

Photosynthesis



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المزيد من مادة
علوم:

إعداد: Gilgil Omar

التواصل الاجتماعي بحسب الصف التاسع المتقدم



صفحة المناهج
الإماراتية على
فيسبوك

الرياضيات

اللغة الانجليزية

اللغة العربية

التربية الاسلامية

المواد على تلغرام

المزيد من الملفات بحسب الصف التاسع المتقدم والمادة علوم في الفصل الأول

Water and Its Solutions

1

Unit 1 Lesson 3 Water and Its Solutions Question Bank

2

U1: Chemistry in Biology

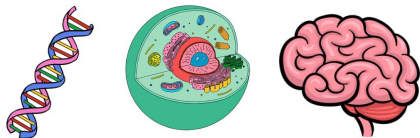
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Biology in Chemistry وحدة

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Biology for Advanced Grade 9: Unit One - Chemistry in Biology - Lesson 3: Water and Solutions

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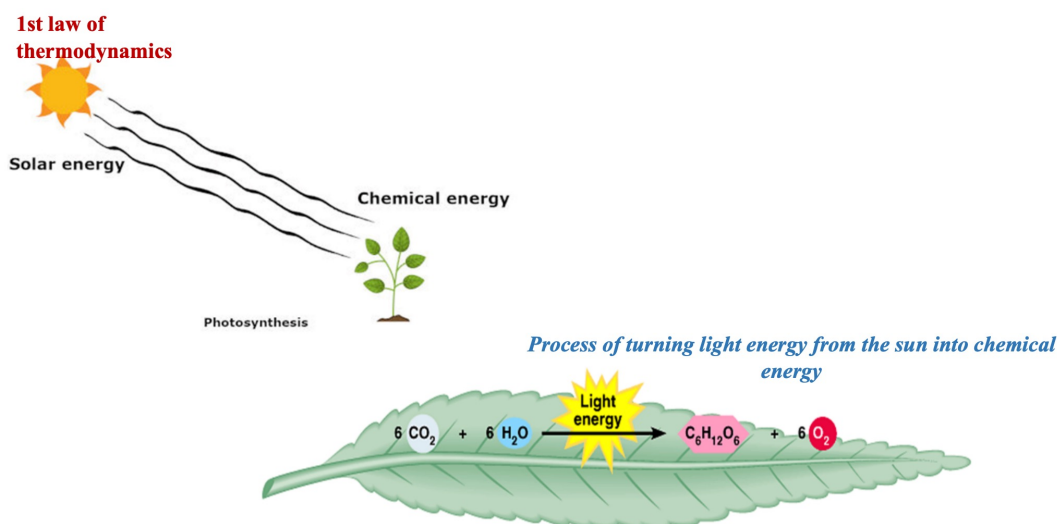


Term 1 – lesson 2

Photosynthesis

Overview of photosynthesis

- Energy cannot be created or destroyed. It only changes form. **Photosynthesis** is a chemical process that **converts energy from** light into chemical energy. It is the main way solar energy is stored on Earth. With cellular respiration, it supplies most energy for life.
- Autotrophs, including plants, make organic compounds like sugars by photosynthesis. The main function is converting light energy into chemical energy. The overall reaction shows the inputs and outputs:
$$6\text{CO}_2 + 6\text{H}_2\text{O} + \text{light} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$$
- Photosynthesis occurs in **two phases**. **Phase one** is the **light-dependent** reactions. Light is absorbed in chloroplasts. This energy is converted into chemical energy and stored in ATP and NADPH.
- **Phase two** is the **light-independent** reactions. ATP and NADPH from phase one are used to produce glucose, a sugar.
- After glucose is formed, it can combine to make larger carbohydrates like starch. These molecules contain carbon, hydrogen, and oxygen. They are used to build amino acids and other carbon-based molecules. These can form larger structures like proteins, lipids, and DNA, which are needed to build new cells.





Phase one: Light reaction

- **Light absorption** is the **first step** in photosynthesis. Plants have organelles that absorb light energy. After light is captured, **ATP and NADPH are produced**. These are used in the next phase.

Chloroplasts

- Chloroplasts are organelles that capture light energy. In plants, they are found mainly in leaf cells. As shown in Figure 5, chloroplasts are **disk-shaped** and have two main parts needed for photosynthesis.
- The first part is the **thylakoid**. Thylakoids are **flattened sacs arranged in stacks**. The stacks are called **grana**. Light-dependent reactions happen inside the thylakoids.
- The second part is the **stroma**. It is the fluid around the grana. The stroma, shown in Figure 5, is where light-independent reactions happen in phase two.

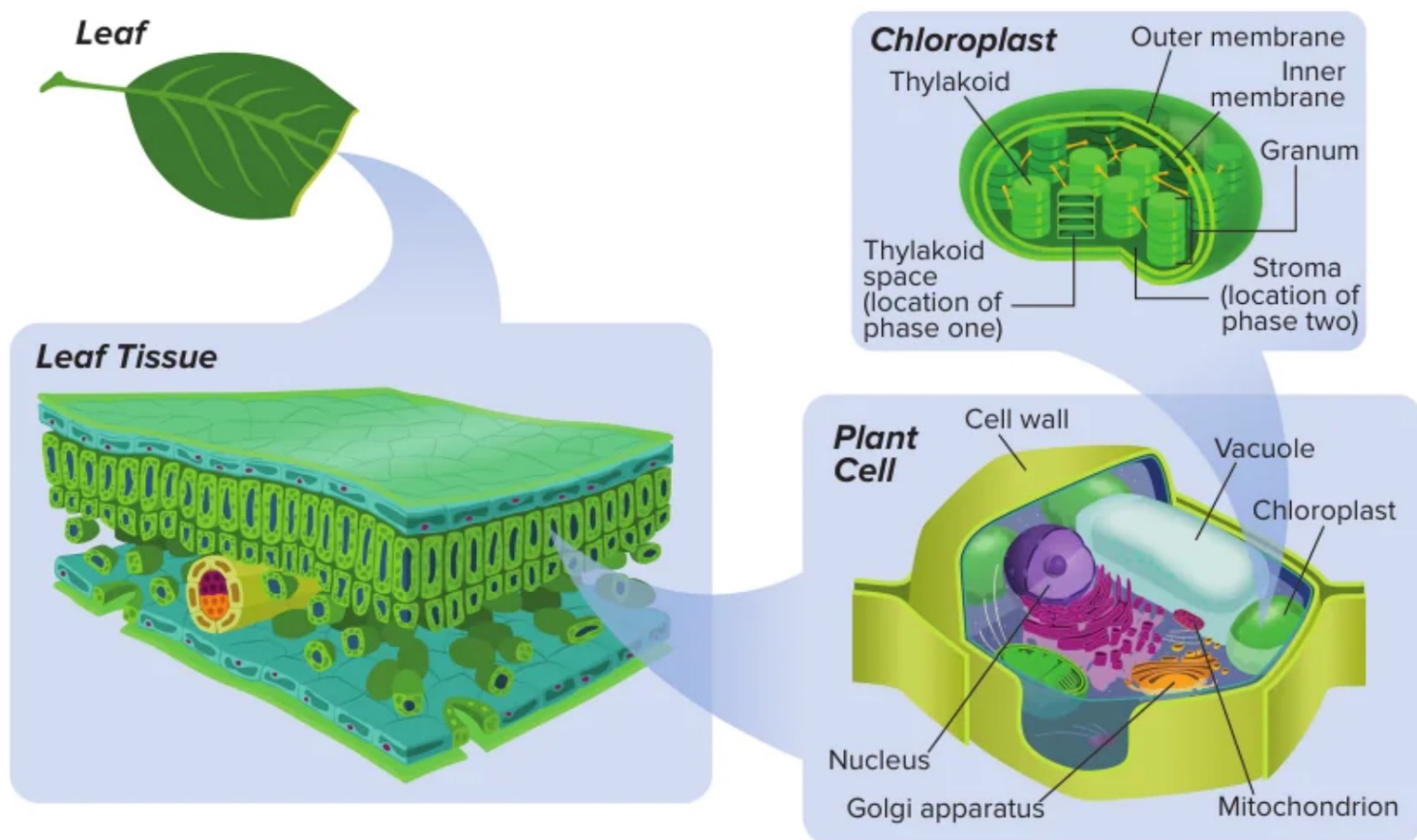
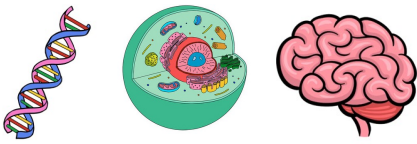


Figure 5 Photosynthesis occurs inside pigmented organelles called chloroplasts.





Pigments

- Pigments are colored **molecules in the thylakoid membranes**. They absorb light energy. Each pigment absorbs specific wavelengths, as shown in Figure 6. Different pigments absorb different wavelengths.
- The main pigments in plants are **chlorophylls**. The most common types are **chlorophyll a** and **chlorophyll b**. Their structures differ, so they absorb light at different parts of the visible spectrum.
- Chlorophyll absorbs light strongly in the violet-blue region. It reflects green light. This is why plants appear green.

Absorption Spectrum of Photosynthetic Pigments

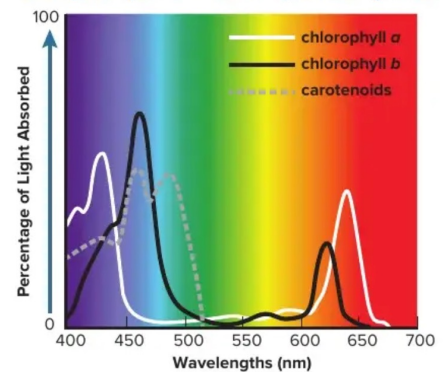


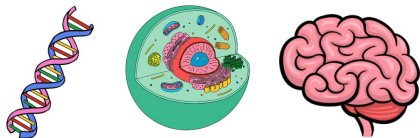
Figure 6 Colorful pigments found in the leaves of trees differ in their ability to absorb specific wavelengths of light.

- Besides chlorophyll, plants have accessory pigments. These help **absorb more light** from other parts of the spectrum.
- One group is **carotenoids**. For example, beta-carotene. They absorb light mainly in the blue and green regions. They reflect yellow, orange, and red, as shown in Figure 6. These pigments give carrots and sweet potatoes their color.
- Chlorophyll is more abundant in leaves, so it hides other pigment colors. In autumn, chlorophyll breaks down. This reveals yellow, orange, and red colors, as shown in Figure 7.



Figure 7 When chlorophyll breaks down in the leaves of some trees, the other pigments become visible.

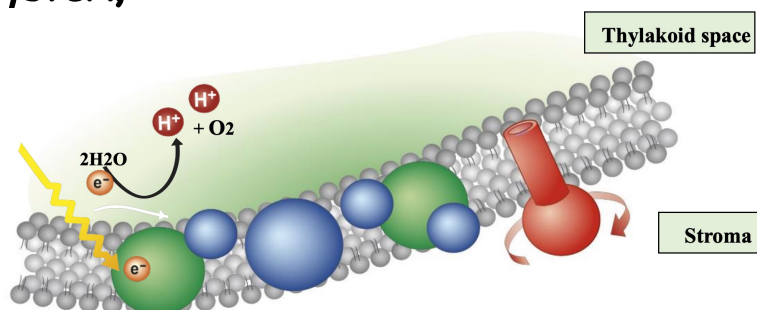




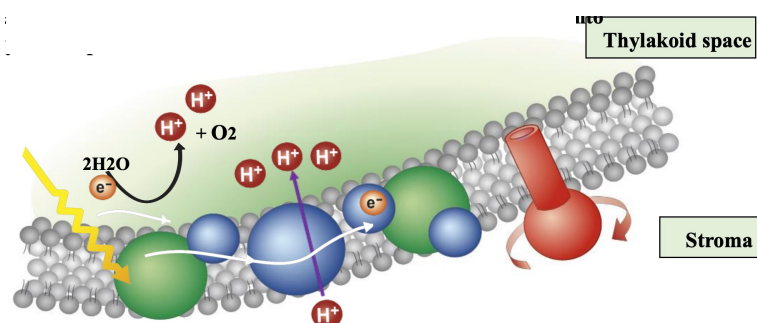
Electron Transport

- The thylakoid membrane structure **helps efficient energy** transfer during electron transport. It has a large surface area. This allows many electron transport molecules to be present. It also holds two protein complexes called **photosystems**.
- Photosystem I and Photosystem II contain pigments and proteins. They absorb light and play key roles in the light reactions.
- First:**
- Light energy excites electrons in photosystem II and also causes a water molecule to split, releasing:

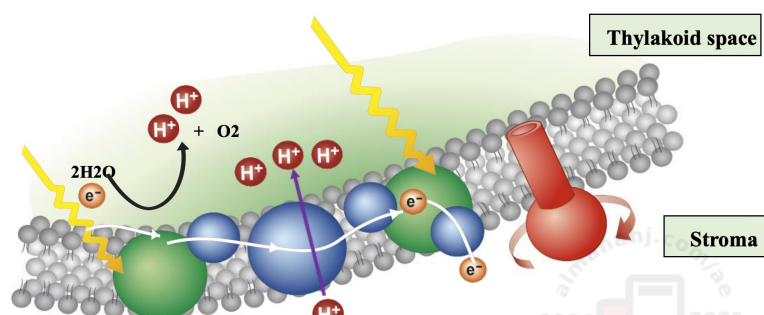
- an electron into the electron transport system,
- H^+ into the thylakoid space,
- and O_2 as a waste prod

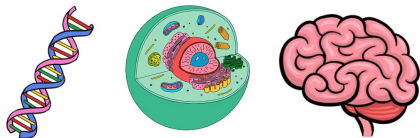


- Second:**
- The excited electrons move from photosystem II to an electron acceptor molecule in the thylakoid membrane.
- As electrons move through the membrane, protons H^+ are pumped into the thylakoid space.

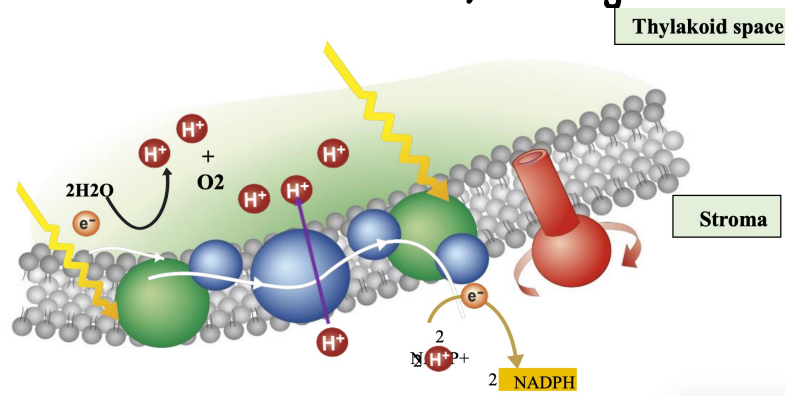


- third:**
- The electron-acceptor molecule transfers the electrons along a series of electron carriers to photosystem I.



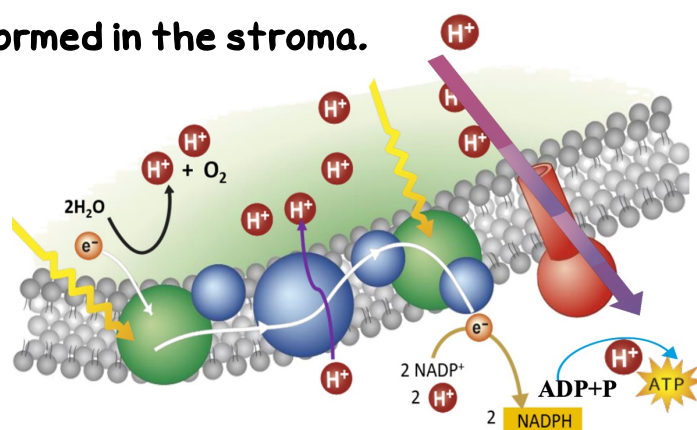


- **fourth:**
- In the presence of light, Photosystem I transfers the electrons to a protein called ferredoxin.
- **Finally;**
- Ferredoxin transfers the electrons to the electron carrier NADP^+ , forming the energy-storing molecule NADPH .



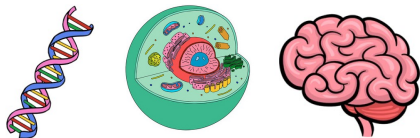
Chemiosmosis

- ATP is produced in conjunction with electron transport by the process of chemiosmosis.
- ATP is produced due to the flow of electrons down concentration gradient.
- The breakdown of water provides the necessary protons for ATP synthesis.
- H^+ protons diffuse down their concentration gradient out of the thylakoid interior into the stroma through ATP synthases
- As H^+ moves through ATP synthases, ATP is formed in the stroma.



- Activated electrons are passed from one molecule to another along the thylakoid membrane in a chloroplast.
- The energy from electrons is used to form a proton gradient.
- As protons move down the gradient, a phosphate is added to ADP, forming ATP.





Phase Two: The Calvin Cycle

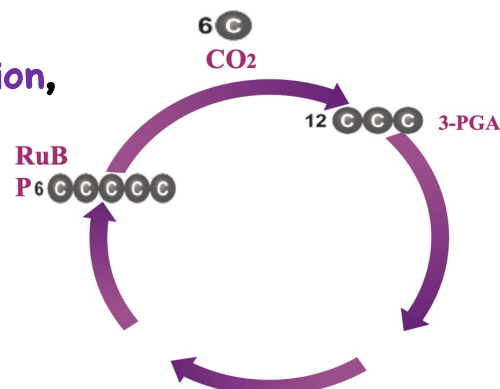
- Although NADPH and ATP provide a lot of energy, they are not stable for long-term storage. Therefore, photosynthesis has a second phase called the **Calvin cycle**, where energy is stored in organic molecules like glucose. The Calvin cycle is also known as the **light-independent reactions**.

First:

- In the first step of the Calvin cycle, called **carbon fixation**,

What does CO₂ fixation mean?:

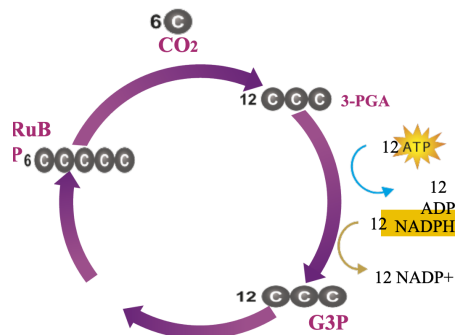
-Carbon fixation or carbon assimilation is the conversion process of inorganic carbon (carbon dioxide) to organic compounds by living organisms.



- The joining of carbon dioxide with other organic molecules is called carbon fixation.
- In Carbon fixation, six carbon dioxide (CO₂) molecules combine with six 5 carbon compounds (RuBP) to form $\rightarrow\rightarrow\rightarrow$ twelve 3-carbon molecules called **3-phosphoglycerate (3-PGA)**.

second:

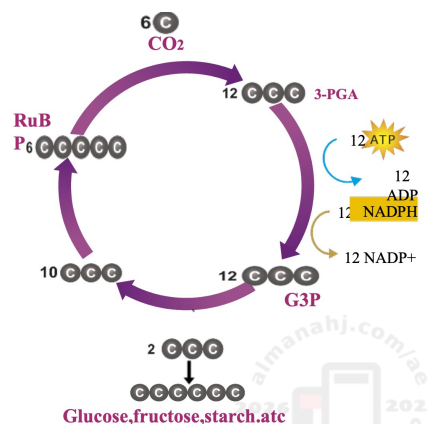
- In the second step, the chemical energy stored in ATP and NADPH is transferred to the 3-PGA molecules to form $\rightarrow\rightarrow\rightarrow$ high-energy molecules called **glyceraldehyde 3-phosphates (G3P)**.



- ATP supplies the phosphate groups for forming G3P molecules, while NADPH supplies hydrogen ions and electrons.
- The chemical energy stored in ATP and NADPH is transferred to make a G3P molecule.

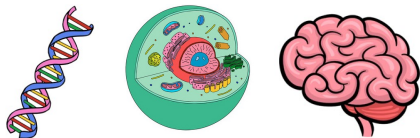
third:

- In the third step, two G3P molecules leave the cycle to be used for the production of $\rightarrow\rightarrow\rightarrow$ **glucose** and other organic compounds.



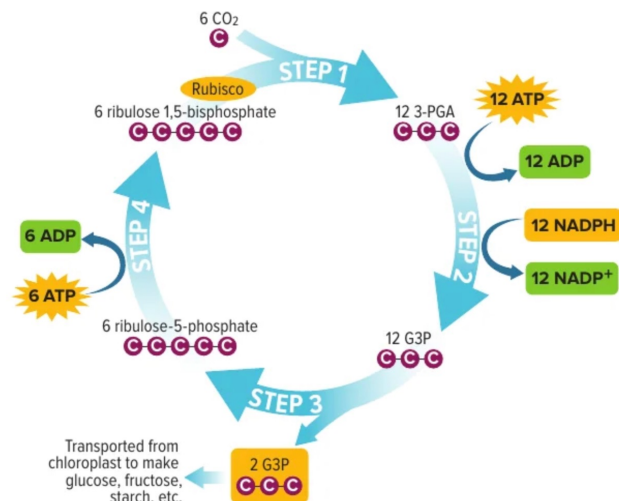
How many G3P left?.





- **finally:**
- In the final step of the Calvin cycle, an enzyme called **rubisco** converts the remaining **ten G3P** molecules into **5-carbon** molecules called **ribulose 1, 5-bisphosphates (RuBP)**. These molecules combine with new carbon dioxide molecules to continue the cycle

Because rubisco converts inorganic carbon dioxide molecules into organic molecules that can be used by the cell, it is considered one of the most important biological enzymes. Plants use the sugars formed during the Calvin cycle both as a source of energy and as building blocks for complex carbohydrates, including cellulose, which provides structural support for plants.



Alternative Pathways

The environment affects photosynthesis. Low water or low CO₂ reduces how well plants make chemical energy. In hot, dry places, plants lose too much water, which lowers photosynthesis. To adapt, some plants use alternative pathways.

Adaptive pathway helps plants **maintain photosynthesis** while minimizing water

C ₄ plants	CAM plants
Fix carbon dioxide into four carbon C ₄ .	Called crassulacean acid metabolism (CAM) pathway
Have structural modifications in the arrangement of cells in the leaves.	Occurs in plants that live in environments where access to water is limited (deserts, salt marshes)
Are able to make glucose in different cells.	At night, CO ₂ fix into organic compounds, During the day, CO ₂ is released from these compounds and enters the Calvin cycle
Keep their stomata closed during hot days.	Are able to make glucose at different time of the day
Ex: Corn and sugarcane.	Ex: Pineapples, orchids and cactus

