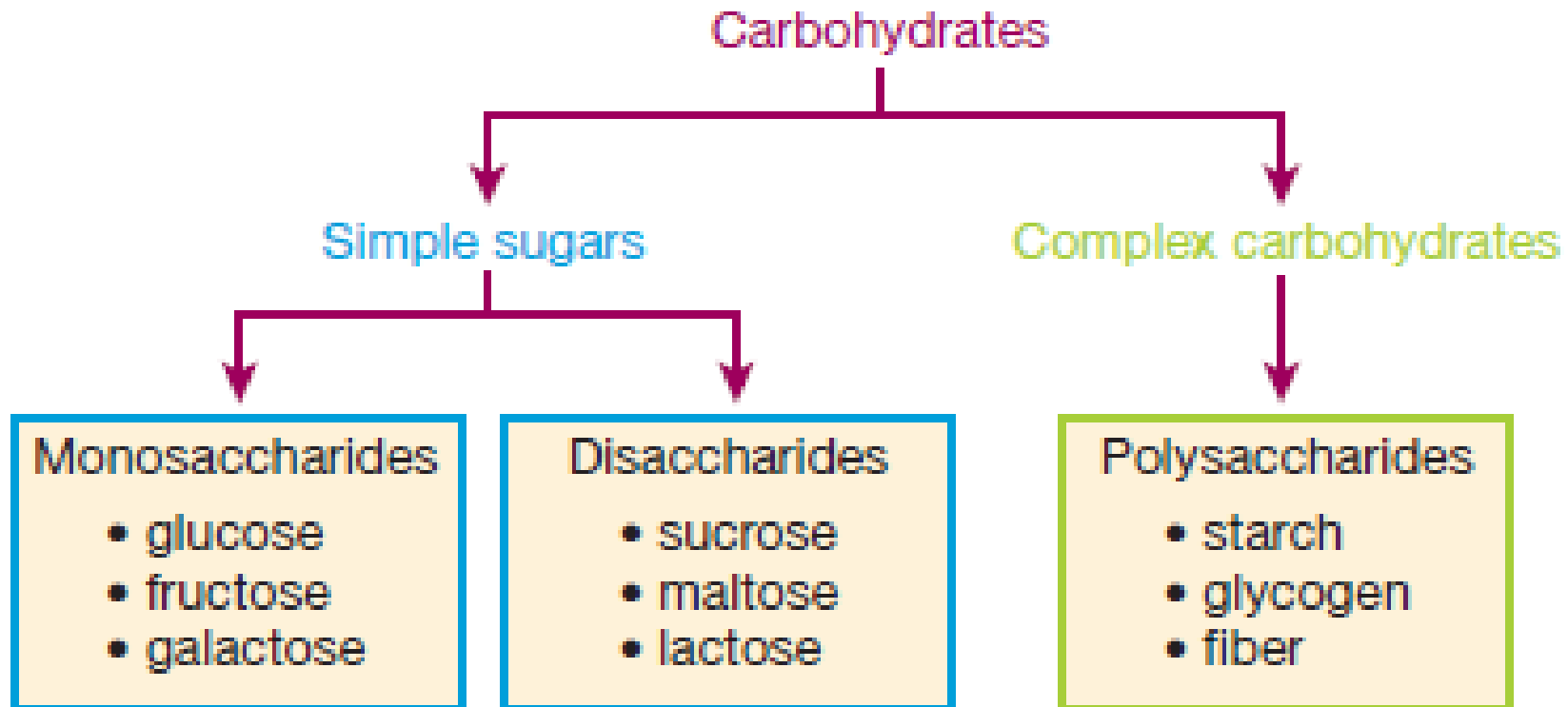
# Carbohydrates

# Introduction

- Provides majority of calories in human body
- Not only in sugars and breads



# Classifications



# Dietary Fibers

- A group name for polysaccharides that cannot be digested by human enzymes.
- Classified to :
  - Soluble
  - Insoluble

# Dietary Fibers

- ✓ It is not digested by human enzymes
- ✓ May trap macronutrients eaten at the same time
- ✓ Prevent them from being absorbed

**Fiber does not provide any calories**

# Dietary Fibers

- **Soluble fibers** are fermented by bacteria in the colon to produce carbon dioxide, methane, hydrogen, and short-chain fatty acids which serve as a source of energy (calories) for the mucosal lining of the colon.

## TYPES, PHYSIOLOGICAL EFFECTS, AND SOURCES OF SOLUBLE AND INSOLUBLE FIBER

Soluble Fiber (More Fermentable)	Insoluble Fiber (Less Fermentable)
<p><b>Types</b></p> <ul style="list-style-type: none"> <li>Pectin</li> <li>Some hemicelluloses</li> <li>Vegetable gums</li> <li>Psyllium</li> <li>Mucilages</li> </ul>	<p><b>Types</b></p> <ul style="list-style-type: none"> <li>Cellulose</li> <li>Many hemicelluloses</li> <li>Lignans</li> <li>Psyllium</li> </ul>
<p><b>Mixed with water</b></p> <p>Dissolve to form a viscous gel</p>	<p><b>Mixed with water</b></p> <p>Do not dissolve but act like a sponge in the intestine to soak up water</p>
<p><b>Physiologic effects</b></p> <ul style="list-style-type: none"> <li>Slow gastric emptying time</li> <li>Promote a feeling of fullness</li> <li>Delay and blunt the rise in serum glucose after eating</li> <li>Lower serum cholesterol, possibly by trapping cholesterol which increases cholesterol excretion</li> </ul>	<p><b>Physiologic effects</b></p> <ul style="list-style-type: none"> <li>Increase stool bulk</li> <li>Promote laxation</li> <li>Prevent constipation</li> </ul>
<p><b>Best Sources</b></p> <ul style="list-style-type: none"> <li>Dried peas and beans</li> <li>Lentils</li> <li>Oats</li> <li>Certain fruits and vegetables</li> </ul>	<p><b>Best Sources</b></p> <ul style="list-style-type: none"> <li>Whole wheat bread and cereals</li> <li>Certain fruits and vegetables</li> </ul>

# Dietary Fibers

## Fiber Content of Selected Foods

Food Source	Soluble Fiber (g)	Insoluble Fiber (g)	Total Fiber (g)
<b>Grains</b>			
Barley, ½ cup cooked	1	3	4
Oatmeal, ½ cup cooked	1	1	2
Popcorn, popped, 3 cups	0.1	1.9	2
Puffed wheat cereal, 1 cup	0.5	0.5	1.0
Spaghetti, white, ½ cup	0.4	0.5	0.9
Spaghetti, whole wheat, ½ cup	0.6	2.1	2.7
White bread, 1 slice	0.3	0.3	0.6
Whole wheat, 1 slice	0.3	1.2	1.5
<b>Dried Peas and Beans (½ Cup Cooked)</b>			
Black beans	2.4	3.7	6.1
Black-eyed peas	0.5	4.2	4.7
Kidney beans, light red	2	5.9	7.9
Lima beans	3.5	3	6.5
Pinto beans	1.4	4.7	6.1
Lentils	0.6	4.6	5.2

*(table continues on page 23)*



# Dietary Fibers

## Fiber Content of Selected Foods (continued)

Food Source	Soluble Fiber (g)	Insoluble Fiber (g)	Total Fiber (g)
<b>Fruit (1 Medium)</b>			
Apple	1	3	4
Bananas	1	2	3
Blackberries (½ cup)	1	3	4
Orange	2	0–1	2–3
Pears	2	2	4
Prunes (¼ cup)	1.5	1.5	3
<b>Vegetables (½ Cup Cooked)</b>			
Broccoli	1	0.5	1.5
Brussels sprouts	3	1.5	4.5
Carrots	1	1.5	2.5
Cauliflower	0.4	0.6	1.0
Corn, canned	0.2	1.4	1.6
Okra, frozen	1	3.1	4.1
Peas, frozen	1.3	3.0	4.3

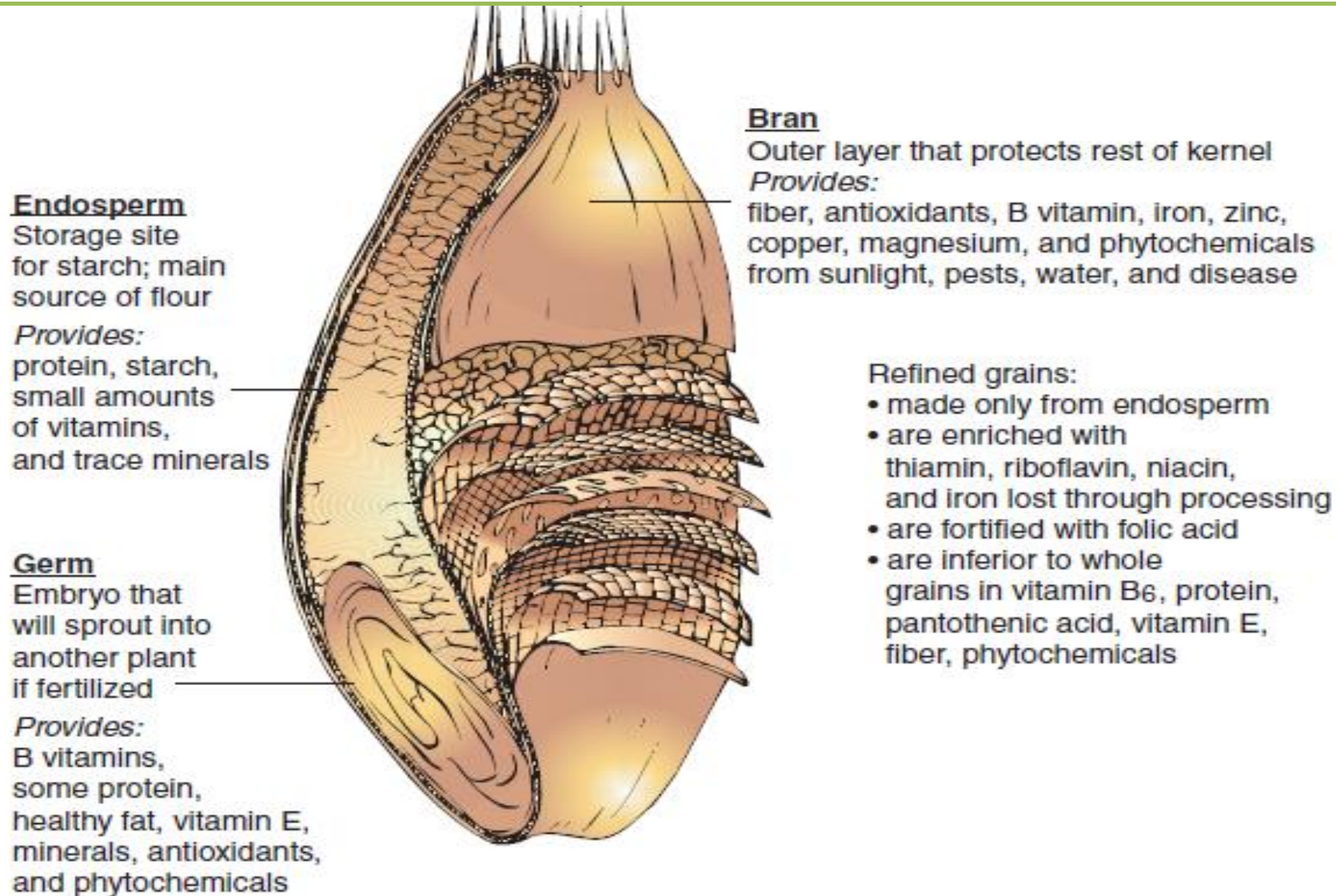
# Sources of Carbohydrates



# Grains

- Consists of:
  1. Grains
    - (e.g., wheat, barley, oats, rye, corn, and rice)
  2. Products made with flours from grains
    - (e.g., items made with wheat flour, such as bread, crackers, pasta, and tortillas)

# Grains Classification



## **Enrichment**

adding back  
certain nutrients  
(to specific levels)  
that were lost  
during processing.

## **Fortification**

adding nutrients  
that are not  
naturally present  
in the food or  
were present in  
insignificant  
amounts.

# Grains

- Each **1 ounce** of grains have **15 grams CHO**
- 1 ounce equivalence :
  - 1 slice of bread
  - $\frac{1}{2}$  cup cereals / cooked rice / pasta

# Vegetables

- A **1/2 cup** serving of “**starchy**” vegetables provides **15 g** CHO
  - Corn, Lentils ,Peas, Potato , Sweet potato
- The same amount of “**watery**” vegetables provides **5 g** CHO
  - Asparagus ,Bean sprouts, Broccoli, Carrots, Green beans ,Greens, Okra, Tomato

# Fruits

- All of the calories come from fruits, mostly as **fructose**
- **Except : Avocado , olives , coconut**
- a serving of fruit, defined as :
  - 3/4 cup of juice
  - 1 piece of fresh fruit
  - 1/2 cup of canned fruit
  - 1/4 cup of dried fruit
    - provides **15 g** of carbohydrate and approximately **2 g fiber**





## Q U I C K B I T E

The effect of processing on fiber content

	<i>Fiber (g/serving)</i>
Unpeeled fresh apple (1)	3.0
Peeled fresh apple (1)	1.9
Applesauce ( $\frac{1}{2}$ cup)	1.5
Apple juice ( $\frac{3}{4}$ cup)	Negligible

# Milk

- One cup of milk, regardless of the fat content, provides 12 g of carbohydrate in the form of lactose.
- Flavored milk, yogurt and ice cream have more added sugars !!

# CHO and Fiber Requirements

- CHO :
  - 45% to 65% of total calories
- Total Fibers:
  - 14 g/1000 calories or 25 g/day for women and 38 g/day for men
- Sugar :
  - a maximal level of 25% of total calories or less from added sugars is recommended

# **Functions of Carbohydrates**

# 1. Glucose for Energy

- Glucose is burned more efficiently and more completely than either protein or fat.
- The **brain** is totally dependent on glucose for energy.
- All digestible carbohydrates provide 4 cal/g consumed.

## 2. Protein Sparing

- Consuming adequate carbohydrate to meet energy needs has the effect of “sparing protein” from being used for energy, leaving it available to do its special functions.
- Especially whenever protein **needs are increased** such as ...

## 3. Preventing Ketosis

- Without adequate glucose, fat oxidation prematurely stops at the intermediate step of **ketone body** formation

## 3. Preventing Ketosis

- An increased production of ketone bodies and their accumulation in the bloodstream causes:
  - Nausea
  - Fatigue
  - Loss of appetite
  - Ketoacidosis



# 4. Using Glucose to Make Other Compounds

- **1. Glycogen**
- **2. Nonessential Amino Acids**
- **3. Carbohydrate-Containing Compounds**
  - Ribose ( in DNA, RNA)
  - keratin sulfate (in fingernails)
  - hyaluronic acid (found in the fluid that lubricates the joints)

# 4. Using Glucose to Make Other Compounds

- **4. Fat :**

After energy needs are met glycogen stores are saturated, and other specific compounds are made

- converted by liver cells to **triglycerides** and stored in the body's fat tissue.

# CHO in Health Promotion

# Concentrate on Fibers and Whole Grains



# Whole Grains

- To relieve or prevent **constipation**
- Provide **fiber** and a “**whole package**” of healthful components, such as essential fatty acids, antioxidants, vitamins, minerals, and phytochemicals

# Whole Grains

*The Dietary Guidelines* recommend that adults and children consume **at least one-half of their grain** servings of whole grains

# Proof

- People who eat **three or more servings** of whole grains daily:
  - have a 20% to 30% lower risk of atherosclerotic cardiovascular disease
  - are less likely to develop insulin resistance and metabolic syndrome
  - improved body weight management

# Whole Grains and Weight

- They are generally less **calorically dense** than refined foods
- High in bulk
  - They may take longer to consume; and prolong gastric emptying, delaying the return of hunger



Reflect on yesterday to calculate your fiber intake.

1. *Multiply total number of servings of fruit and vegetables per day by 1.5 grams of fiber.*

**Example:** 5 servings x 1.5 = 7.5 grams of fiber

Yesterday, I had \_\_\_\_\_ servings x 1.5 = \_\_\_\_\_ grams of fiber from fruits and vegetables

2. *Multiply servings of refined grains by 1.0 grams of fiber. Refined grains include white flour, white bread, white rice or pasta and cereals such as cheerios, frosted flakes, corn flakes.*

**Example:** 4 servings x 1.0 = 4 grams of fiber

Yesterday, I had \_\_\_\_\_ servings x 1.0 grams of fiber = \_\_\_\_\_ grams of fiber from refined grains.

3. *Multiply servings of whole grains by 2.5 grams of fiber. Whole grains are whole wheat breads, flours, cereals, brown rice or pastas.*

**Example:** 3 servings x 2.5 = 7.5 grams of fiber

Yesterday, I had \_\_\_\_\_ servings x 2.5 grams of fiber = \_\_\_\_\_ grams of fiber from whole grains.

4. *Multiply servings of high fiber foods by 5 grams of fiber. High fiber foods may include beans or high fiber cereal.*

**Example:**    cup of black beans or 1 high fiber serving x 5 = 5 grams of fiber

Yesterday, I had \_\_\_\_\_ servings x 5 grams of fiber = \_\_\_\_\_ grams of fiber from high fiber foods.

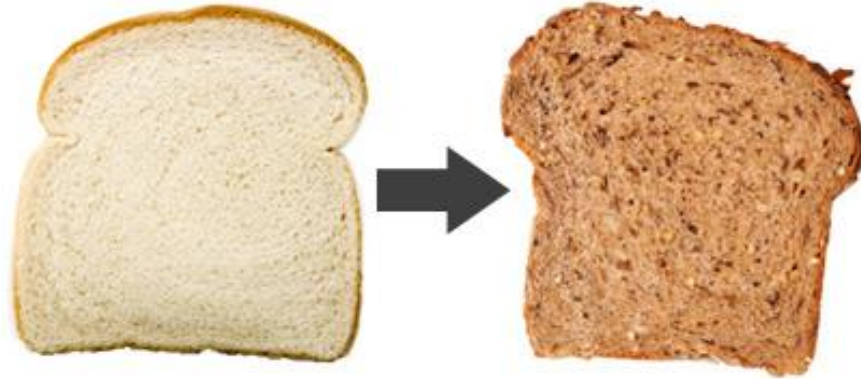
**TOTAL:** \_\_\_\_\_ grams of fiber for day

*Add up your total grams of fiber from each category, #1-4.*

*This is an estimate of how many grams of fiber you are getting per day.*

# Ways to increase fiber intake ???

- whole wheat bread
- half of the white flour in pancakes, waffles, muffins, quick breads, and cookies with whole wheat flour or oats



- whole wheat bread or cracker crumbs as a coating or breading for meat, fish, and poultry

# Limit Added Sugars

High added sugar foods are likely to be “empty calories” !!!

- Displace more nutritious foods
- Calorie intake will be excessive (if empty calorie foods are added to the diet)

# WAYS TO LIMIT ADDED SUGARS

- **Cut Back or Eliminate Sugar-Sweetened Soft Drinks**
  - every can of soft drink provides **9 to 10** teaspoons of added sugar
- **Rely on Natural Sugars in Fruit to Satisfy a “Sweet Tooth”**
- **Cut Sugar in Home-Baked Products, If Possible**
- **Read Labels**
  - Corn syrup, Dextrose, Fructose, Fruit juice concentrate, HFCS, Honey, Molasses
- **Consider Using Sugar Alternatives ????**

# Sugar Alternatives

- **Sugar Alcohols**
  - (e.g., sorbitol, mannitol, xylitol)
- **Nonnutritive Sweeteners**

# Sugar Alcohols

- Small amounts are found in some fruits and berries
- Commercially synthesized and used as alternative sweeteners
- low-calorie sweeteners → absorbed slowly and incompletely  
→ produce a smaller effect on blood glucose levels and insulin secretion

# Sugar Alcohols

- Approved to use in
  - candies, chewing gum, jams and jellies, baked goods, and frozen confections
- Offer sweetness without promoting **cavities**
- Some people experience a **laxative effect**.

# Nonnutritive Sweeteners

- Calorie free
- Hundreds to thousands of times sweeter than sugar
- They do not raise **blood glucose levels**



## Nonnutritive Sweeteners Approved for Use in the United States

Sweetener	Sweetness (Sucrose = 1)	Taste Characteristics	Uses	Comments
Saccharin (Sweet Twin™, Sweet 'n Low™)  saccharin	200–700	Persistent aftertaste; bitter at high concentrations	Soft drinks, assorted foods, tabletop sweetener	Potential (weak) carcinogen; the FDA has officially withdrawn its proposed ban so warning labels no longer required
Aspartame (NutraSweet™, Equal™, Spoonful™)	180	Similar to sucrose; no aftertaste	Tabletop sweeteners, dry beverage mixes, chewing gum, beverages, confections, fruit spreads, toppings, and fillings	Made from the amino acids aspartic acid and phenylalanine; people with PKU must avoid aspartame

Acesulfame K (Sunette™, Sweet One™)	130–200	Bitter aftertaste like saccharin	Tabletop sweeteners, dry beverage mixes, and chewing gum	Often mixed with other sweeteners to synergize the sweetness and minimize the aftertaste Not digested; excreted unchanged in the urine
acesulfame sucralose neotame				
Sucralose (Splenda™)	600	Maintains flavor even at high temperatures	Soft drinks, baked goods, chewing gums, and tabletop sweeteners	Poorly absorbed; excreted unchanged in the feces
Neotame	8000	Clean, sugar- like taste; enhances flavors of other ingredients	Under review	Made from aspartic acid and phenylalanine but is not metabolized to phenylalanine so a warning label is not required Has the potential to replace both sugar and HFCS

# Risks and Benefits of Nonnutritive Sweeteners

*Weight management*

*????????!!!!*

# *Safety*

The ADI of aspartame is 50 mg/kg of body weight

\*\* average intake is only 3 mg/kg !

- For most adults, nonnutritive sweeteners are safe
- For pregnant women and children (the approved ones only: within the intake guidelines)

