

# Bioenergetics

## Descriptive Questions

### Bioenergetics

**Q.1 Describe bioenergetics and the role of ATP.**

09408003

**Ans. Definition**

'Bioenergetics is the study of how living organisms acquire, convert, store, and utilize energy to fuel their life processes'. Or 'Bioenergetics is the study of energy transformations in living organisms'.

#### Explanation

Organisms obtain energy primarily from their surroundings. Plants capture sunlight through photosynthesis, while animals and other organisms consume food. This energy is then converted into usable chemical energy, stored in molecules like ATP (adenosine triphosphate). ATP acts as a ready source of energy that cells can access whenever they need it for processes such as growth, movement, repair, and reproduction.

**Q.2 What are redox reactions? Write their role.**

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**Ans. Introduction**

Oxidation-reduction (redox) reactions are fundamental to the metabolism of organisms. In these reactions, electrons are transferred between molecules. In oxidation, molecule loses electrons and in reduction, it gains electrons.

#### Role

This electron flow is essential for generating energy in the form of ATP during processes like cellular respiration and photosynthesis.

## ATP: The Cell's Energy Currency

**Q.3 Explain ATP as a molecule that is the chief energy currency of all cells.**

09408003

**Ans. ATP**

Cells use a special energy currency for their reactions. This currency is a nucleotide called adenosine triphosphate (ATP).

#### Need of Energy

When cells store energy, they make ATP. When cells need energy, they break ATP.

#### Structure

ATP molecule has three subunits i.e. adenine, (a nitrogen containing base); ribose (a five-carbon sugar) and three phosphate groups.

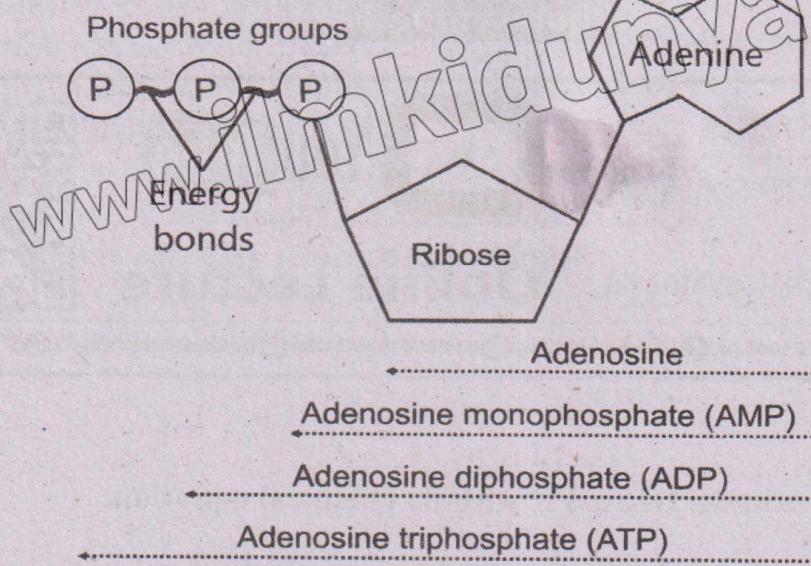


Figure 8.1: Molecular structure of ATP

### ATP-ADP cycle

#### a) ATP into ADP

In the molecule of ATP, the covalent bonds between two phosphates are high-energy bonds. When one of these bonds is broken, inorganic phosphate ( $P_i$ ) separates and energy is released.

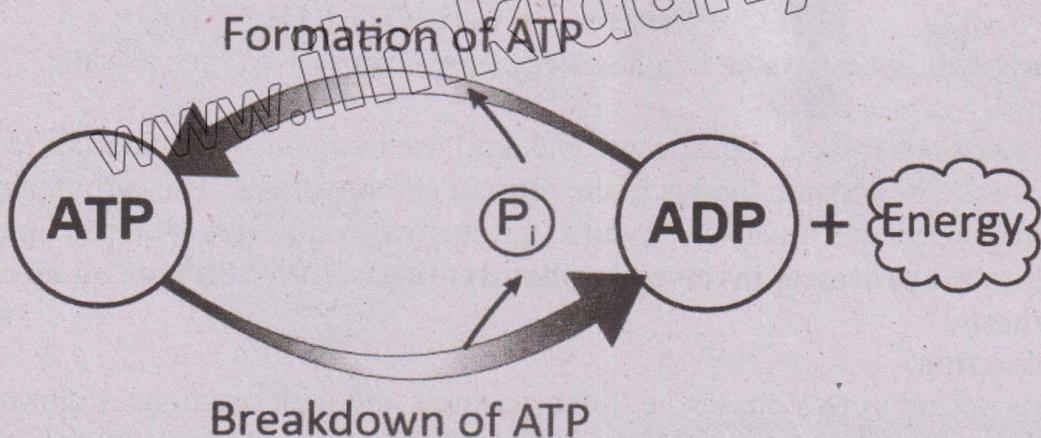
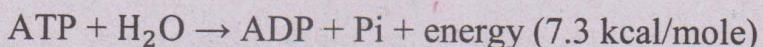


Figure 8.2: ATP-ADP Cycle

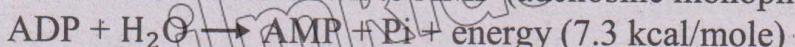
The breaking of one phosphate bond releases about 7.3 kcal (7,300 calories) per mole of ATP.



In common energy reactions only the outer P-P high-energy bond breaks. When this happens, ATP becomes ADP (adenosine diphosphate) and one  $P_i$  is released.

#### b) ADP into AMP

In some cases, ADP is further broken down to AMP (adenosine monophosphate) and  $P_i$ :



Cells get energy from the oxidation of food. They store this energy by combining ADP with  $P_i$  to form ATP.

### Summary

ATP is made during energy-releasing processes and is broken down during energy-consuming processes. In this way ATP transfers energy between metabolic reactions.

## Photosynthesis

- ◆ Overview
- ◆ Phases
- ◆ Light Reaction of Photosynthesis



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**Q.4 Define photosynthesis. Discuss it with its chemical equation.**

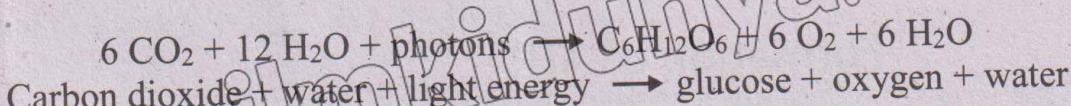
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**Ans. Introduction**

Photosynthesis is the synthesis of glucose from carbon dioxide and water in the presence of sunlight (and chlorophyll), with oxygen as a by-product.

### Chemical Equation

It is the most important metabolic reaction and all life depends on it. A simple general equation for photosynthesis is as follows;



### Explanation

Autotrophic organisms (plants, algae, some bacteria) use inorganic raw materials to prepare their organic food. The organic food is in the form of carbohydrates. The carbohydrates are used for getting energy and are also converted to other molecules like proteins, lipids etc.

**Q.5 Outlines the processes involved in photosynthesis. / Write a note on mechanism of photosynthesis.**

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**Ans. Introduction**

Photosynthesis occurs in two phases i.e. light reactions and dark reactions. Light reactions take place on the thylakoid membranes of chloroplasts. Dark reactions take place in the stroma of the chloroplasts.

### 1. Light reactions

#### Definition

During light reaction, light energy is used to make high-energy molecules (ATP and NADPH).

#### Key Events of Light Reactions

Following are the key events of light reactions:

##### a) Emission of Electrons

When chlorophyll absorbs light, reactions start in it. High energy electrons are released from chlorophyll.

##### b) Production of ATP

The high energy electrons are passed to an electron transport chain. In this chain, electrons pass from higher to lower energy level. They release energy which is used to produce ATP.

**c) Breakage of Water Molecule (Photolysis)**

Light also breaks water molecule. Oxygen is released while hydrogen atoms give electrons to chlorophyll and become hydrogen ions.

**d) Reaction of NADP into NADPH**

The electrons of chlorophyll, after the production of ATP, and the hydrogen ions of water are used to reduce a NADP into NADPH.

**e) Nicotinamide Adenine Dinucleotide (NAD)**

It is a coenzyme. One form of this coenzyme also carries phosphate. It is called NADP.

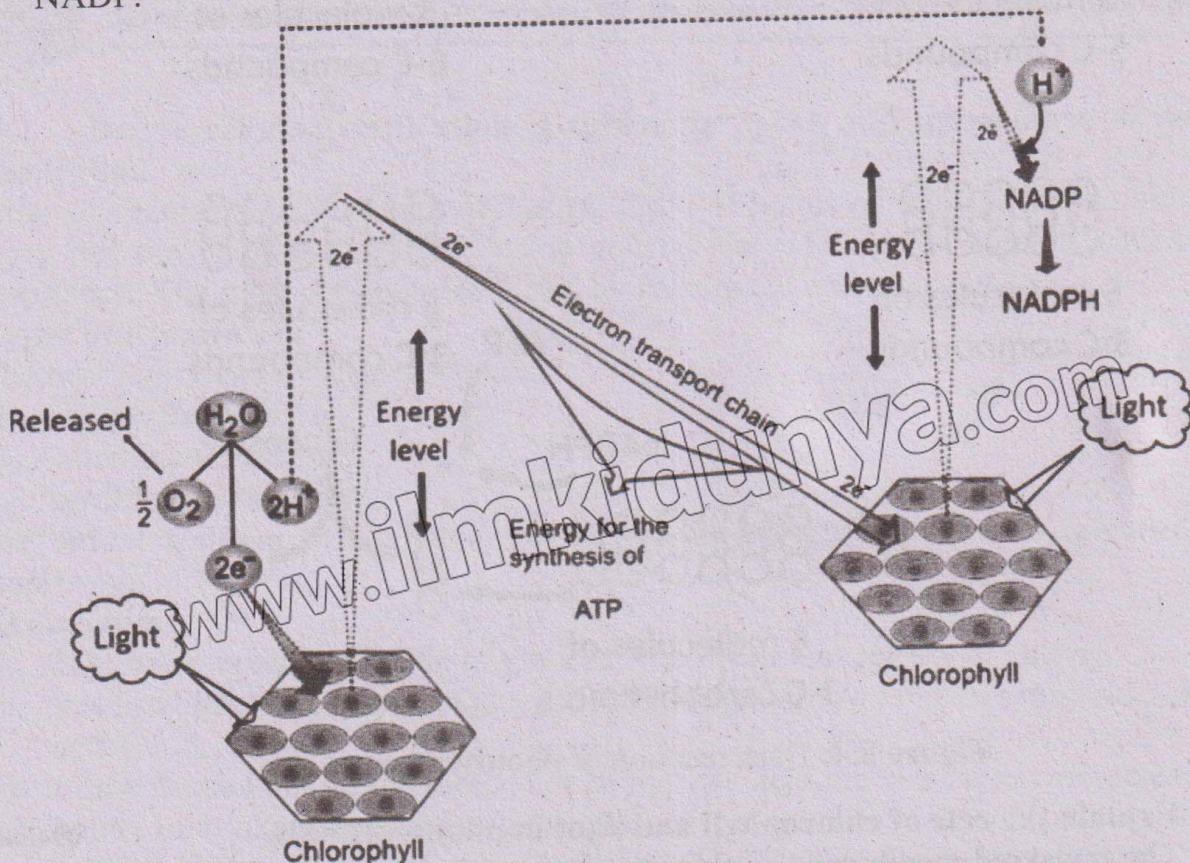


Figure 8.3: Light reactions of photosynthesis (HQ picture is available on Pg # 212)

## 2. Dark Reactions (Calvin Cycle)

### Definition

During this phase, carbon dioxide is reduced to make glucose. The details of dark reactions were discovered by Melvin Calvin.

### Summary of Dark Reactions

**a) Splitting of 6-carbon Compounds**

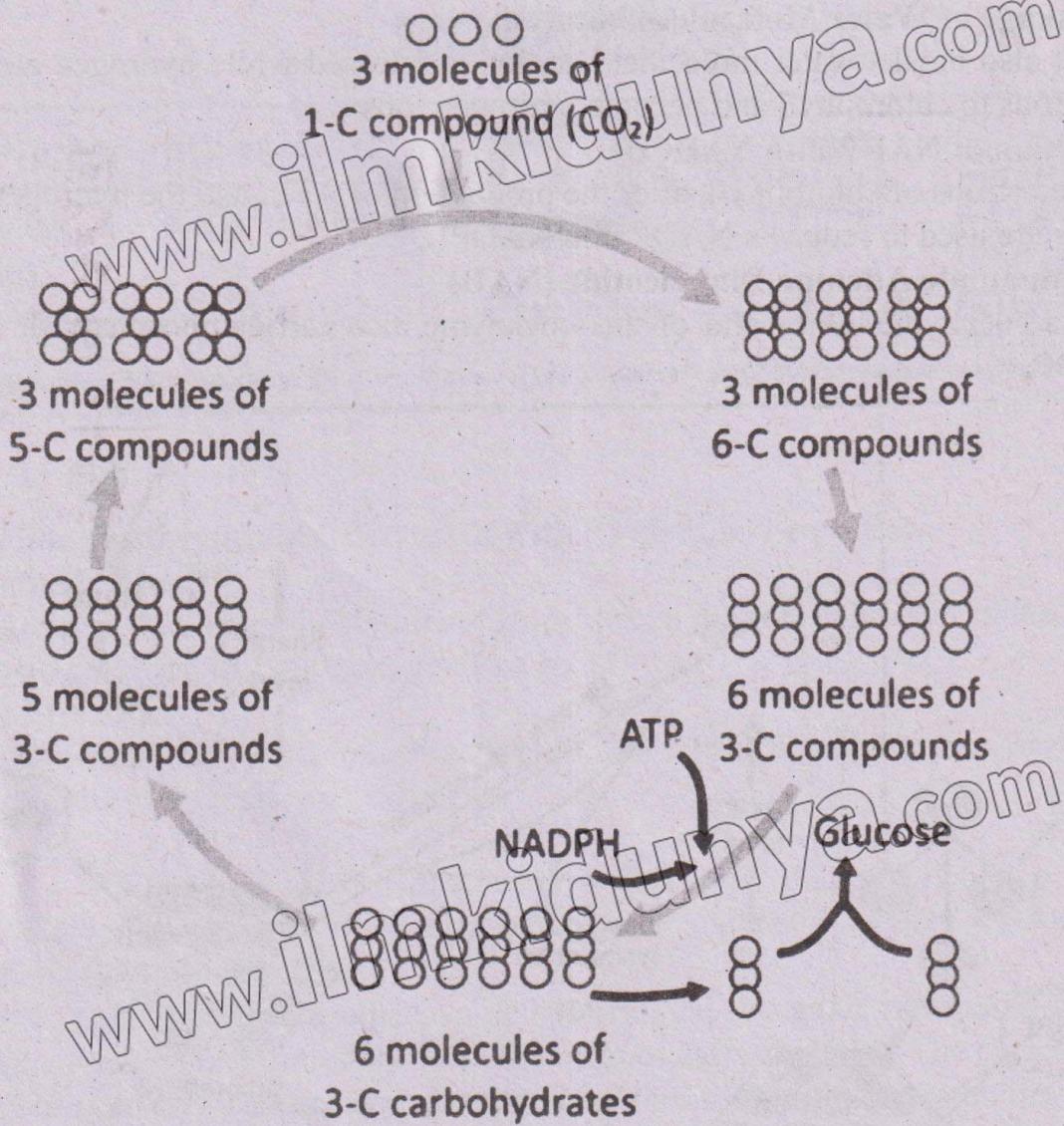
$CO_2$  molecules combine with 5-carbon compounds to form 6-carbon compounds. Each 6-carbon compound splits into two 3-carbon compounds.

**b) Reduction of 3-Carbon Compounds**

The 3-carbon compounds are reduced to 3-carbon carbohydrates by using ATP and hydrogen from NADPH. The 3-carbon carbohydrates are used to make glucose.

**c) Regeneration of Original 5-Carbon Compounds**

The 3-carbon carbohydrates are also used to regenerate the original 5-carbon compounds. This step also utilizes ATP.



**Figure 8.4:** Dark reaction of photosynthesis

**Q.6 Explain the role of chlorophyll and light in photosynthesis.**

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**Ans.** The thylakoid membranes of chloroplasts contain pigments. **Chlorophyll-a** is the main pigment. Others are called accessory pigments and include chlorophyll-b and carotenoids.

#### Absorption of Light by Pigments

Pigments absorb sunlight and convert it into chemical energy for photosynthesis. Only about 01% of the light falling on the leaf surface is absorbed, the rest is reflected or transmitted. The blue and red lights carry out photosynthesis. Different pigments absorb different wavelength of light. Chlorophyll-a absorbs light of blue and red wavelengths. The wavelengths which are not absorbed by chlorophyll-a are absorbed by accessory pigments.

#### Pigments

Pigments are the substances that absorb visible light. Different pigments absorb light of different wavelengths (colours).

#### Formation of ATP

When a pigment absorbs light, reactions occur in it and its electrons are released. The high energy electrons pass through electron transport chain and their energy is used for the formation of ATP and for reducing NADP to NADPH.

# Mechanism of Respiration

- ◆ Overview
  - ◆ Glycolysis
  - ◆ Kreb's Cycle
  - ◆ Explanation



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**Q.7 Define cellular respiration. Explain the types and importance of anaerobic respiration.** 09408007

**Ans.** Organisms get energy by breaking the C-H bonds of food. For this purpose, they carry out the oxidation of food inside cells. This oxidation of food is called cellular respiration. The most common food used by cells to get energy is glucose.

## **Types of Respiration**

The two main types of respiration are:

- (1) Aerobic Respiration
  - (2) Anaerobic Respiration

## 1. Aerobic Respiration

**Definition:** Cellular respiration occurring in the presence of oxygen is called aerobic respiration.

## **Explanation**

- i. It is the complete oxidation of glucose with maximum release of energy.
  - ii. It is first phase, a molecule of glucose (6-C) is broken down into two molecules of pyruvic acid (3-C).
  - iii. In the second phase, the molecules of pyruvic acid are completely oxidized (all C-H bonds are broken) and all energy is released.

## **2. Anaerobic Respiration (Fermentation)**

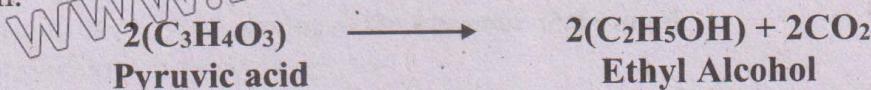
**Definition:** Cellular respiration that occurs in the absence of oxygen is called anaerobic respiration.

## **Explanation**

- i. In anaerobic respiration, glucose is incompletely oxidized with less amount of energy released.
  - ii. Its first phase is exactly similar to that of aerobic respiration. A molecule of glucose is broken down into two molecules of pyruvic acid.
  - iii. In the second phase, pyruvic acid may be treated in two ways:

## A. Alcoholic Fermentation

During anaerobic respiration in bacteria and yeast etc. pyruvic acid is further broken down into alcohol ( $C_2H_5OH$ ) and  $CO_2$ . This type of anaerobic respiration is called alcoholic fermentation.



Yeast and bacteria can ferment sugars of berries to alcohol. Birds eating these berries can become quite drunk, as is obvious from their flight pattern.

## B. Lactic Acid Fermentation

During anaerobic respiration in the skeletal muscles of humans and other animals, pyruvic acid is converted into lactic acid ( $C_3H_6O_3$ ). This type of anaerobic respiration is called lactic acid fermentation.



## **Importance of Fermentation**

### i. Early Life and Anaerobes

The environment of Earth did not have free oxygen ( $O_2$ ) in the early phases of life. The early organisms respired anaerobically and got energy for their life. Even today, some organisms including some bacteria and some fungi get energy from anaerobic respiration and are called anaerobes.

## ii. Anaerobic Respiration in Skeletal Muscles

When skeletal muscles of humans work hard (during exercise etc.) but oxygen supply is not sufficient to fulfil the demand, the skeletal muscles carry out anaerobic respiration to get energy.

### iii. Use of Fermentation

Scientists have used fermentation in fungi and bacteria for making useful products for mankind.

## Examples

- a. The fermentation in bacteria is used for making cheese and yogurt.
  - b. Fermentation in yeasts is used in brewing and baking industries.
  - c. Similarly, the soy sauce is made through the fermentation by a fungus.

**Q.8** Outline the mechanism of aerobic respiration.

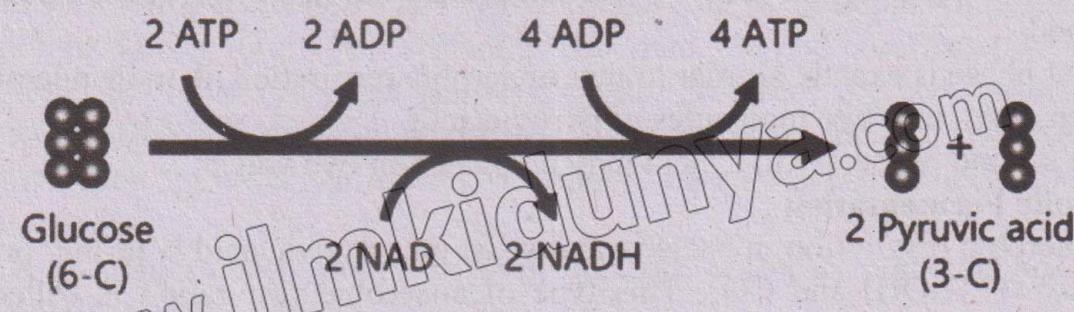
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## Ans. Introduction

For the study of all the reactions of cellular respiration, mechanism of aerobic respiration is studied. There are three main steps of aerobic respiration.

## 1. Glycolysis

In the first step, the glucose (6C) molecule is broken. It results in two molecules of pyruvic acid (3C) with 2 ATPs and 2 molecules NADH. This process is called glycolysis and it occurs in cytoplasm. Oxygen is not required for glycolysis. That is why, it also occurs in anaerobic respiration.



**Figure 8.5:** Summary of Glycolysis

## 2. Krebs Cycle

When oxygen is available, the molecules of pyruvic acid move from cytoplasm to the matrix of mitochondria. Here, a series of reaction called Krebs cycle (discovered by a

British Scientist Sir Hans Krebs) occurs. Before Krebs cycle, each pyruvic acid is converted into acetyl coenzyme-A, carbon dioxide and NADH. In Krebs cycle, the acetyl Coenzyme-A is completely oxidized to carbon dioxide. It results in the formation of ATP and energy-rich compounds i.e. NADH and FADH<sub>2</sub> (Flavin Adenine Dinucleotide - reduced).

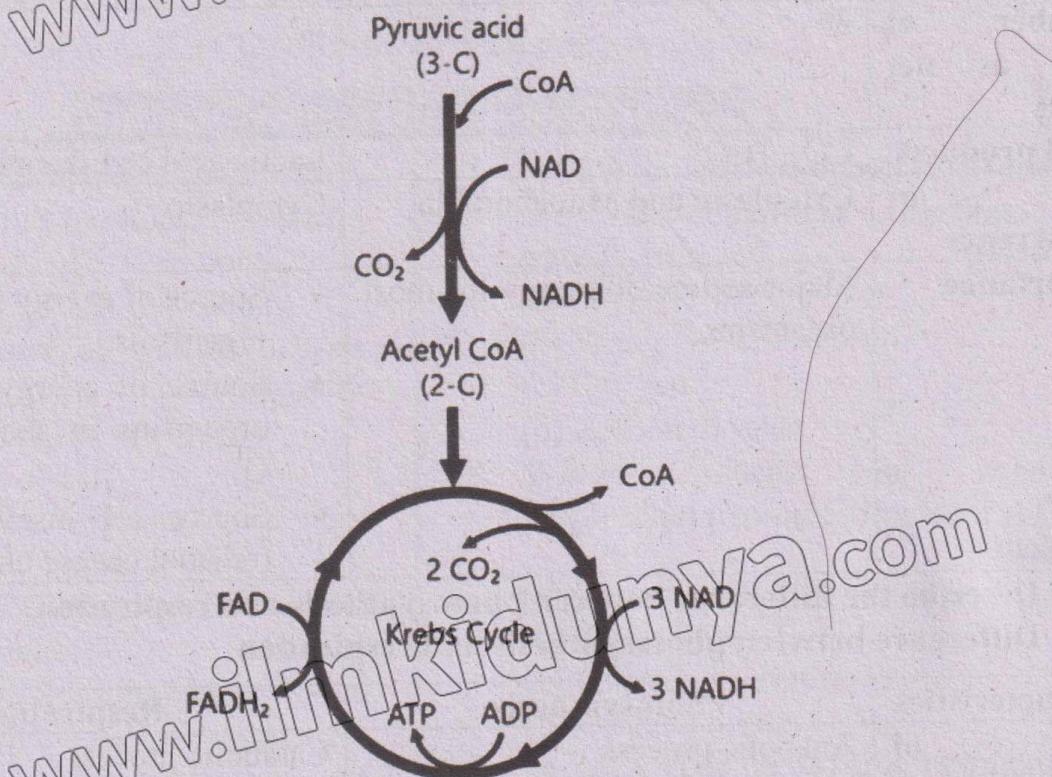


Figure 8.6: Summary of Kr̄b's Cycle

### 3. Electron Transport Chain

This step occurs on the membranes of mitochondria. During it, NADH and FADH<sub>2</sub> change back to NAD and FAD by releasing electrons and hydrogen ions. The released electrons pass through an electron transport chain and release energy. This energy is used to make ATP. At the end of chain, electrons and hydrogen ions combine with oxygen and form water.

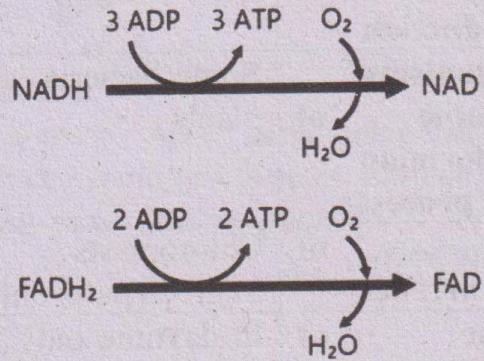


Figure 8.7: Electron Transport Chain  
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### Q.9 What are the uses of ATP?

- Ans.** Respiratory energy produced during cellular respiration is used in various ways:
1. Muscle contractions and movement
  2. Active transport of substances
  3. Synthesis of biomolecules
  4. Replication of DNA and mitosis
  5. Transmission of nerve impulse
  6. Maintenance of body temperature
  7. Break down and elimination of toxins from the body

**Q.10** Describe the difference between aerobic and anaerobic respiration.

09408010

**Ans.** Difference between aerobic and anaerobic respiration

	Aerobic Respiration	Anaerobic Respiration
Presence of Oxygen	Yes	No
Number of ATP as net profit	36	02
Final products	CO <sub>2</sub> , H <sub>2</sub> O	Lactic acid or Ethanol + CO <sub>2</sub>
Site of Occurrence	Cytoplasm and Mitochondria	Cytoplasm
Importance	Major source of energy for most organisms	<ul style="list-style-type: none"> <li>Source of energy for anaerobic organisms.</li> <li>Source of energy for aerobic organisms in short supply of O<sub>2</sub></li> <li>Source of useful products (ethanol, cheese etc.)</li> </ul>

**Q.11** Describe the difference between photosynthesis and respiration.

09408011

**Ans.** Difference between photosynthesis and respiration

Characteristics	Photosynthesis	Respiration
Type of metabolism	Anabolic process	Catabolic process
Energy investment / production	Energy is stored in the form of bond energy	Bond energy of food is transformed into ATP
Organisms capable of performing this process;	Some bacteria, all algae and all plants	All organisms
Site of Occurrence	Chloroplasts In green parts only	In cytoplasm and mitochondria in all cells
Time of occurrence	In daytime only in the presence of light	All the time

**Q.12** How does the intake of water and CO<sub>2</sub> take place for photosynthesis? Which phenomenon is involved in the intake of CO<sub>2</sub> and water by plants?

09408012

**Ans.** Intake of water and CO<sub>2</sub> for photosynthesis

Water and CO<sub>2</sub> are the raw materials of photosynthesis. The plants have mechanisms for the intake and transport of these materials.

#### i. Intake of water

Water present in soil is absorbed by roots and root hairs through osmosis. This water is eventually transported to leaves through xylem vessels. (After the entry of water in the inner cells of the root, it reaches xylem vessels).

## ii. Intake of Carbon dioxide ( $\text{CO}_2$ )

The air that enters the leaf through tiny pores (stomata) reaches into the air spaces present around mesophyll cells. Stomata cover only 1-2% of leaf surface but they allow much air to pass through them.

This air carries  $\text{CO}_2$  which gets absorbed in the thin layer of water surrounding the mesophyll cells. From here, the  $\text{CO}_2$  diffuses into the mesophyll cells.

### Multiple Choice Questions (Exercise)

1. When we get energy from ATP, which bonds are broken? 09408013
  - (a) P-P bonds
  - (b) C-H bonds
  - (c) C-N bonds
  - (d) C-O bonds
2. Light reactions of photosynthesis occur in: 09408014
  - (a) Plasma membrane of cell
  - (b) Cytoplasm of cell
  - (c) Stroma of chloroplasts
  - (d) Thylakoids of chloroplasts
3. Which type of chlorophyll is most common in plants? 09408015
  - (a) Chlorophyll a
  - (b) Chlorophyll b
  - (c) Chlorophyll c
  - (d) Chlorophyll d
4. Where does the reaction of photosynthesis take place? 09408016
  - (a) Chloroplast
  - (b) Mitochondria
  - (c) Cytoplasm
  - (d) Ribosomes
5. When yeast ferments glucose, the products are: 09408017
  - (a) Alcohol and  $\text{CO}_2$
  - (b) Alcohol and water
  - (c) Lactic acid
  - (d)  $\text{CO}_2$  and  $\text{H}_2\text{O}$
6. In which part of the chloroplast does the light-dependent reaction occur? 09408018
  - (a) Stroma
  - (b) Thylakoid membrane
  - (c) Outer membrane
  - (d) Matrix
7. Which molecule donates electrons in the light-dependent reactions of photosynthesis? 09408019
  - (a) NADPH
  - (b) Water
  - (c) Oxygen
  - (d) Carbon dioxide
8. Which process in aerobic respiration produces the most ATP? 09408020
  - (a) Glycolysis
  - (b) Krebs cycle
  - (c) Electron transport chain
  - (d) Fermentation
9. In yeast cells, anaerobic respiration leads to the production of: 09408021
  - (a) Lactic acid
  - (b) Ethanol
  - (c) Acetic acid
  - (d) Glucose
10. How many ATP molecules are produced from one glucose molecule during anaerobic respiration? 09408022
  - (a) 2
  - (b) 4
  - (c) 12
  - (d) 36
11. What is a common byproduct of anaerobic respiration in animal cells? 09408023
  - (a) Oxygen
  - (b) Water
  - (c) Lactic acid
  - (d) Carbon dioxide

## Multiple Choice Questions (Additional)

### ATP as cell's energy currency

12. The major energy currency of all cells is: 09408024

- (a) ADP
- (b) ATP
- (c) AMP
- (d) P-bonds

13. There are \_\_\_\_\_ P-bonds in an ATP molecule. 09408025

- (a) Two
- (b) Nine
- (c) Six
- (d) Four

### Photosynthesis

14. The mechanism of ATP synthesis is: 09408026

- (a) Phosphorylation
- (b) Photosynthesis
- (c) Respiration
- (d) Glucose

15. What are the products of light reactions in photosynthesis? 09408027

- (a) ATP, NADPH and oxygen
- (b) ATP and NADP
- (c) ATP, PGA and oxygen
- (d) PGA and oxygen

16. Which of the following processes is used by plants to make oxygen during the process of photosynthesis? 09408028

- (a) Intake of water
- (b) Intake of CO<sub>2</sub>
- (c) Photolysis of water
- (d) Calvin cycle

17. A child left a carton on the lawn for two days. When the carton was picked up, the grass under it had turned yellow. What caused the grass to change colour? 09408029

- (a) Lack of oxygen
- (b) Lack of carbon dioxide
- (c) Lack of light
- (d) Lack of water

18. In which component of leaf cells, chlorophyll is present? 09408030

- (a) Stroma
- (b) Thylakoid
- (c) Plasma membrane
- (d) Cytoplasm

19. Which of the following is not a product of the light-dependent reactions of photosynthesis? 09408031

- (a) Oxygen
- (b) ATP
- (c) NADPH
- (d) Glucose

20. In which part of the plant cell does photosynthesis occur? 09408032

- (a) Mitochondria
- (b) Nucleus
- (c) Ribosome
- (d) Chloroplast

### Cellular Respiration

21. Glycolysis is the breakdown of: 09408033

- (a) Fructose
- (b) Glucose
- (c) Lactose
- (d) Maltose

22. In aerobic respiration pyruvic acid changes to: 09408034

- (a) Glucose
- (b) Fructose
- (c) Acetyl CoA
- (d) Citric acid

23. Which of these uses oxygen as the final acceptor? 09408035

- (a) Glycolysis
- (b) Electron transport chain
- (c) Krebs cycle
- (d) Photosynthesis

24. Which of these produces carbon dioxide? 09408036

- (a) Krebs cycle
- (b) Electron transport chain
- (c) Glycolysis
- (d) Photosynthesis

25. Which of these can enter into Krebs cycle? 09408037

- (a) Glucose
- (b) Pyruvic acid
- (c) Citric acid
- (d) Acetyl CoA

26. Alcoholic fermentation occurs in: 09408038

- (a) Bacteria
- (b) Yeast
- (c) Man
- (d) Bacteria and yeast

**27. Lactic acid fermentation occurs in:**

09408039

- (a) Protozoans
- (b) Skeletal muscles of humans
- (c) Aerobes
- (d) Yeasts

**28. End product of glycolysis is:** 09408040

- (a)  $\text{CO}_2 + \text{ATP}$
- (b)  $\text{CO}_2$
- (c)  $\text{CO}_2 + \text{ATP} + \text{NADH}$
- (d) 2 pyruvic acids + 2ATP + 2NADH

**29. After strenuous exercise you get tired because skeletal muscles accumulate:**

09408041

- (a) Lactic acid only
- (b) Ethyl alcohol
- (c) Lactic acid and  $\text{CO}_2$
- (d) Ethyl alcohol and  $\text{CO}_2$

**30. Where does the Krebs cycle occur in a cell?** 09408042

- |                 |                  |
|-----------------|------------------|
| (a) Nucleus     | (b) Mitochondria |
| (c) Chlorophyll | (d) Ribosome     |

### Answer Key

<b>1</b>	a	<b>2</b>	d	<b>3</b>	a	<b>4</b>	a	<b>5</b>	a
<b>6</b>	b	<b>7</b>	b	<b>8</b>	c	<b>9</b>	b	<b>10</b>	a
<b>11</b>	c	<b>12</b>	b	<b>13</b>	a	<b>14</b>	a	<b>15</b>	a
<b>16</b>	c	<b>17</b>	c	<b>18</b>	b	<b>19</b>	d	<b>20</b>	d
<b>21</b>	b	<b>22</b>	c	<b>23</b>	b	<b>24</b>	a	<b>25</b>	d
<b>26</b>	d	<b>27</b>	b	<b>28</b>	d	<b>29</b>	a	<b>30</b>	b

### Short Answer Questions (Exercise)

**Q.1. Write the importance of oxidation reduction reactions.** 09408043

**Ans.** Oxidation-reduction (redox) reactions are fundamental to the metabolism of organisms. In these reactions, electrons are transferred between molecules. In oxidation, molecule loses electrons and in reduction, it gains electrons. This electron flow is essential for generating energy in the form of ATP during processes like cellular respiration and photosynthesis.

**Q.2. What do ATP and ADP mean? What are the roles of these molecules for the cellular metabolism?** 09408044

**Ans. ATP**  
Cells use a special energy currency for their reactions. This currency is nucleotide called adenosine triphosphate (ATP). ATP is the main energy transfer molecule in the cell.

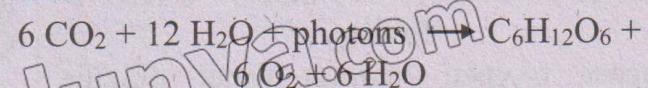
**ADP**

In common energy reactions, when outer P-P high-energy bond of ATP breaks, ATP become ADP (adenosine diphosphate) and one Pi is released.

Cells get energy from the oxidation of food. They store this energy by combining ADP with Pi to form ATP.

**Q.3. Write down the word equation for photosynthesis.** 09408045

**Ans.**



Carbon dioxide + water + light energy  $\rightarrow$  glucose + oxygen + water

**Q.4. Why is chlorophyll important for photosynthesis?** 09408046

**Ans.** Sunlight is absorbed by chlorophyll. It is then converted into chemical energy which drives the photosynthetic process.

**Q.5. How is oxygen produced during photosynthesis?**

09408047

**Ans.** During light reaction of photosynthesis, light breaks water molecule. Oxygen is released while hydrogen atoms give electrons to chlorophyll and become hydrogen ions.

**Q.6. Which organisms carry out photosynthesis? Which cell organelle is responsible for the absorption of light for photosynthesis?**

09408048

**Ans.**

- Autotrophic organisms (plants, algae, some bacteria) use inorganic raw materials to prepare their organic food in the form of carbohydrates during photosynthesis.
- Chloroplast are the sites of photosynthesis in eukaryotes. They contain pigments which absorb sunlight and convert it into chemical energy for photosynthesis.

**Q.7. State the main purpose of cellular respiration.**

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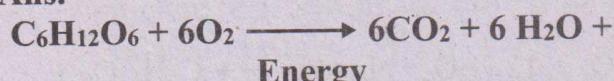
**Ans.** In cellular respiration, food is oxidized to  $\text{CO}_2$ ,  $\text{H}_2\text{O}$  and energy is released. This respiratory energy (ATP) produced during cellular respiration is used in various ways:

- Muscle contractions and movement
- Active transport of substances
- Synthesis of biomolecules
- Replication of DNA and mitosis etc.

**Q.8. State the equation (in words or symbols) for aerobic respiration.**

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**Ans.**



Glucose oxygen carbon water dioxide

**Q.9. Write a brief note on the role of oxygen in aerobic respiration.**

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**Ans.** Cellular respiration occurring in the presence of oxygen is called aerobic respiration. Oxygen helps in the complete oxidation of glucose with maximum release of energy.

**Q.10. Define anaerobic and aerobic respiration.**

09408052

**Ans.**

#### Aerobic respiration

Cellular respiration occurring in the presence of oxygen is called aerobic respiration.

#### Explanation

- It is the complete oxidation of glucose with maximum release of energy.
- It is first phase, a molecule of glucose (6-C) is broken down into two molecules of pyruvic acid (3-C).
- In the second phase, the molecules of pyruvic acid are completely oxidized (all C-H bonds are broken) and all energy is released.

#### Anaerobic Respiration (Fermentation)

Cellular respiration that occurs in the absence of oxygen is called anaerobic respiration.

#### Explanation

- In anaerobic respiration, glucose is incompletely oxidized with less amount of energy released.
- Its first phase is exactly similar to that of aerobic respiration. A molecule of glucose is broken down into two molecules of pyruvic acid.

**Q.11. What are the end products of anaerobic respiration in animals and yeast?**

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**Ans.**

The end product of anaerobic respiration in animals is lactic acid and in yeast is ethyl alcohol.

**Q.12. How do muscles respond to oxygen deficiency during intense exercise?**

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**Ans.** When skeletal muscles of humans work hard (during exercise etc.) but oxygen supply is not sufficient to fulfil the demand, the skeletal muscles carry out anaerobic respiration to get energy.

**Q.13.** List ways in which respiratory energy is used in the body. 09408055

**Ans.** Respiratory energy produced during cellular respiration is used in various ways:

1. Muscle contractions and movement
  2. Active transport of substances

3. Synthesis of biomolecules
  4. Replication of DNA and mitosis
  5. Transmission of nerve impulse
  6. Maintenance of body temperature
  7. Break down and elimination of toxins from the body

## **Short Answer Questions (Additional)**

## **ATP the Cell's Energy Currency**

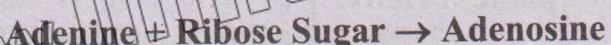
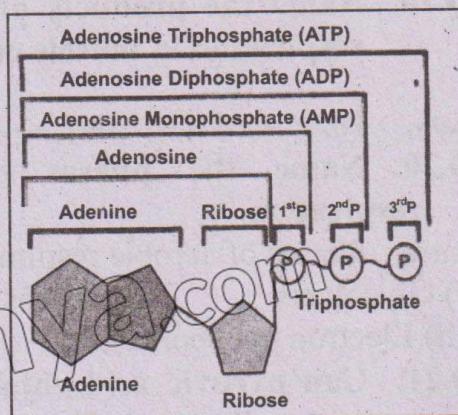
**Q.14.** Sketch and describe the structure of ATP.

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### **Ans. Structure of ATP Molecule**

ATP molecule consists of three components:

1. Adenine (double ringed nitrogen base)
  2. Ribose (Five carbon sugar)
  3. Three Phosphate Groups ( $\text{PO}_4$ ) linked in a chain called a triphosphate group Adenine nitrogen base binds to ribose sugar and become adenosine.



**Q.15. What is AMP?**

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**Ans.** AMP stands for adenosine monophosphate. ADP is broken down to AMP and Pi is released.

## Photosynthesis

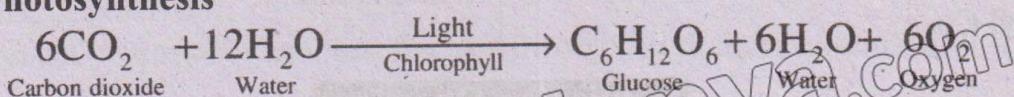
**Q.16. Why dark reactions of photosynthesis are called so?**

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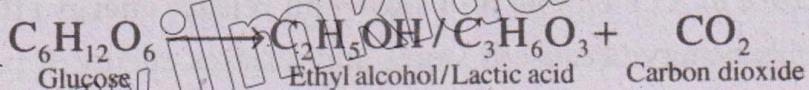
**Ans.** Once the light reactions produce ATP and NADPH, a photosynthetic cell can fix carbon dioxide to synthesize sugar molecules. These reactions does not depend directly on light that is why it is called dark reactions.

**Q.17.** Write the equation of: (a) photosynthesis (b) fermentation (c) aerobic respiration.

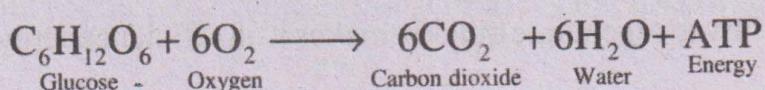
**Ans. (a) Photosynthesis**



### (b) Fermentation



### (c) Aerobic Respiration



**Q.18. How photosynthesis and aerobic respiration are interlinked with each other?**

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**Ans.** Both are interlinked in the following ways:

(i) Both take place in living organisms.

(ii) Energy conversion take place in both processes.

(iii) The exchange of carbon dioxide and oxygen during photosynthesis and cellular respiration worldwide helps to keep atmospheric oxygen and carbon dioxide at stable levels.

(iv) Photosynthesis requires the product of aerobic respiration ( $\text{CO}_2$  and  $\text{H}_2\text{O}$ ) while aerobic respiration requires the products of photosynthesis (glucose and oxygen).

### Respiration

**Q.19. Name the products of anaerobic respiration in muscle cells.**

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**Ans.** lactic acid ( $\text{C}_3\text{H}_6\text{O}_3$ ).

**Q.20. Name the phases of aerobic respiration.**

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**Ans.** Phases of aerobic respiration are:

(i) Glycolysis      (ii) Krebs cycle

(iii) Electron transport chain

**Q.21. Can pyruvic acid enter in Krebs cycle directly? Explain briefly.**

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**Ans.** No it cannot enter in Krebs cycle directly. Each pyruvic acid molecule is oxidized to a two-carbon acetyl group which also combines with coenzyme A to form acetyl CoA. Carbon dioxide is removed and NADH is produced. The acetyl CoA enters mitochondrion where Krebs cycle will occur.

**Q.22. What is acetyl Co-A?**

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**Ans.** Before entering in Krebs cycle, pyruvic acid combines with coenzyme A and changed into a 2- carbon compound called acetyl Co-A.

**Q.23. Define aerobic respiration.**

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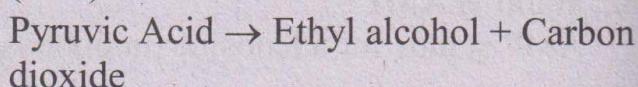
**Ans.** A type of respiration in which complete oxidation of glucose occur with maximum release of energy in the presence of oxygen.



**Q.24. What is alcoholic fermentation?**

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**Ans.** In this type of anaerobic respiration, pyruvic acid is further broken down into alcohol ( $\text{C}_2\text{H}_5\text{OH}$ ) and carbon dioxide ( $\text{CO}_2$ ).



**Q.25. Define anaerobic respiration (Fermentation).**

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**Ans.** Some organisms oxidize their food incompletely without using any molecular oxygen called anaerobic respiration. Glucose is incompletely oxidized with less amount of energy released. It is of two types:

(i) Lactic acid fermentation (ii) Alcoholic fermentation.

### Inquisitive Questions

**Q1. How does structure of ATP enable it to store and release energy efficiently?**

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**Ans:** It is like the cell's battery because it stores and releases energy. It has three phosphate groups that are connected by bonds that are easy to break. When these bonds break during hydrolysis, ATP releases energy that cells use for various activities and when bond forms energy is restored again. Its ability to regenerate quickly makes it an efficient energy carrier.