

## Chapter 3

# Carbohydrates



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# Introduction

- Carbohydrates
  - Preferred energy source for many of the body's functions
  - When available, used exclusively by brain as an energy source
  - Should not be avoided when trying to lose weight
    - Portion size and balance of nutrients is important

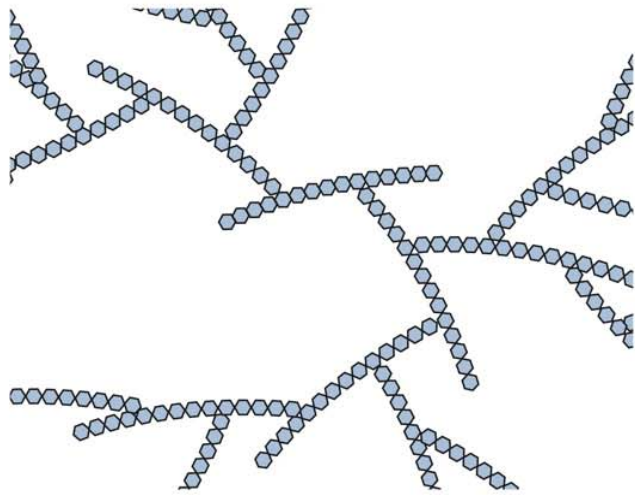


# Dietary carbohydrates

– Polysaccharides: chains of monosaccharides

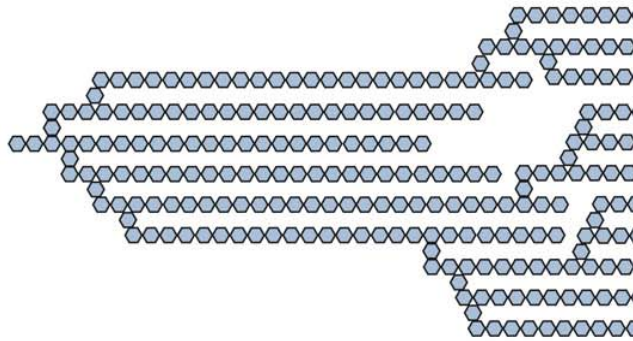
- **Starch**: hundreds of glucose molecules in either occasionally branched chains or unbranched chains
- **Glycogen** highly branched polysaccharide?
- **Dietary** fibers: found in plant-derived foods; non-digestible by human digestive enzymes





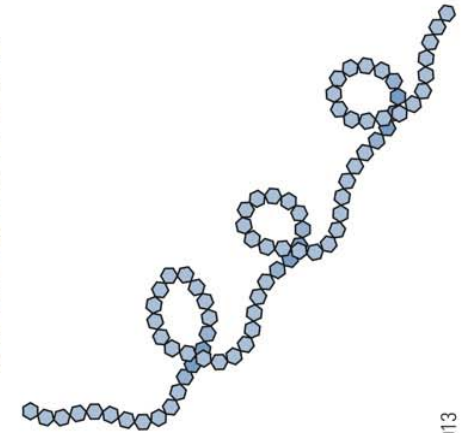
Glycogen

A glycogen molecule contains hundreds of glucose units in highly branched chains.



Starch (branched)

A starch molecule contains hundreds of glucose molecules in either occasionally branched chains or unbranched chains.



Starch (unbranched)



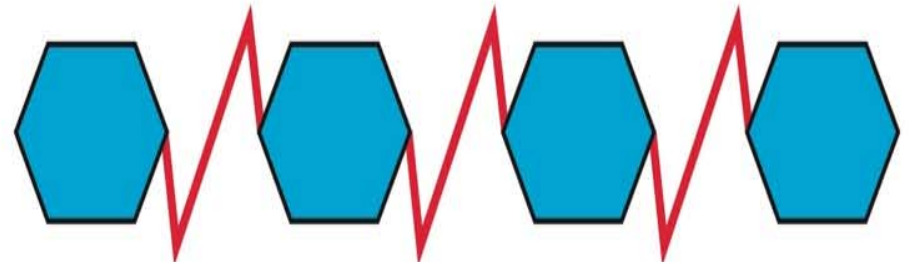
Human enzymes can digest starch, but they cannot digest cellulose (fiber)



Starch

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$1\alpha \rightarrow 4$  linkage  
Can be digested by humans



Cellulose

$1\beta \rightarrow 4$  linkage  
Cannot be digested –  
Except termites



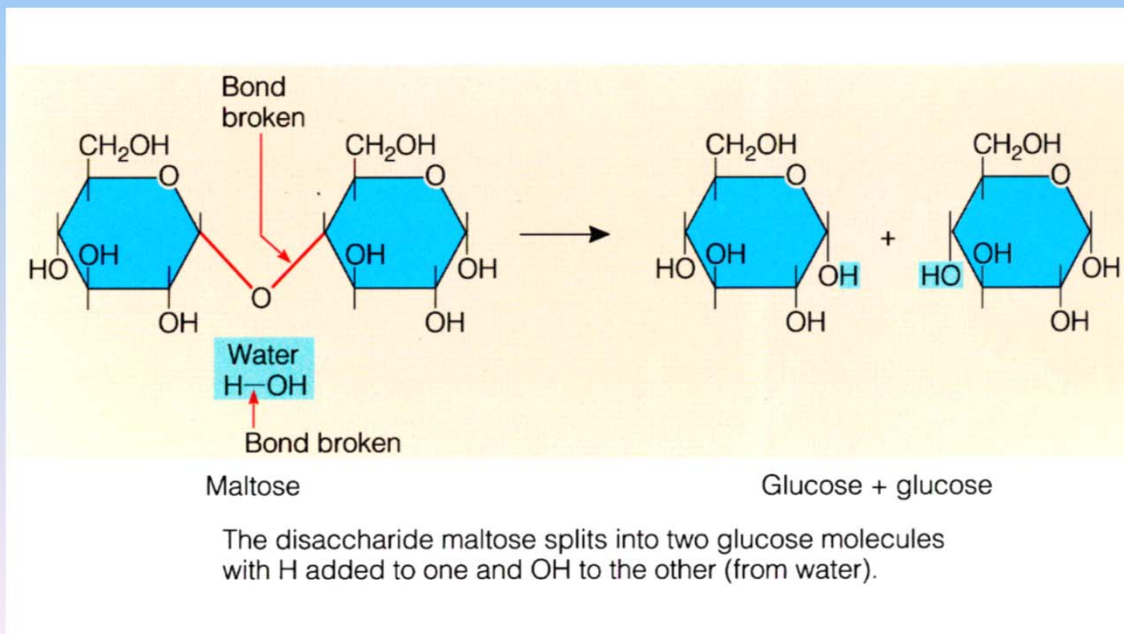
# The Chemist's View of Carbohydrate

- Other notes regarding **fibers**
  - Digestion resistant starches: classified as fibers
  - Some fibers: digested by bacteria in the human digestive tract
  - Fiber groups: soluble and insoluble fibers



# Digestion and Absorption of Carbohydrates

- Goal of digestion and absorption of sugars and starches
  - Break them into small molecules that body can absorb and use



A sign that you consume too much sugar...



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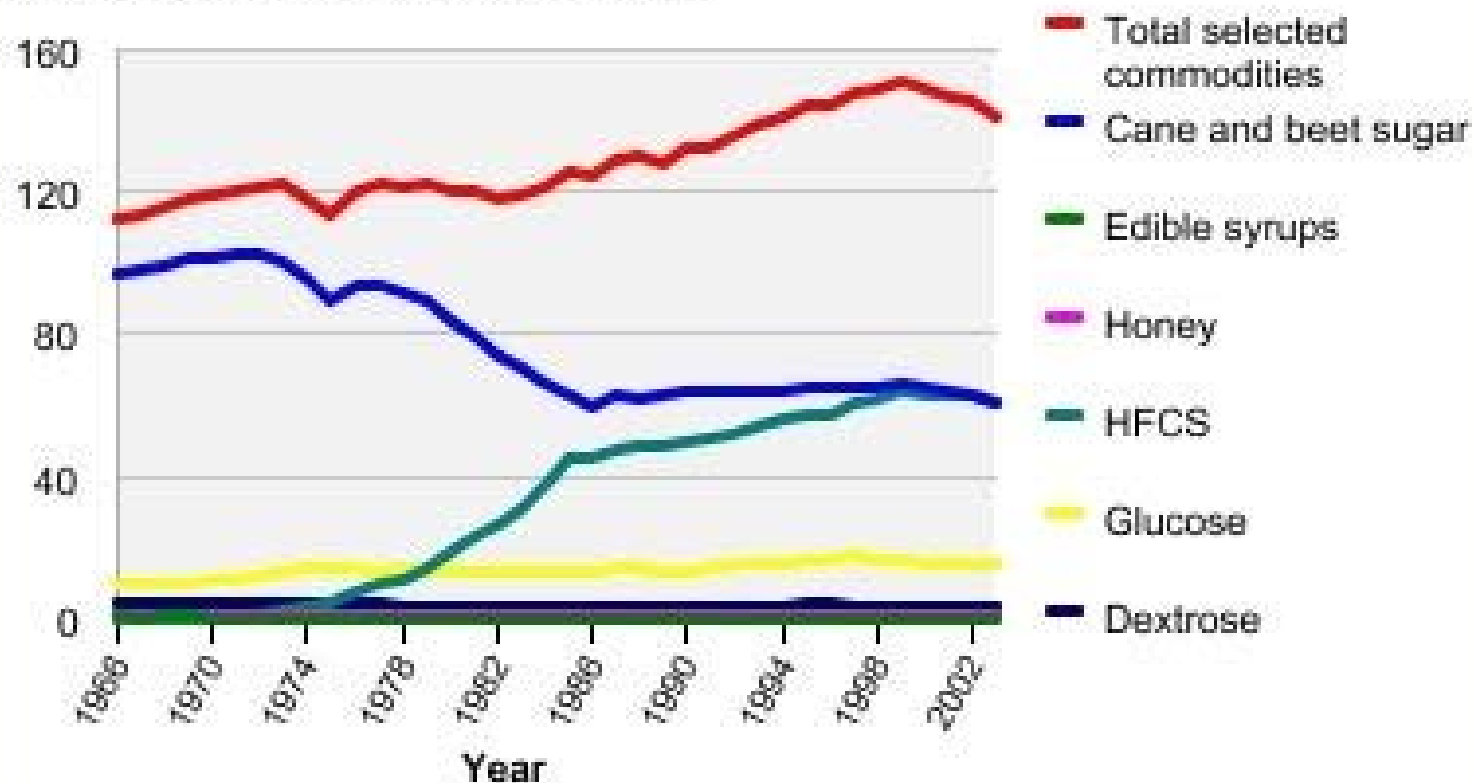
# Health Effects of Added Sugars?

- Added sugars
  - Consumption in recent decades
    - Dramatic upward trend
  - Leading source
    - Soft drinks
  - Excessive amounts
    - Linked to obesity, heart disease, nutrient deficiencies, and dental caries



## U.S. per capita food consumption *Sugar and sweeteners (individual)*

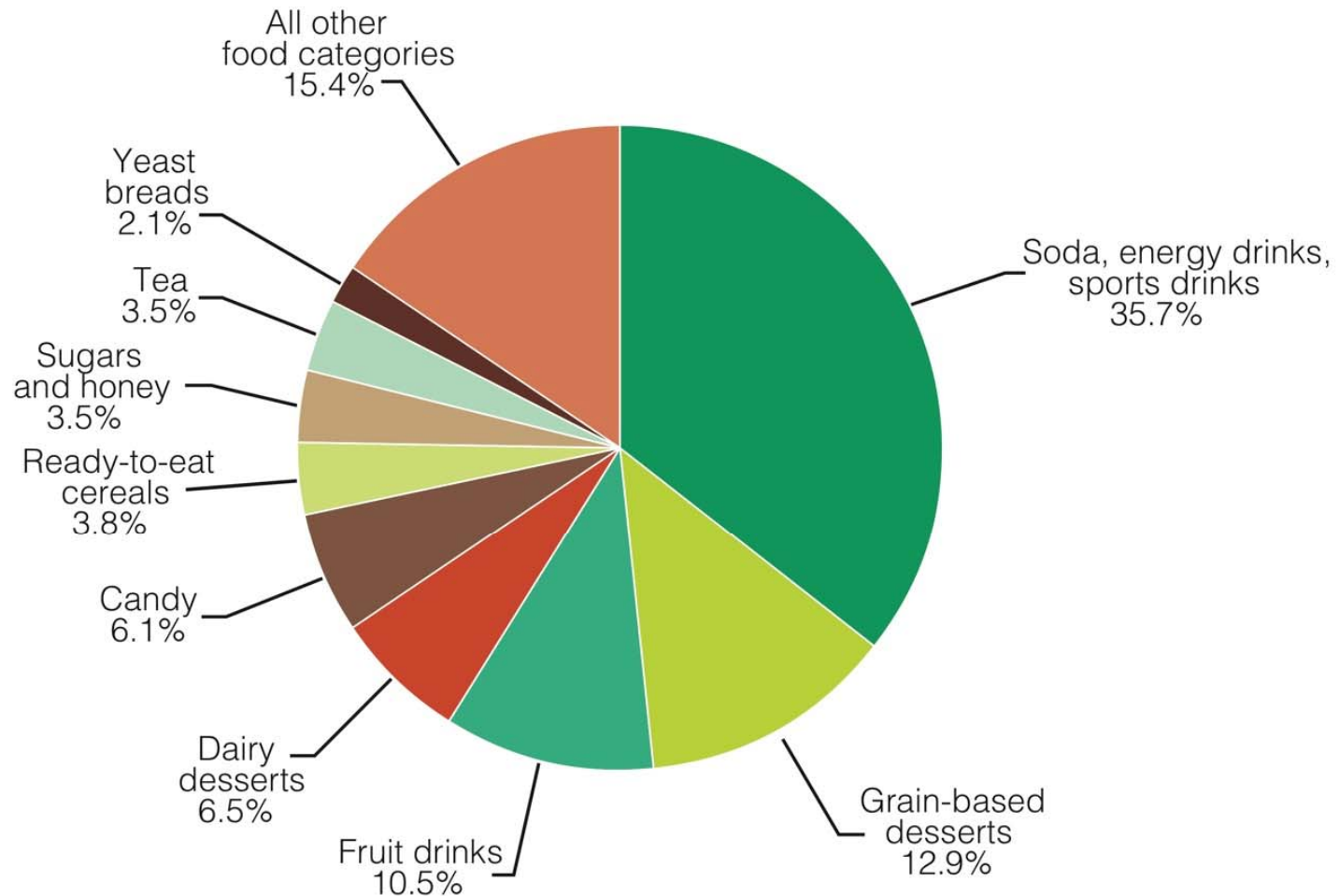
Dry weight, pounds per capita per year



HFCS stands for high fructose corn syrup. Calculated from unrounded data.

Source: USDA/Economic Research Service. Last updated Dec. 21, 2004.





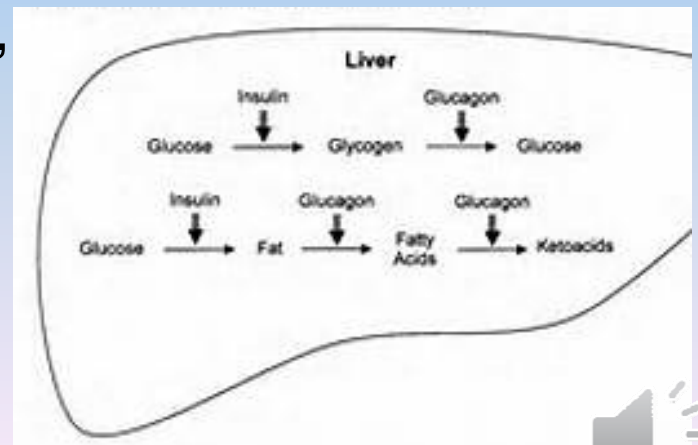
<sup>a</sup>NHANES data, 2005–2006.

Source: U.S. Department of Agriculture and U.S. Department of Health and Human Services, *Dietary Guidelines for Americans 2010*, available at [www.dietaryguidelines.gov](http://www.dietaryguidelines.gov). Figure 3-6, p. 29.



# Regulation of Blood Glucose

- Blood glucose homeostasis
  - Insulin's role in regulating blood glucose
    - Facilitates blood glucose uptake by the muscles and adipose tissue
    - Stimulates glycogen synthesis in the liver
  - Glucagon
    - Triggers the breakdown of liver glycogen to single glucose molecules
    - Remember “Starve-feed cycle”



# Dietary Requirements:

Absolute Requirement Not Established  
However Requires About 50 gm  
Or 200Kcal /day

1. Maintain Kreb's Cycle Intermediates
2. Spare Protein (Gluconeogenesis)
3. Prevent Ketosis

Recommended: 55% Total Calories

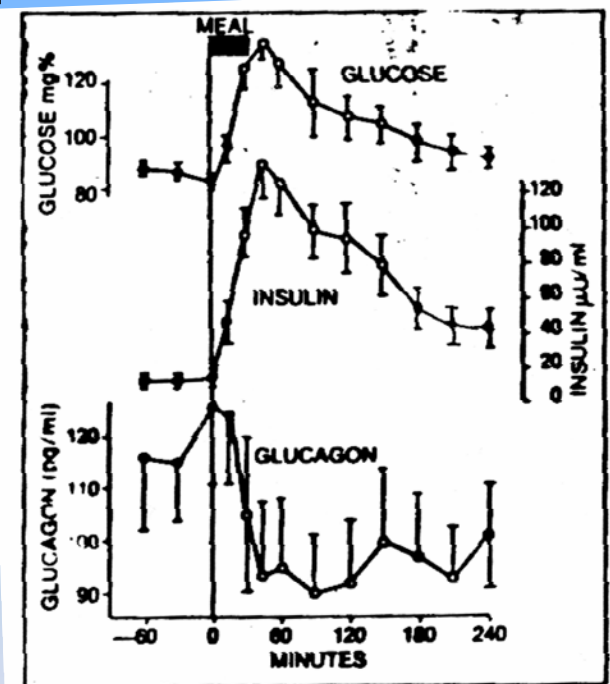


Fig. 13. Glucagon response to a carbohydrate meal in 11 normal adults.



# EAT NO CHO?

## Metabolic Effect Of CHO Free Diet

1. Ketosis
2. Breakdown Of Protein
3. Loss of Na<sup>+</sup>
4. Dehydration
5. These symptoms appear on the second day of CHO Free Diet.
6. Reversed by 100g of CHO/DAY.
7. Basis for weight loss on low CHO Diet.



# Hypoglycemia

- Blood Sugar < 40 mg/dl

- **EFFECTS**

- 1. Epinephrine
- 2. Tachycardia
- 3. Sweating, Anxiety
- 4. Hunger
- 5. Weakness
- 6. Confusion, Coma

**PROBLEM?:**

Not Specific for Hypoglycemia

**HYPOGLYCEMIA NOT A COMMON PROBLEM!**



**TABLE 3-3** Sample Nutrients in Sugars and Other Foods

The indicated portion of any of these foods provides approximately 100 kcalories. Notice that—for a similar number of kcalories and grams of carbohydrate—milk, legumes, fruits, grains, and vegetables offer more of the other nutrients than do the sugars.

	Size of 100 kCal Portion	Carbohydrate (g)	Protein (g)	Calcium (mg)	Iron (mg)	Vitamin A (µg)	Vitamin C (mg)
<b>Foods</b>							
Milk, 1% low-fat	1 c	12	8	300	0.1	144	2
Kidney beans	½ c	20	7	30	1.6	0	2
Apricots	6	24	2	30	1.1	554	22
Bread, whole wheat	1½ slices	20	4	30	1.9	0	0
Broccoli, cooked	2 c	20	12	188	2.2	696	148
<b>Sugars</b>							
Sugar, white	2 tbs	24	0	trace	trace	0	0
Molasses, blackstrap	2½ tbs	28	0	343	12.6	0	0.1
Cola beverage	1 c	26	0	6	trace	0	0
Honey	1½ tbs	26	trace	2	0.2	0	trace

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# Sugars Intake

- Recommended sugar intakes
  - Dietary Guidelines for Americans
    - Reduce the intake of kcals from added sugars
  - The USDA Food Patterns
    - Eight teaspoons for 2200 kcal (5 – 10 percent of day's total energy intake)
  - Recognize sugar in all its forms – e.g., added sugars



# Alternative Sweeteners: Nonnutritive Sweeteners

- Minimal or no carbohydrate or energy
- FDA endorsement
  - Safe over a lifetime within Acceptable Daily Intake (ADI) levels
- Do not cause tooth decay
- Safe?



# Health Effects: Dietary Fibers

- Carbohydrates: recommended intakes
  - DRI advises 45 to 65 percent of energy requirement
  - Daily Values: 60 percent of kcalories
  - Fiber (a type of Carb)
    - FDA proposes 25 grams per day
    - Adequate Intake (AI): 14 g/1000 kcal/day



# Health Effects of Starch and Dietary Fibers

- Fiber-rich carbohydrate foods
  - Lower risk of heart disease
  - Reduce the risk of type 2 diabetes
  - May enhance the health of the large intestine
  - Lower risk for colon cancer
  - Weight control



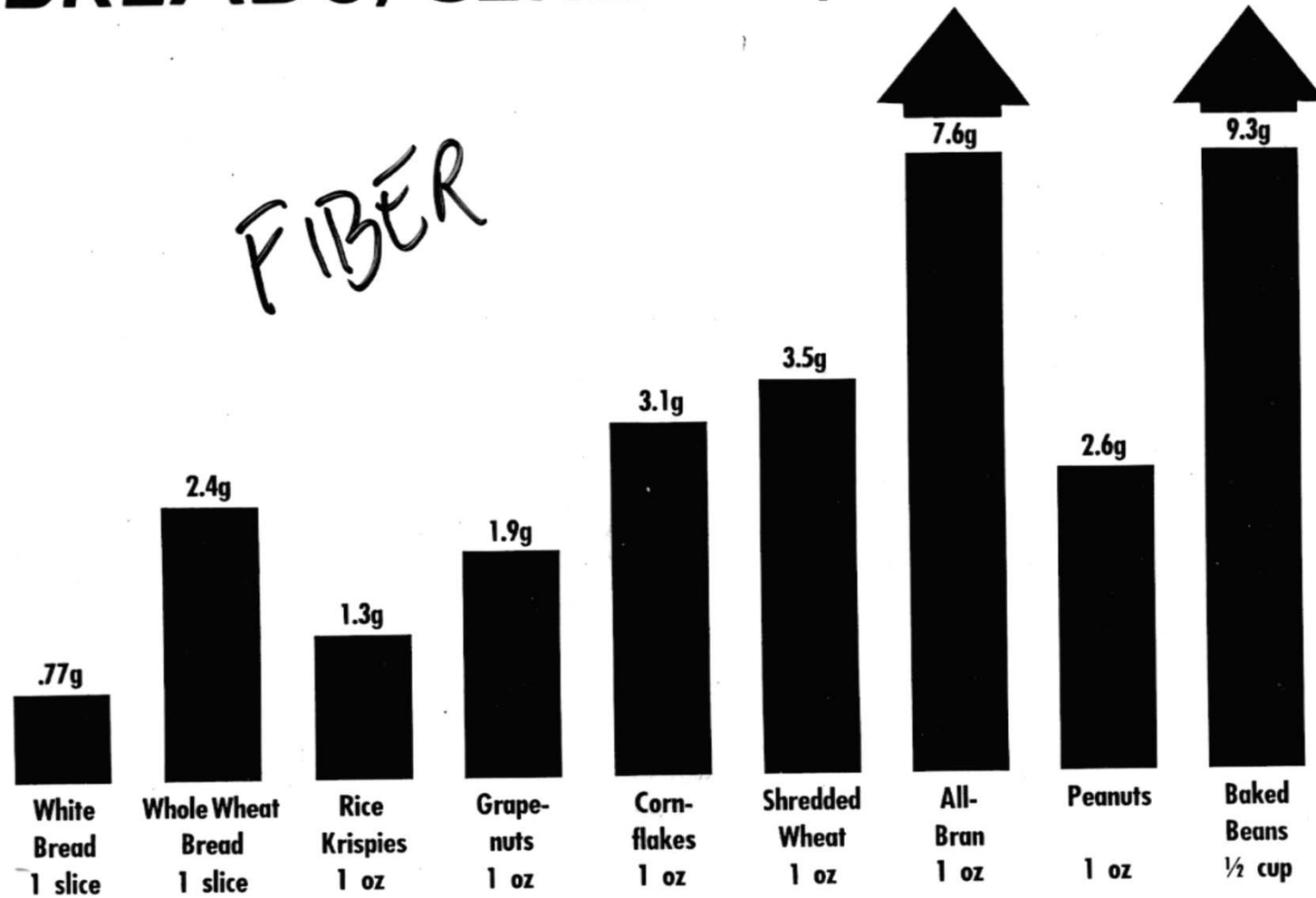
# Carbohydrates: food sources

- Grains
- Vegetables
- Fruits
- Milk and milk products
- Protein foods: limited to nuts and dry beans



# BREADS, CEREALS, LEGUMES

FIBER



# Health Effects of Starch and Dietary Fibers

- FDA authorized health claims
  1. Fiber-containing grain products, fruits, and vegetables: reduced risk of cancer
  3. Fruits, vegetables, and grain products that contain fiber: reduced risk of coronary heart disease
  4. Soluble fiber from whole oats and from psyllium seed husk: reduced risk of coronary heart disease
  5. Whole grains: reduced risk of heart disease and certain cancers



# END OF Carbohydrates PART 1

Nutrition for Health and Health Care, 5th Edition

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