Explanations to smooth your lesson

Explanation (1):

Teacher start by showing students this image and ask them what they see and discuss it:

When you think of carbohydrates, you may think of starchy foods like bread, rice, pasta, and potatoes. And you would be correct! Starch is a type of carbohydrate and is a source of readily available energy in the human diet because it is easily digestible and broken down to release energy. Starch is common in these foods that come from plants because starch is one way that plant cells store the molecules they use to generate cellular energy.

Carbohydrates are biological macromolecules with several different functions. They play an important role as a source of energy and a form of energy storage in cells. They are also important structural molecules in the cell walls of plant cells and the cells of other organisms. Carbohydrates include simple sugars as well as complex carbohydrates.

Activity (sugary debate) (5 min)

1- divide class into 2 teams .

2- one defend that sugar is beneficial and the other disagree and claims the bad effects.

3- have them discuss and search for 2 min

4- choose two representatives from each group for the debate.

5- extract 5 students out of the two groups.

6- they evaluate the debate and choose the winner.

7- you as a teacher choose winner also by your vote and students votes.

8- claim winner and start lesson.

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(Activity 2, 10 min)

Then you show them a video and make them write notes about it and each group exchange notes and come out to present it.

Then start explanations carbs definition:

Key Term: Carbohydrates

Carbohydrates are molecules composed mainly of carbon and water. They primarily function in energy storage and transfer as well as structure and support.

A carbohydrate is a molecule that contains carbon, hydrogen, and oxygen atoms in a particular ratio. *Carbo-* means "carbon" and *-hydrate* means "water," which we know is HO2.The ratio that most carbohydrates follow is C(HO)□□2.This means that there is an "*m*" number of carbon atoms and an "*n*" number of water molecules arranged in a particular carbohydrate.

Certain carbohydrates, called complex carbohydrates, are macromolecules that are also referred to as polysaccharides. A polysaccharide is a type of polymer. You may know that a polymer is a large molecule made of several smaller repeating units, or parts, called monomers. The monomers that make up complex carbohydrates are sugars, which are also called monosaccharides.

(Activity 3 (10 min)

Share with students QR code to start playing 3 games each teaches them a thing about each type of carbs.

After finishing the games, you start the other activity:

Each group will present one type with a full presentation and then groups score the best presentation.

Then you explain it yourself …

Definition: Polysaccharide

A polysaccharide is a polymer consisting of monosaccharide monomers.

Definition: Monosaccharide

A monosaccharide is the simplest form of carbohydrate also called a simple sugar.

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The simplest carbohydrates are monosaccharides: Mono- means “one “, that is because one molecule of monosaccharide represents a single sugar unit. Monosaccharides usually follow the ratio (CHO)2□, where n is a number between 3 and 7.

Give students an example:

For example, most hexose sugars have the chemical formula CHO6126, which is equivalent to (CHO)26. Monosaccharides are generally soluble in water. Monosaccharides can be categorized by the number of carbon atoms they possess. Hexose sugars have 6 carbons each (*hex*- means “six”). Examples of hexose monosaccharides include glucose, fructose, and galactose. Pentose sugars have 5 carbon atoms each (*pent*- means “five”). The ribose and deoxyribose you find in nucleic acids are pentose monosaccharides. You may have noticed that many of these sugar-related terms rhyme with each other. That is because the suffix -*ose* is a word part that refers to sugar. The chemical structures of some monosaccharides are shown in Figure 1.

show them diagrams for more details:

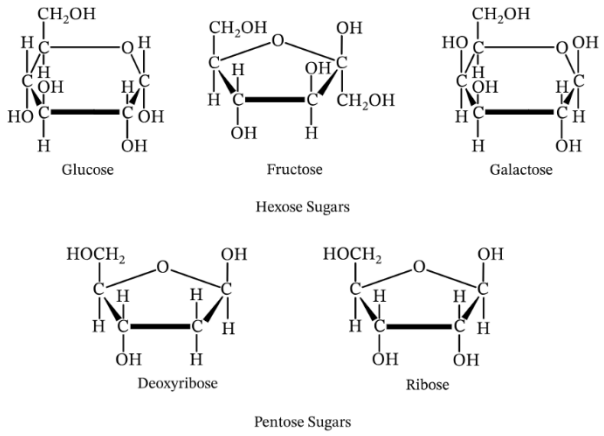

Figure 1: A diagram to show the chemical structures of some common monosaccharides. Hexose sugars have 6 carbon atoms and pentose sugars have 5.

Glucose is particularly important to cells since it is one of the reactants in cellular respiration. A diagram illustrating cellular respiration is shown in Figure 2. The energy found within the bonds between the atoms in glucose molecules is released and transferred to ATP to power our other life processes:

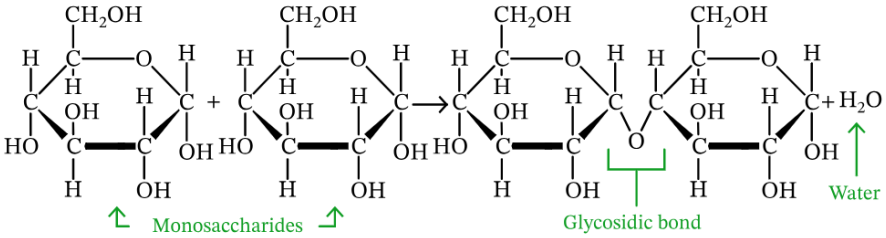

Figure 2: The reactants and products of cellular respiration. The carbohydrate glucose (CHO6126) is a reactant in cellular respiration, which releases energy to be transferred and used in cellular processes.

Monosaccharides can be bonded together during a chemical reaction called a condensation reaction, also called dehydration synthesis. This occurs when the hydroxyl groups of two monosaccharides rearrange and join in what is called a "glyosidic bond" as shown in Figure 3. The reaction releases a water molecule, which is how the condensation reaction gets its name.

To help you remember this, it may help to think of how water is released from the air when it "condenses" into droplets.

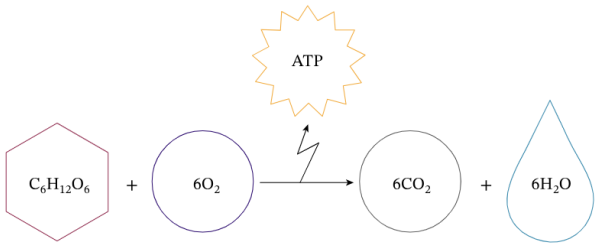

Figure 3: A diagram to show how glyosidic bonds form between monosaccharides through a condensation reaction that releases a molecule of water.

(Activity 4 (5 min)

Show them game to differentiate each type by animations.

And then start explaining different reactions.

Definition: Condensation Reaction

A condensation reaction is a chemical reaction in which a chemical bond is formed, causing a molecule of water to be released.

Definition: Glycosidic Bond

A glycosidic bond is a chemical bond that is formed between monosaccharides as a result of a condensation reaction.

Two monosaccharides bonded together is called a “disaccharide.” *Di-* means “two.” Maltose, sucrose, and lactose are examples of disaccharides. Disaccharides follow the chemical formula C(HO)□□2,where $m=n+1$.Sucrose is what we commonly use as table sugar. It consists of a molecule of glucose bonded with a molecule of fructose. Lactose is found in milk, and it consists of a molecule of glucose bonded with a molecule of galactose. Maltose is found in many grains, such as wheat and barley. It consists of two molecules of glucose bonded with each other. Table 1 summarizes the compositions of common disaccharides.

Definition: Disaccharide

A disaccharide is a molecule that consists of two monosaccharides bonded together. Disaccharides, like monosaccharides, are considered to be simple sugars.

Table 1: A table of some common disaccharides. Disaccharides consist of two monosaccharides bonded together.

Monosaccharides	Disaccharides
Glucose + glucose	Maltose
Glucose + fructose	Sucrose
Glucose + galactose	Lactose

(Activity 5 (10 min)

Start giving examples with answers:

Example 1: Identifying the Type of Chemical Reaction That Occurs When Monosaccharides Bond

What type of reaction occurs when two or more monosaccharides join together?

Answer

Monosaccharides are the simplest carbohydrates. Three common monosaccharides are glucose, fructose, and galactose. *Mono-* means "one." Two monosaccharides can join together to form a disaccharide. *Di-* means "two." An example of a disaccharide is sucrose, or common table sugar. Sucrose is composed of a molecule of glucose bonded to a molecule of fructose. Many monosaccharides can join together to form a polysaccharide. *Poly-* means "many." Some examples of common polysaccharides are starch, cellulose, and glycogen. All three of these polysaccharides are polymers of glucose monomers. In order to make a disaccharide or a polysaccharide, monosaccharides have to join together. The hydroxyl groups of two molecules (OH) rearrange so that both molecules share a bond with one oxygen atom (O). This means that two hydrogen atoms (2H) and one oxygen atom (O) are removed. These atoms bond together into a molecule of water (HO2), which is released. Because a molecule of water is released, this chemical reaction is called a "condensation reaction."

This means that the type of reaction that occurs when two or more monosaccharides join together is a condensation reaction.

Then give them another question and explain the answer :

Example 2: Identifying Monosaccharides from a List of Carbohydrates

Which of the following is an example of a monosaccharide?

A. Lactose
B. Sucrose
C. Glucose
D. Maltose

Answer

A monosaccharide is a type of simple sugar. Disaccharides are also considered to be simple sugars, but disaccharides are made of two monosaccharides bonded together. *Mono-* means "one," and *di-* means "two." Monosaccharides can also be distinguished because they typically follow the chemical formula (CHO)2□,while disaccharides follow the chemical formula C(HO)□□2,where $m=n+1$.

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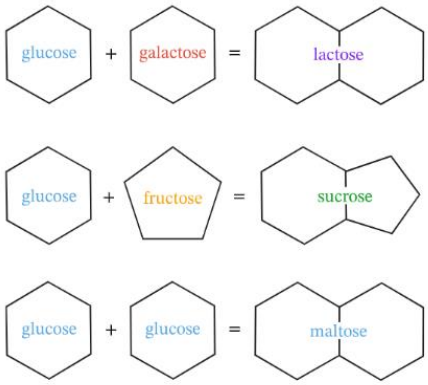
Lactose (CHO)122211 is composed of two monosaccharides, glucose and galactose (each CHO6126), bonded together.

Sucrose (CHO)122211 is composed of two monosaccharides, glucose and fructose (each CHO6126), bonded together.

Maltose (CHO)122211 is composed of two monosaccharides, glucose and glucose (each CHO6126), bonded together.

This can be seen in the following:



So, the answer that is an example of a monosaccharide is glucose.

Monosaccharide monomers can also polymerize into larger polymer carbohydrates called polysaccharides. Polysaccharides are insoluble in water, so they are ideal for energy storage and also for use as structural components within the cell. Examples of polysaccharides include starch, glycogen, and cellulose. All three of these polysaccharides are made of several glucose molecules bonded together in specific arrangements.

Then Describe the Relationship between Monosaccharides and Polysaccharides by this example:

Example 3: Describing the Relationship between Monosaccharides and Polysaccharides

Which of the following best describes the relationship between monosaccharides and polysaccharides?

A. Monosaccharides can be broken down to form polysaccharides.
B. Monosaccharides can be joined together by bonds called polysaccharides.
C. Polysaccharides have complementary binding sites to monosaccharides.
D. Many monosaccharides can join together to form a polysaccharide.

Answer

Polysaccharides are polymers. This means that polysaccharides are made of many similar, repeating molecular subunits called monomers. The monomers of polysaccharides are called monosaccharides. Monosaccharides are soluble in water, and they are used to transfer energy that is used in cellular processes. Polysaccharides are insoluble in water, and they function either as energy storage molecules or as structural components of cells. Polysaccharides can be used for energy storage because they are made of monosaccharide monomers that can be broken apart and used in cellular respiration.

Therefore, we can conclude that many monosaccharides join together to form a polysaccharide.

The monomers in starch and glycogen are a different isomer of glucose than the monomers in cellulose. An isomer is a molecule with the same chemical formula but with a different arrangement of atoms. The monosaccharides glucose, galactose, and fructose are actually all isomers with the chemical formula CHO6126.The isomers of glucose found in starch, glycogen, and cellulose are called “alpha-glucose” and “beta-glucose,” and they can be seen in Figure 4. Alpha-glucose and beta-glucose are almost exactly the same, except that the hydrogen and the hydroxyl attached to the first carbon (also called c-1) are flipped.

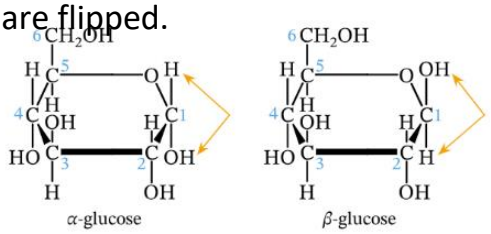


Figure 4: Alpha-glucose and beta-glucose are isomers, meaning that they have the same chemical formula but different arrangements.

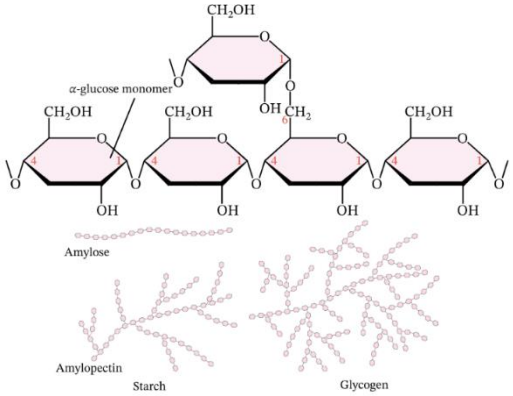


Figure 5: Cellulose is made of beta-glucose monomers joined together in alternating orientations with 1,4 glyosidic bonds. Strands of cellulose can stack together with hydrogen bonds.

Key Term: Cellulose

Cellulose is a polysaccharide made of beta-glucose monomers joined together in chains that are able to easily link into larger structures. Cellulose provides strength and rigidity to plant cell walls.

Starch and glycogen are made of alpha-glucose monomers, illustrated in Figure 6. The alpha-glucose monomers also form 1,4 glyosidic bonds, but all the molecules point in the same direction. Starch is made by plant cells, and it can occur in long branched or unbranched chains. Glycogen is made by animal cells, and it occurs in highly branched complexes. Where branches occur in these molecules, one monomer will form a 1,4 glyosidic bond and a 1,6 glyosidic bond with two other monomers, which allows two chains to join together.

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Figure 6: A diagram of different polysaccharides. Starch and glycogen are made of alpha-glucose monomers joined together with 1, 4 and 1, 6 glyosidic bonds. Glycogen is a highly branched polymer, but starch may be branched or unbranched.

Both starch and glycogen function as energy storage molecules. In order to release this energy from storage, the polysaccharides must first be broken apart into monosaccharides in a process called hydrolysis. Hydrolysis reactions, shown in Figure 7, use a molecule of water to break a bond apart. It is basically the exact opposite of a condensation reaction. Once they are broken down again, the monosaccharides can be used as reactants in cellular respiration.

Key Term: Starch

Starch is a polysaccharide of alpha-glucose monomers joined in long branched or unbranched chains. Starch is an energy storage molecule in plant cells.

Key Term: Glycogen

Glycogen is a polysaccharide of alpha-glucose monomers joined in large, highly branched structures. Glycogen is an energy-storage molecule in animal cells.

Definition: Hydrolysis

Hydrolysis is a chemical reaction in which a chemical bond is broken and a molecule of water is consumed.

Carbohydrates are molecules that function in energy storage and transfer as well as provide structure to certain types of cells. The different compositions of different carbohydrates make them adapted for their different functions. These structures and functions are summarized in Table 2.

Show them this table and let them build a mind map about it in 10 min:

Table 2: A table comparing the structures and functions of three common polysaccharides.

Polysaccharide	Glucose isomer	Structure	Function
Cellulose	Beta-glucose	Unbranched	Structure, plant cell walls
Starch	Alpha-glucose	Unbranched or branched	Energy storage, plant cells
Glycogen	Alpha-glucose	Highly branched	Energy storage, animal cells

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Example 4: Identifying the Polysaccharide Used for Glucose Storage in Animal Cells

Glucose can be stored as the polysaccharide starch in plant cells. What polysaccharide acts as the primary unit of glucose storage in animal cells?

Answer

Polysaccharides are polymers made of monosaccharide monomers. Monosaccharides, such as glucose, join together by glyosidic bonds through condensation reactions into long chains or branched structures to form polysaccharides. While monosaccharides are usually soluble in water, polysaccharides are usually insoluble in water. In order to function as a reactant in cellular respiration, monosaccharides must first be separated from larger polysaccharides. This is why polysaccharides are effective glucose-storage molecules. Alpha-glucose monomers polymerize into starch, which is the glucose-storage molecule in plants. In animals, alpha-glucose monomers polymerize into a different polysaccharide, called glycogen.

Based on this information, we can conclude that the polysaccharide that acts as the primary unit of glucose storage in animal cells is glycogen.

You make sure you explained everything and then you close the lesson by exit ticket and divide homework:

Group 1, 2 : build up a model for carb structures in human body.

Group 3 : summary mind map about the lesson.

Group 4: presentation about lipids.

Group 5 : presentation about carbs and its relation to Egypt grand challenges.

(Final activity 5 min)

1- give them a paragraph individually.

2- what did you understand from it.

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3- how can we use sugars in our capstones.

4- search up for previous capstones that used sugars

5- how can you link this to your project this term?

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