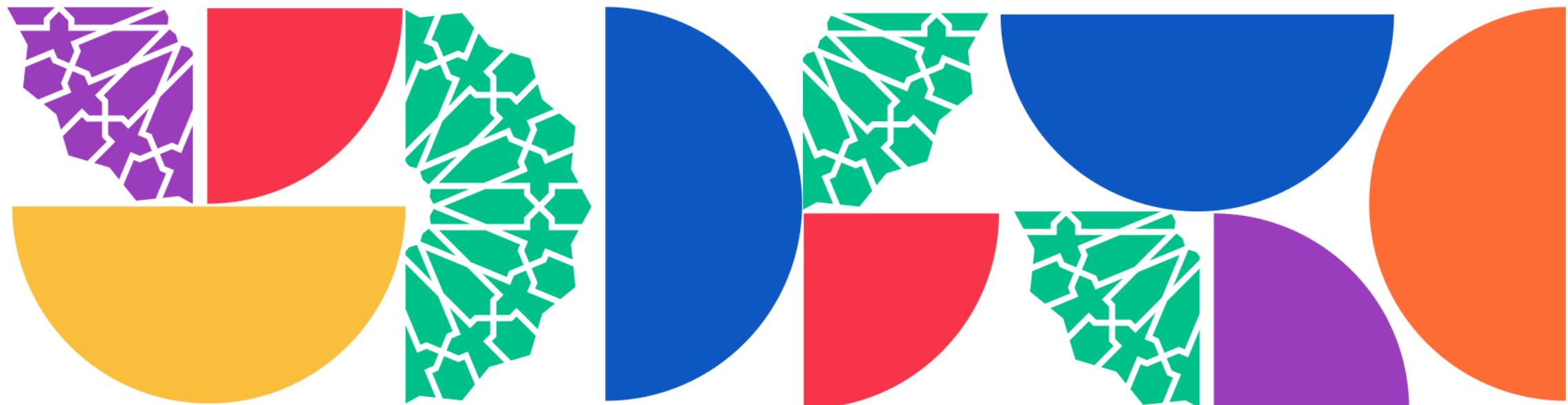


Health Awareness and Nutrition

Department of Clinical Nutrition and Dietetics

College of Health Sciences

Lecture 3: Carbohydrates



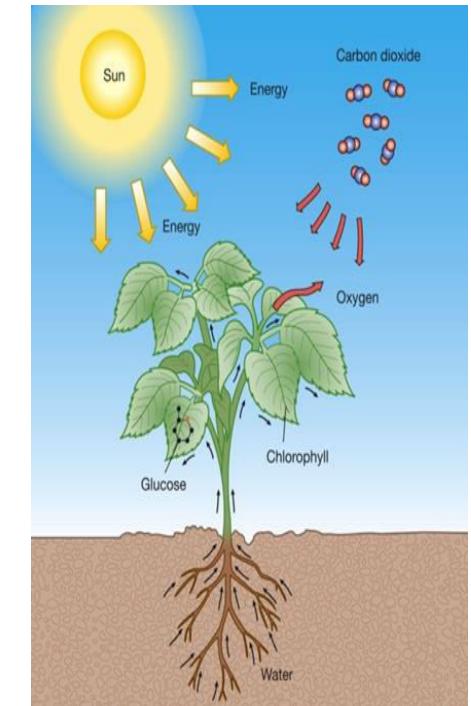
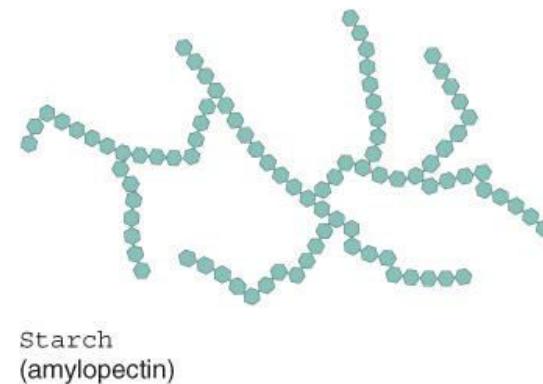
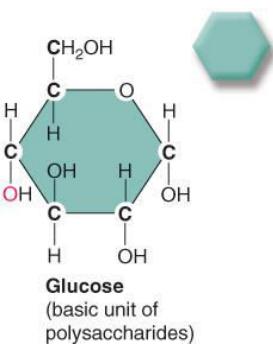
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What are carbohydrates (CHO)?

- Molecules
 - Carbon
 - Hydrogen
 - Oxygen
- Formed by plants via photosynthesis
- Stored in plants as starch



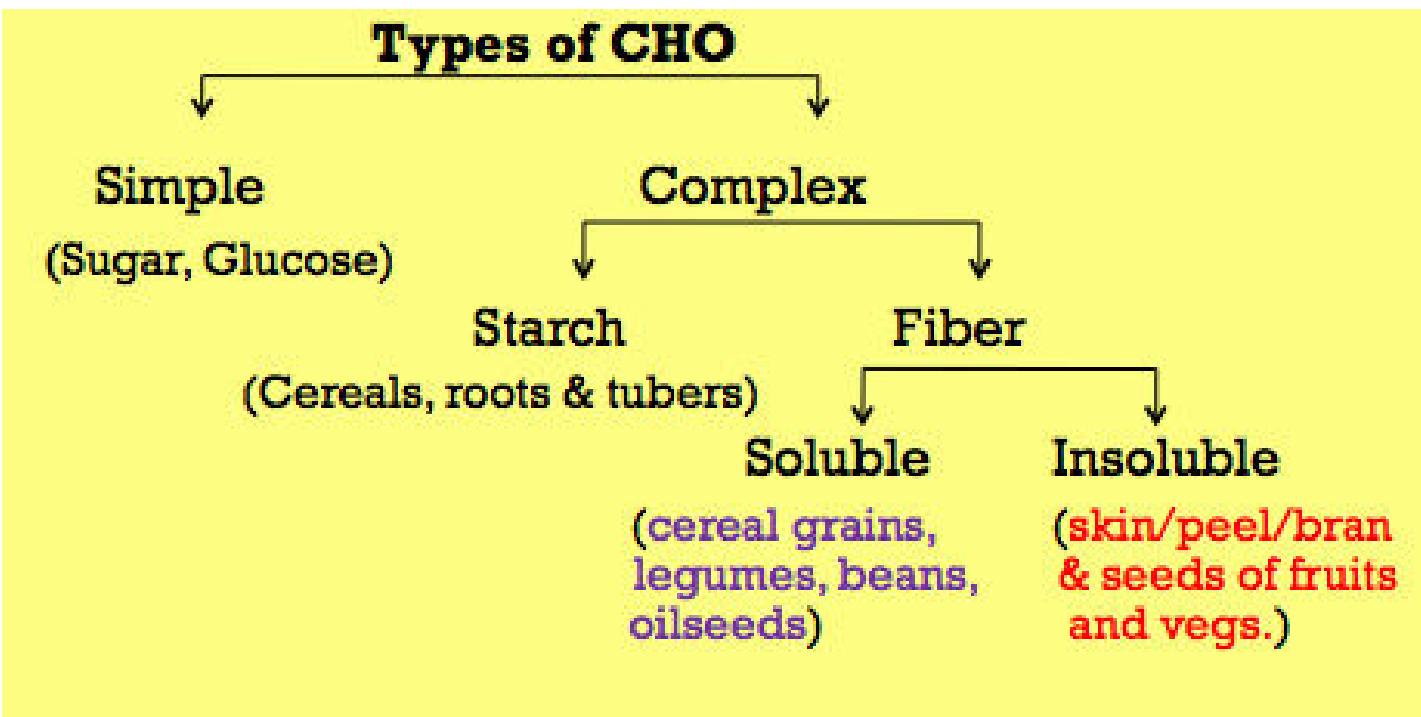


Carbohydrates are found in a wide variety of foods including breads, cereals, pastas, beans, fruits, vegetables, milk, and nuts.

CHO are widely available, low in cost, easily grown and easy to be stored for a long time as compared to many other food items

Classification of CHO

- CHOs can be classified according to their complexity (the number of sugar units making up their structure)





CHO Classification

- Simple CHOs
 - Monosaccharides
 - Disaccharides
- Complex CHOs
 - Polysaccharides

Simple Carbohydrates

They consist of just one or two molecules.

Examples include: sugars, and candies

Monosaccharides: 1 sugar unit

Require no digestion, are directly absorbed

- Glucose
- Galactose
- Fructose



Glucose



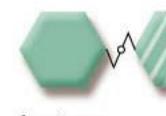
Galactose



Fructose

Disaccharides: 2 sugar units

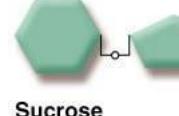
- Sucrose
- Lactose
- Maltose



Lactose



Maltose



Sucrose

Disaccharides

Disaccharides (Sucrose, maltose and lactose)

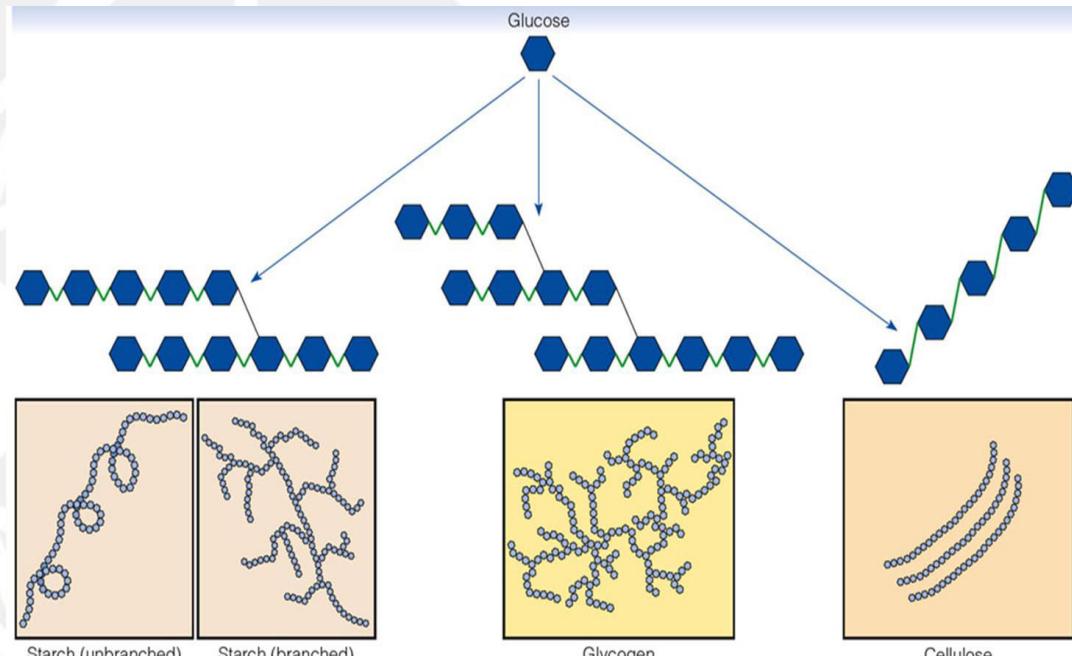
Require little digestion (to give glucose)

- **Sucrose:** is broken down to glucose + fructose
(Common table sugar)
- **Lactose:** is broken down to glucose + galactose
(Main milk sugar)
- **Maltose:** is broken down to glucose + glucose
(Found in starches)



Complex Carbohydrates

Polysaccharides



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Polysaccharides are chains of many sugars. They can consist of hundreds or thousands of monosaccharides.

They act as food stores for plants and animals.

Need to be broken down (digested) into smaller units (glucose) before being absorbed.

Examples include fruits, vegetables, beans, and whole grain pasta

- **glycogen:** which stores energy in the liver and muscles
- **starches:** which are abundant in potatoes, rice, and wheat
- **Fiber :**one of the main structural components of plants

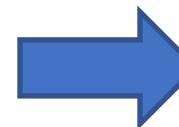
Polysaccharides

Glycogen:

- Similar in structure to starch
- is the form of storage of CHO in humans and animals.
- Glycogen is made and stored primarily in the cells of the liver and the muscles



Glycogen used
by the muscle



Polysaccharides



- Starch:

It consists of a large number of glucose units

It is produced by all green plants as an energy store

It is the most common carbohydrate in the human diet (potatoes, wheat, maize, rice)

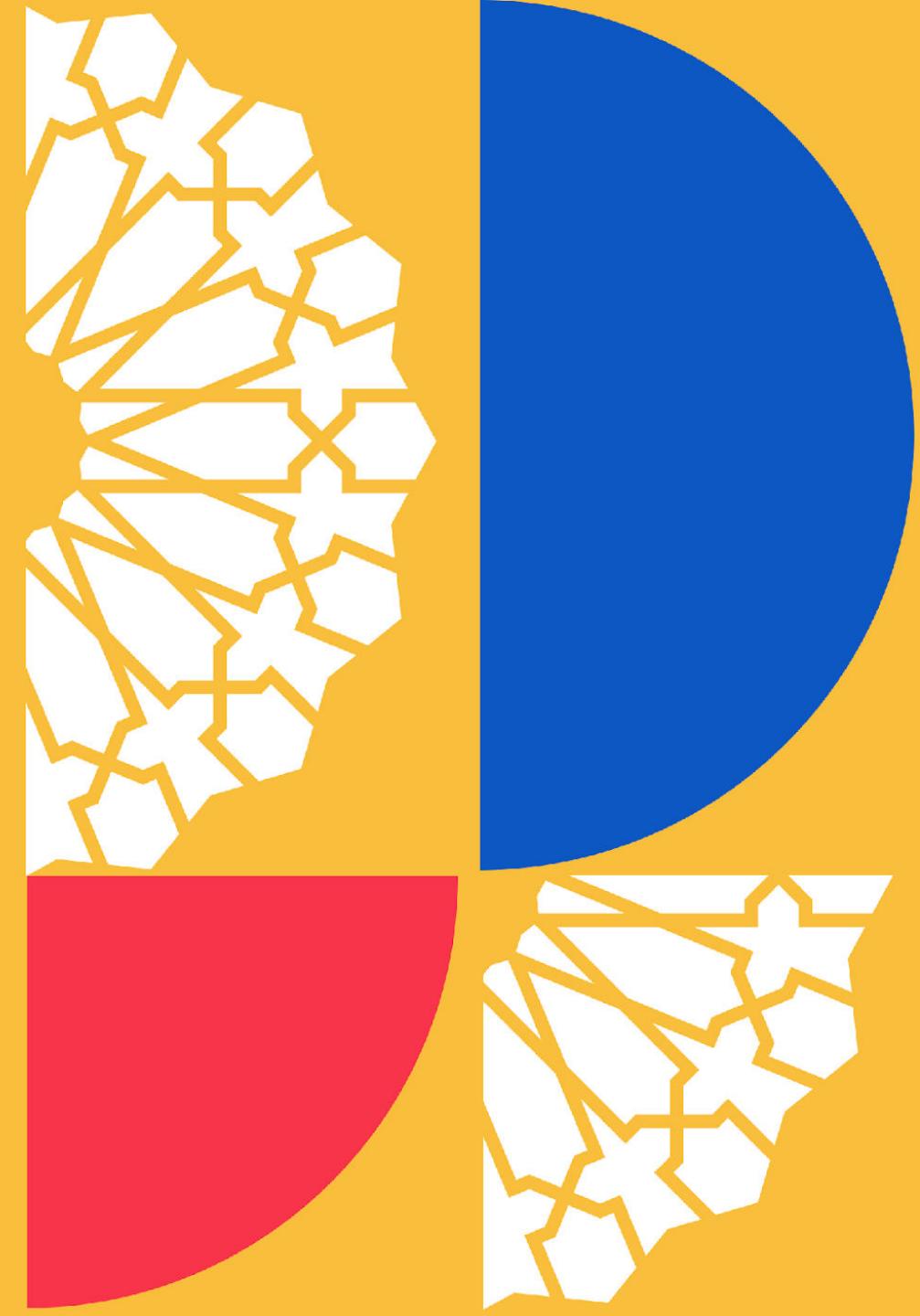
It gets converted into glucose

- Fibers

Not digested by the body

Main sources are fruits, vegetables, legumes and whole grains

Cellulose, Hemicelluloses, Pectins



Fibers

Two types of fibers:

◎ Soluble fibers

Viscous (thick consistency due to their solubility in water)

Fermentable :It is fermented in the large intestine into gases and active byproducts; used as feed for the bacteria in the gut- (prebiotic)

Food Sources: oats, fruits, vegetables, legumes

Health Benefits:

Slow gastric emptying time → give a feeling of satiety

Help reducing glucose and cholesterol levels in the blood



ADAM.

Fiber

● Insoluble fibers

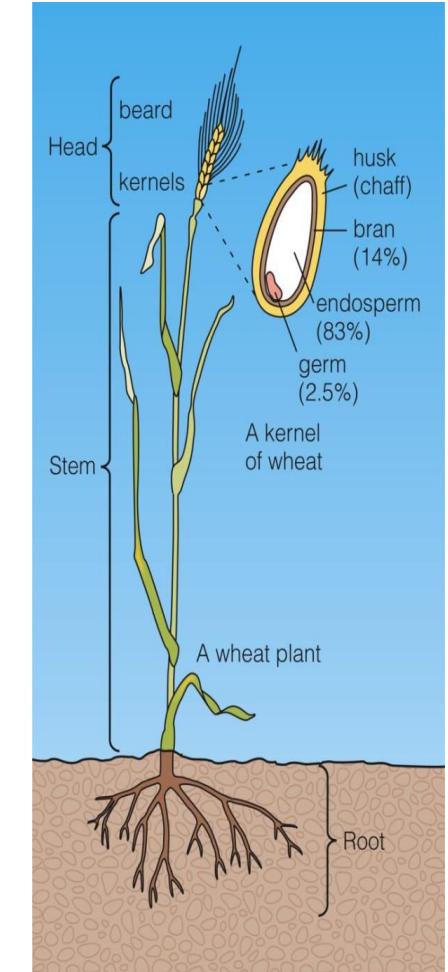
Non-viscous (due to insolubility in water)

less fermentable & aid the digestive system
by easing elimination and **alleviating
constipation**

- **Food sources:** whole grains, skins of fruits and vegetables

Health benefits

Increase bulk → soften stool
prevent constipation



Fiber

Important information:

- If the diet is high in fibers, it is the potential for significant intestinal gas production and bloating
- When you add fiber you should also include more fluids

Constipation can occur if insufficient fluid is consumed with a high-fiber diet
- Excess intake of fibers is not very appreciated as they can reduce the absorption of certain vitamins and minerals

Digestion of CHO

The digestion of CHO starts in the mouth with the help of **salivary amylase**.

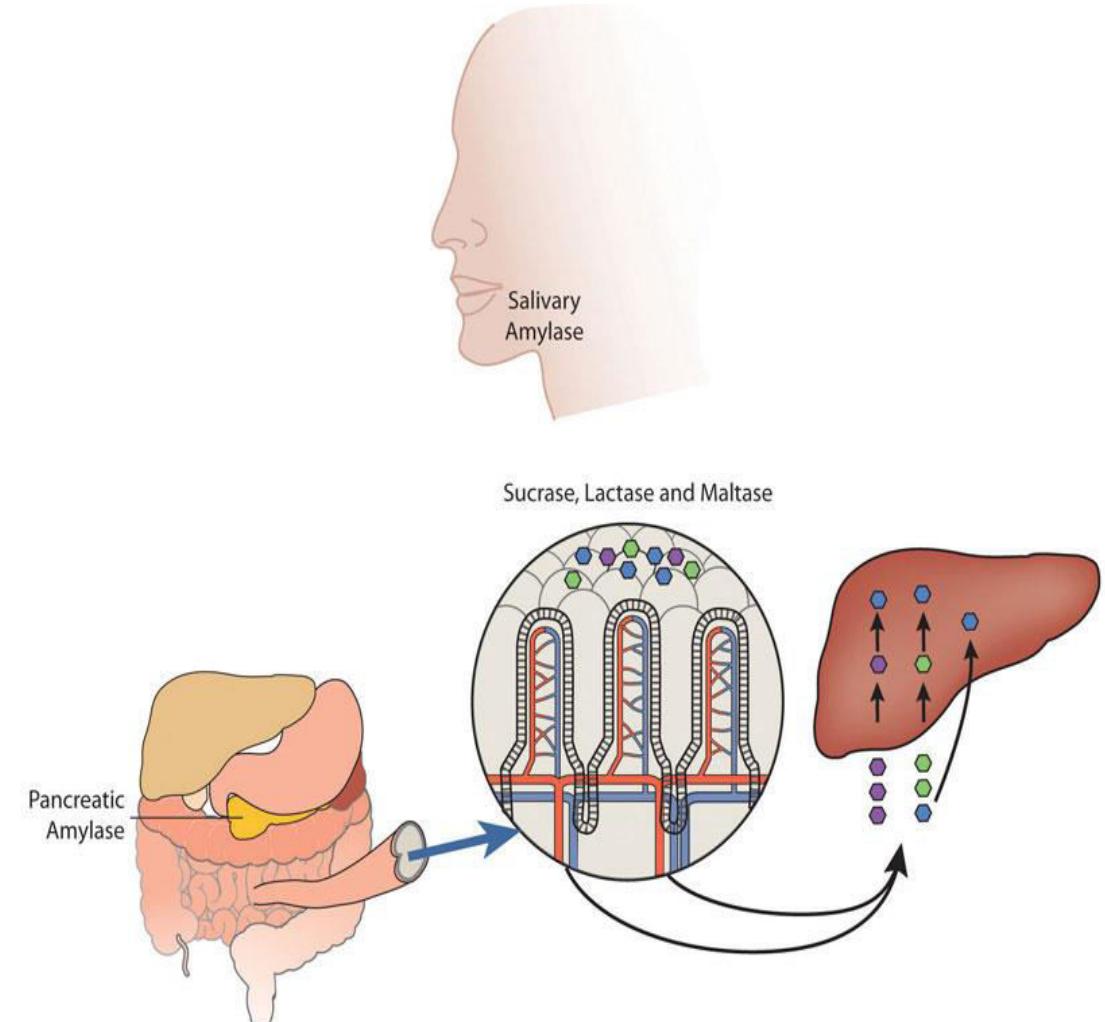
Carbohydrate digestion continues in the small intestine: pancreatic amylases breakdown the CHO into a simpler form

End products of carbohydrate digestion:

Glucose, fructose, galactose

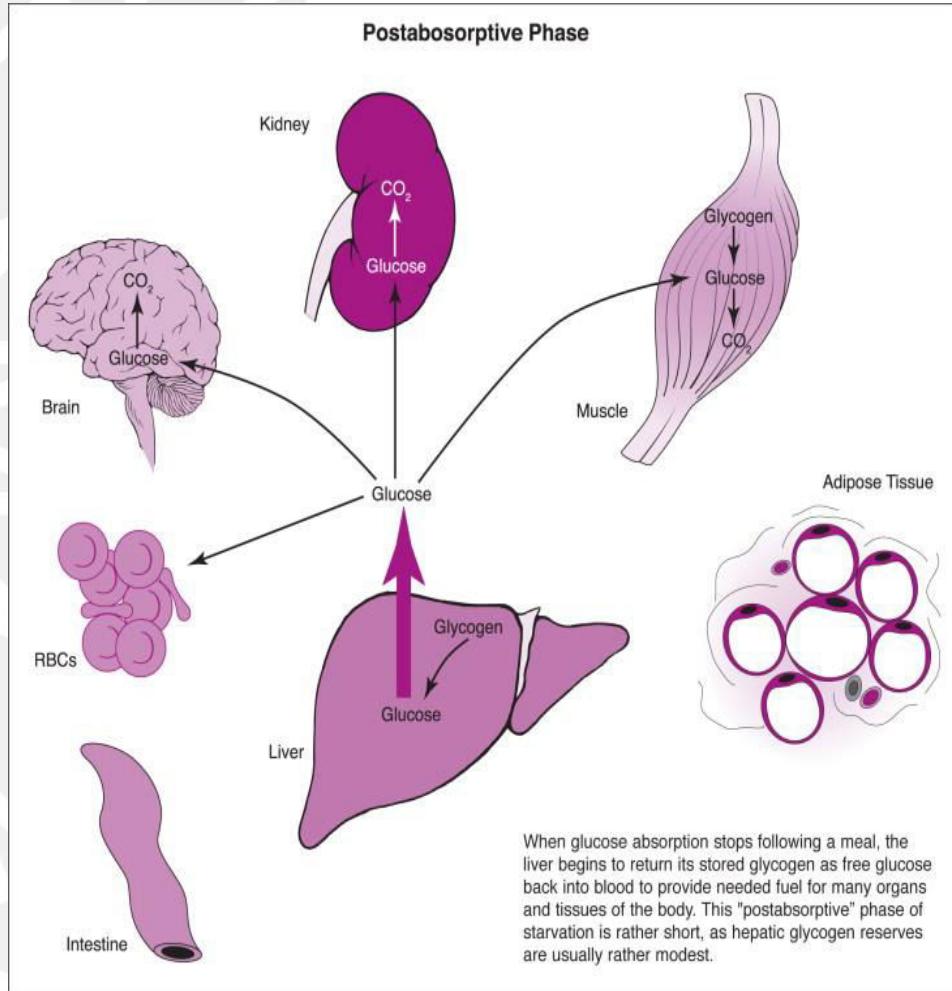
Absorbed into bloodstream

Fibers are not digested, they are excreted in feces



Functions of CHO

- Energy source
- Glucose:
 - Basic simple sugar in body metabolism
 - 1 gram of CHO gives 4 kcals
 - Primary energy source for the body
 - ❖ Adequate carbohydrate intake spares proteins for their prime function of growth & maintenance
- Energy source for the cells of the Central Nervous System and red blood cells



Routes of blood glucose

- Used for energy
- Excess is converted to liver or muscle glycogen
- Excess is converted to and stored as fat in adipose tissues

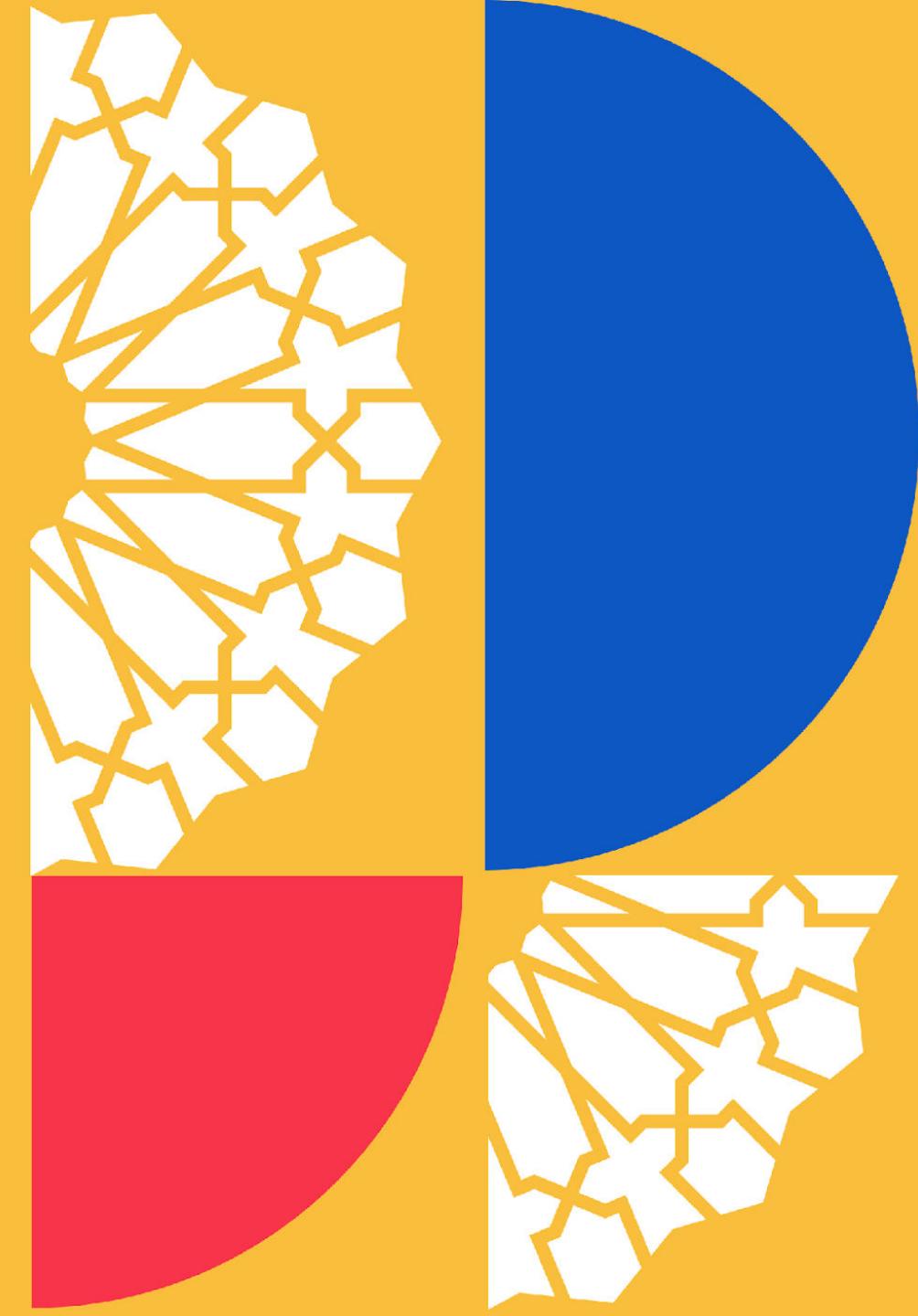
Carbohydrate Recommendation

- Recommended Dietary Allowances for carbohydrates:

Minimum 130 g/day

45% - 65% total daily energy intake

- For Fibers
RDA is 25 to 35g/day. (depends on food intake and gender)



Artificial sweeteners

- Generally sweeter than sucrose
- Artificial sweeteners and other sugar substitutes are found in a variety of food and beverages marketed as "sugar-free" or "diet," including soft drinks and baked goods.
- They are all calorie free
- These substances are harmful if consumed in high doses but the FDA has approved their consumption within the acceptable doses.



Artificial Sweeteners

- Saccharin
 - Sweet'N Low
 - Sugar Twin
- Aspartame
 - NutraSweet
 - Equal
- Acesulfame-K
 - Sunett
 - Sweet One
- Sucratose
 - Splenda
- Cyclamate
- Stevia
 - Truvia
 - Sweetleaf



Artificial Sweeteners

Aspartame:

- Is a type of artificial sweetener
- It is mainly used in all diet soft drinks and beverages
- 200 times sweeter than sugar



Artificial Sweeteners

Stevia

- Stevia is a sugar substitute made from the leaves of the stevia plant.
- It's about 100 to 300 times sweeter than table sugar, but it has no carbohydrates, calories, or artificial ingredients.



Sugar alcohols

- Sugar alcohols are sweeteners that have about half the calories(upto 2 kcal/g) of regular sugar.
- They occur naturally in certain fruits and vegetables, but some are man-made and are added to processed foods.
- Many foods labeled "sugar free" or "no sugar added" have sugar alcohols such as: chewing gum, baked goods, and sweets
- Are not broken down by oral bacteria, hence do not cause dental caries
- Eg: xylitol, mannitol, sorbitol etc.



Lactose intolerance

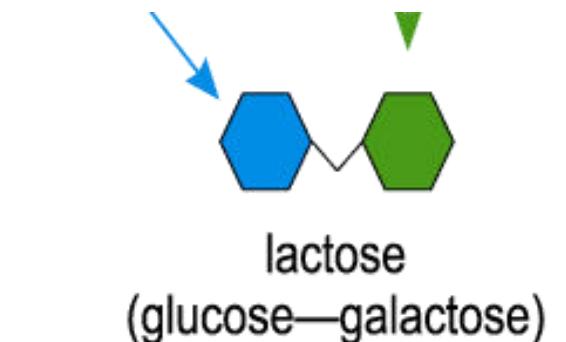
Is the inability to digest lactose in milk and dairy products

Causes:

- A disorder characterized by the **deficiency of the digestive enzyme lactase** that splits the lactose disaccharide into galactose and glucose

Symptoms

- It begins $\frac{1}{2}$ - 2 h after eating or drinking milk or milk products and may result in: pain or cramps in the lower abdomen, excessive gas (flatulence and bloating), diarrhea (sometimes the stools are foamy)



Lactose intolerance

What can I eat if I have lactose intolerance?

- Many people can tolerate as much as a one cup or two of milk a day
- Almost all humans lose some of their ability to produce lactase as they age
- Foods to avoid would be milk and all food containing milk (cream or white sauce)

Alternatives include

- Cheese, Yogurt





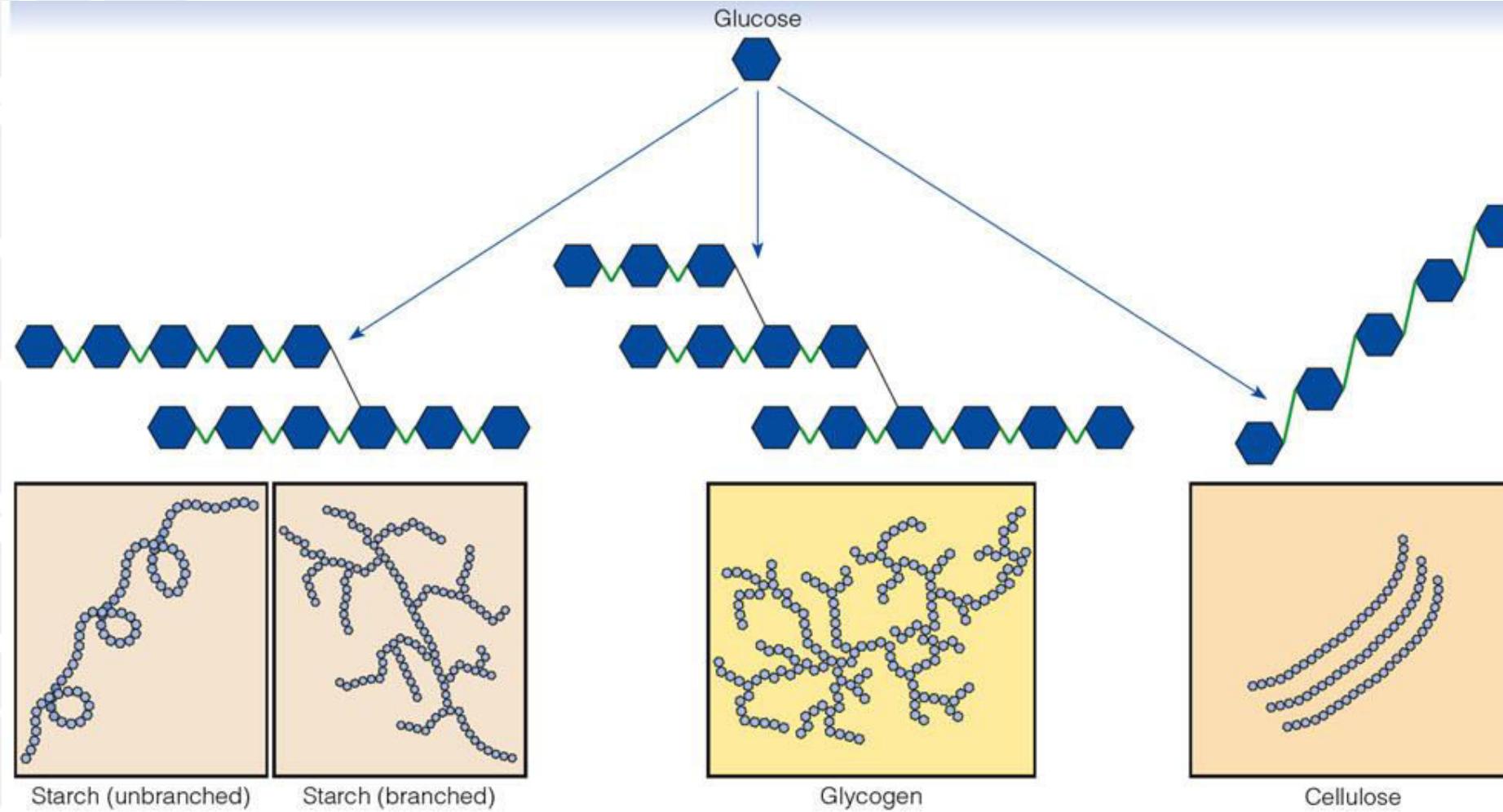
Info for your interest

Tips to improve the sweetness of foods without boosting their calories:

- Serve sweet foods **warm** (heat enhances sweet tastes)
- Add **sweet spices** such as cinnamon, nutmeg,
- Try reducing the sugar added to recipes by **one-third**
- Select **fresh** fruit or fruit juice or those prepared without added sugar
- Use small amounts of **sugar substitutes** instead of sucrose



Classification of CHO



FIBER

Mouth

The mechanical action of the mouth crushes and tears fiber in food and mixes it with saliva to moisten it for swallowing.

Stomach

Fiber is not digested, and it delays gastric emptying.

Small intestine

Fiber is not digested, and it delays absorption of other nutrients.

Large intestine

Most fiber passes intact through the digestive tract to the large intestine. Here, bacterial enzymes digest fiber:

Some fiber  Bacterial enzymes → Fatty acids, gas

Fiber holds water; regulates bowel activity; and binds substances such as bile, cholesterol, and some minerals, carrying them out of the body.

Fiber Characteristics

Viscous, soluble, more fermentable

- Gums and mucilages
- Pectins
- Psyllium^a
- Some hemicelluloses

Major Food Sources

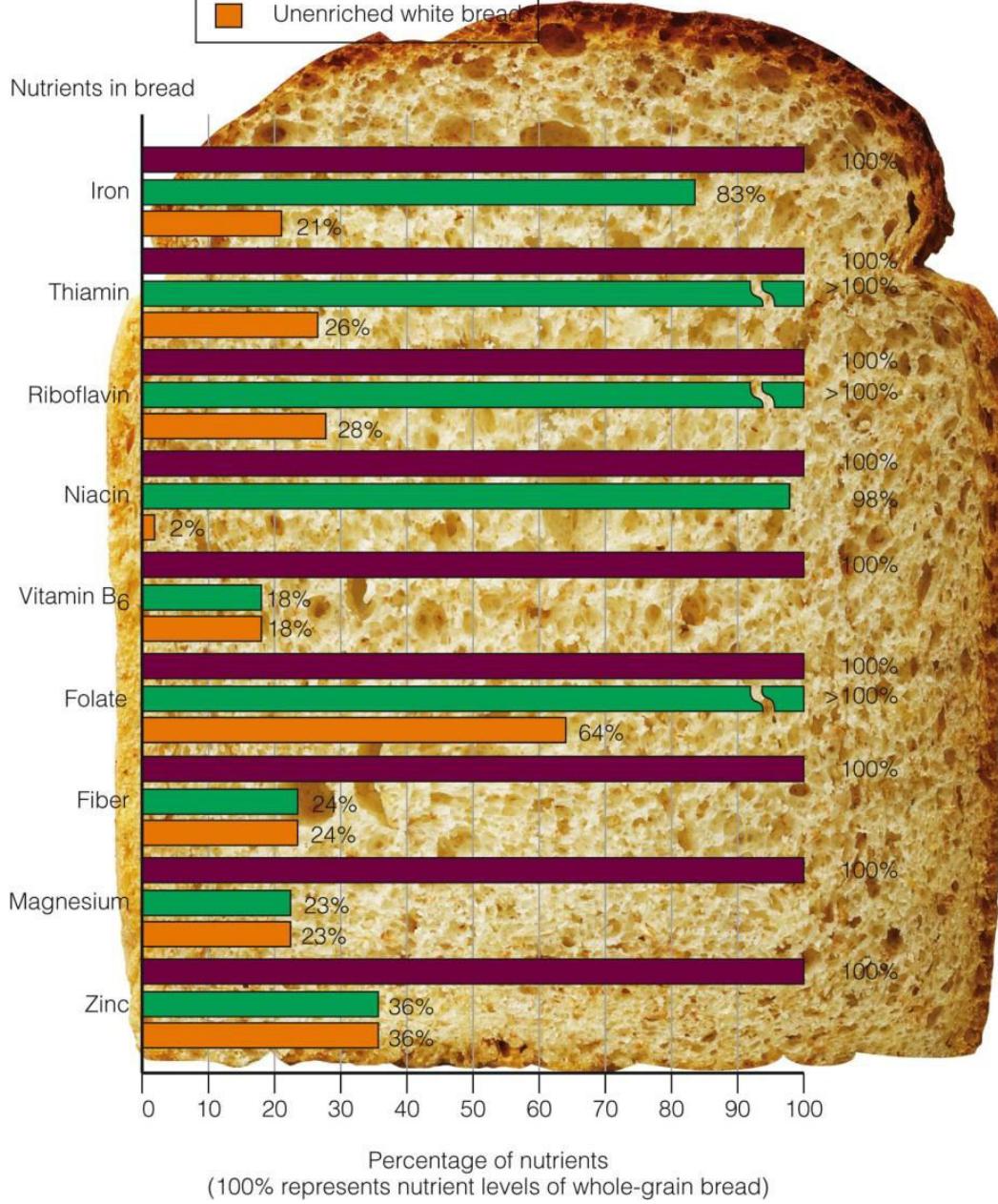
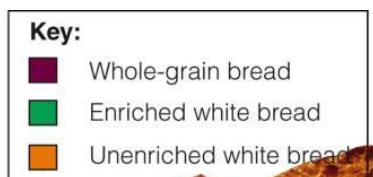
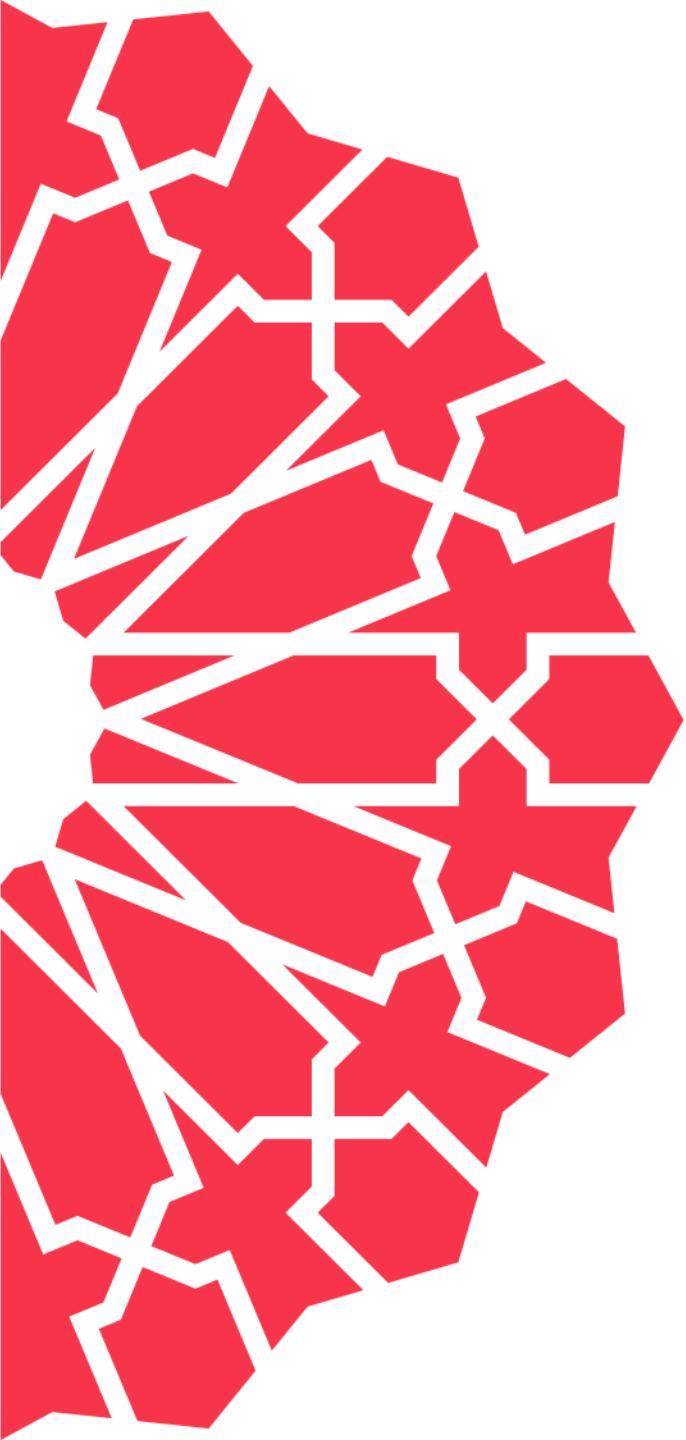
Whole-grain products (barley, oats, oat bran, rye), fruits (apples, citrus), legumes, seeds and husks, vegetables; also extracted and used as food additives.

Actions in the Body

- Lower blood cholesterol by binding bile.
- Slow glucose absorption.
- Slow transit of food through upper GI tract.
- Hold moisture in stools, softening them.
- Yield small fat molecules after fermentation that the colon can use for energy.

Health Benefits

- Lower risk of heart disease.
- Lower risk of diabetes.



Nonviscous, insoluble, less fermentable

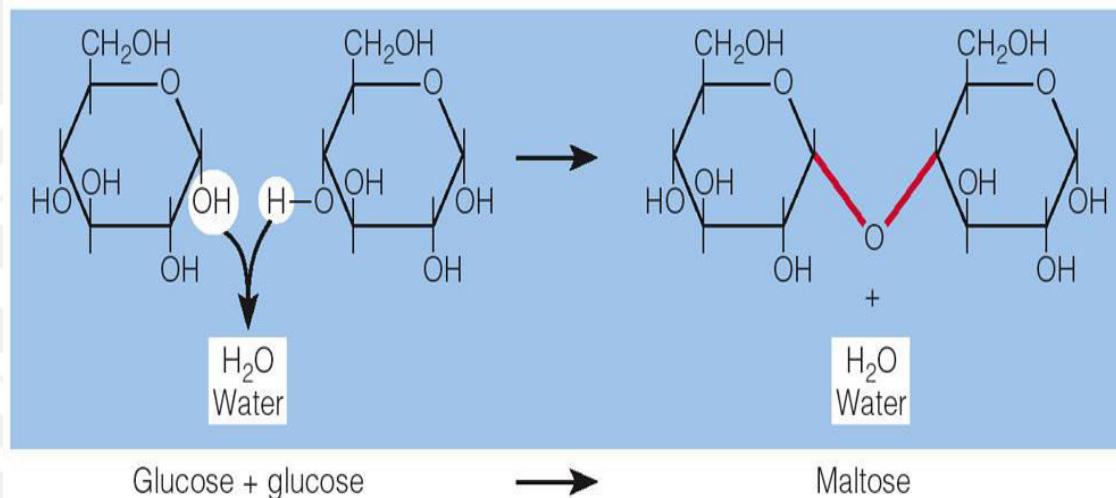
- Cellulose
 - Lignins
 - Psyllium^a
 - Resistant starch
 - Many hemicelluloses
-

Brown rice, fruits, legumes, seeds, vegetables (cabbage, carrots, brussels sprouts), wheat bran, whole grains; also extracted and used as food additives.

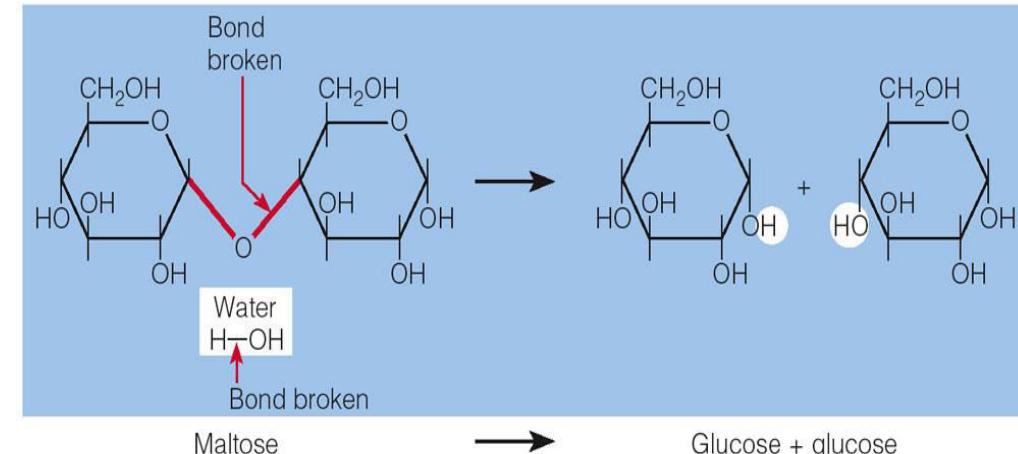
^aPsyllium, a fiber laxative and cereal additive, has both soluble and insoluble properties.

- Increase fecal weight and speed fecal passage through colon.
- Provide bulk and feelings of fullness.
- Alleviate constipation.
- Lower risks of diverticulosis, hemorrhoids, and appendicitis.
- May help with weight management.

Conversion between Mono & Disaccharides



Hydrolysis occurs during digestion.



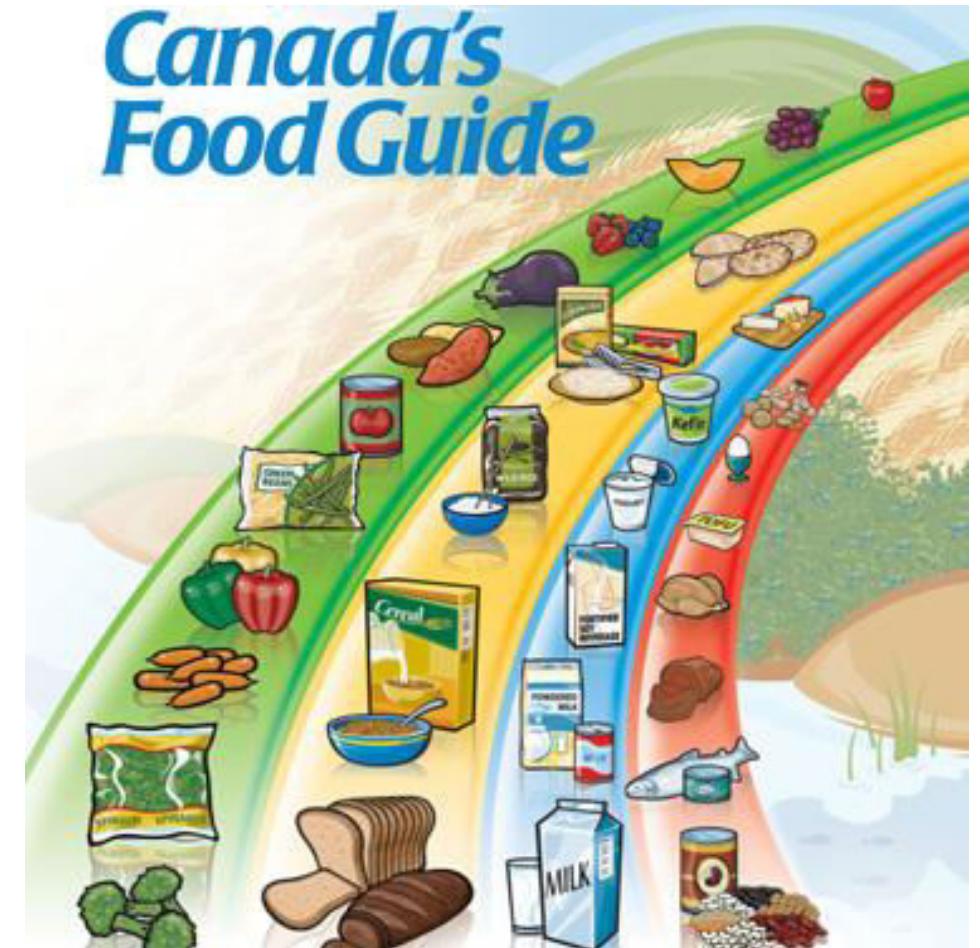
How sweet it is!

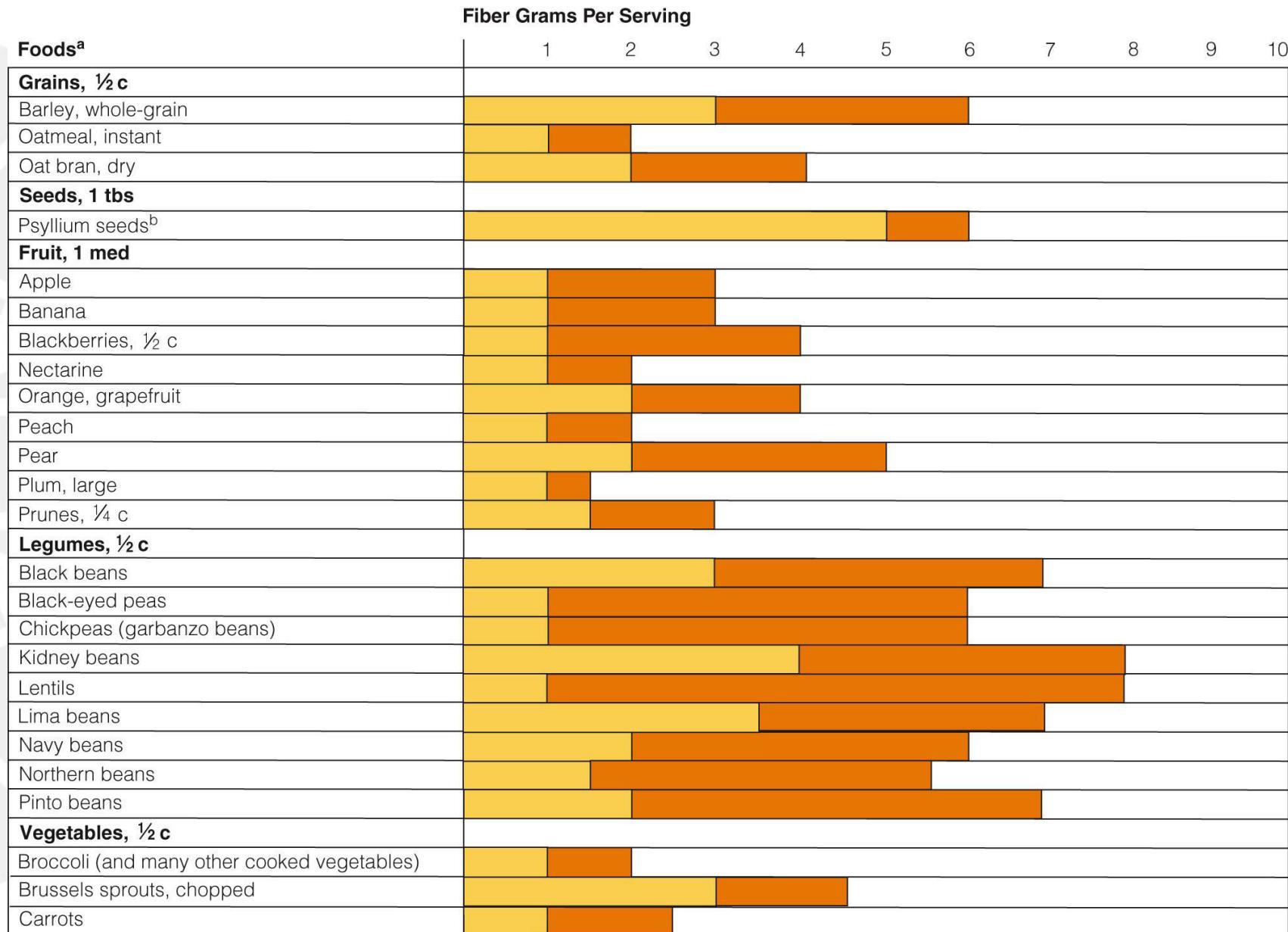
Sugar	Sweetness
Lactose	0.16
Galactose	0.32
Maltose	0.33
Sucrose	1.00
Fructose	1.73
Aspartame	180
Saccharin	450

Values are relative to sucrose.

DRI FOR CHO

- The DRI for CHO is **45-65%** of daily calories
- Min. 130 g/day for adults & children
- Food intake from CHO should be mainly of starch (complex CHO)with a minimal intake of simple sugars.





^aValues are for cooked or ready-to-serve foods unless specified.

^bPsyllium is used as a fiber laxative and fiber-rich food additive.

TABLE 4-10 THE EMPTY CALORIES OF SUGAR

At first glance, honey, jelly, and brown sugar look more nutritious than plain sugar, but when compared with a person's nutrient needs, none contributes anything to speak of. The cola beverage is clearly an empty-calorie item, too.

Food	Energy (cal)	Protein (g)	Fiber (g)	Calcium (mg)	Iron (mg)	Magnesium (mg)	Potassium (mg)	Zinc (mg)	Vitamin A (μg)	Thiamin (mg)	Riboflavin (mg)	Niacin (mg)	Vitamin B ₆ (mg)	Folate (μg)	Vitamin C (mg)
Sugar (1 tbs)	46	0	0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0
Honey (1 tbs)	64	0	0	1	0.1	0	11	0.0	0	0	0.0	0	0.0	0	<1
Molasses (1 tbs)	55	0	0	42	1.0	50	300	0.1	0	0	0.2	0.1	0	0	0
Concentrated grape or fruit juice sweetener (1 tbs)	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jelly (1 tbs)	49	0	0	1	0.0	1	12	0.0	0	0	0.0	0	0	0	<1
Brown sugar (1 tbs)	34	0	0	8	0.2	3	31	0.0	0	0	0.0	0	0	0	0
Cola beverage (12 fl oz)	153	0	0	11	0.1	4	4	0	0	0	0.0	0	0	0	0
Daily Values	2,000	56	25	1,000	18.0	400	3,500	15.0	1,000	1.5	1.7	20.0	2.0	400	60