BIOLOGY FBISE CLASS 9th Notes

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How would you define bioenergetics while relating it to the oxidation-reduction reactions in living systems?

Bioenergetics:

"Bioenergetics is the study of energy relationships and energy transformations in living organisms."

Bioenergetics and the role of ATP:

Organisms obtain energy by metabolizing the food they eat or prepare. The food contains potential energy in its bonds. When these bonds are broken down, a large amount of kinetic energy is usually released. Some of this energy is stored in the form of potential energy in the bonds of ATP molecules while the rest escapes as heat. The potential energy stored in ATP is again transformed into kinetic energy to carry out life activities.

Life processes and constant use of energy:

Life processes in organisms involve a constant flow of energy. This energy flow comprises the acquisition, transformation, and use of energy for various life processes like growth, movement, reproduction, etc.

Bioenergetics and its relation with Oxidation-Reduction reactions:

For all life processes, oxidation-reduction reactions are the direct source of energy. Oxidation-reduction reactions involve the exchange of electrons between atoms.

Definition:

"An oxidation-reduction reaction is any chemical reaction in which the oxidation number of a molecule, atom, or ion changes by gaining or losing an electron."

Oxidation:

Oxidation is the loss of electrons.

Reduction:

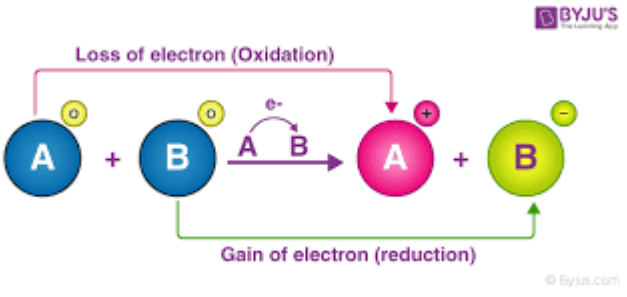
A reduction is the gain of electrons.

Role of electrons in bioenergetics:

Electrons can be an energy source. It depends upon their location and arrangement in atoms.

For example:

When they are present in oxygen, they make a stable association with oxygen atoms and are not a good energy source. But if electrons are dragged away from oxygen and attach to some other atom e.g. carbon or hydrogen, they make an unstable association. They try to move back to oxygen and when this happens, energy is released.



Role of redox reactions:

In living organisms, redox reactions involve the loss and gain of hydrogen atoms. A hydrogen atom contains one proton and one electron, which means when a molecule loses a

hydrogen atom, it actually loses an electron, and similarly, when a molecule gains a hydrogen atom, it actually gains an electron.

Interpret that ATP is the chief energy currency of all cells.

ATP (Adenosine Triphosphate):
"Adenosine triphosphate (ATP) is a complex organic chemical that provides energy to drive many processes in living cells."
Discovery of ATP molecule:
ATP was discovered by Karl Lohmann, in 1929 and it was proposed to be the main energy transfer molecule in the cell by the Nobel Prize winner, Fritz Lipmann in 1941.
ATP: Cell's Energy Currency:
The major energy currency of all cells is a nucleotide called adenosine triphosphate (ATP).
ATP is the main energy source for the majority of cellular functions like the synthesis of macromolecules (DNA, RNA, and Proteins) movement, transmission of nerve impulses, active transport, exocytosis, and endocytosis etc.
The ability of ATP to store and release energy is due to its molecular structure.
Structure of ATP:
Each ATP molecule has three subunits:
Adenine; A double ringed nitrogenous base.
A Ribose; A five-carbon sugar
Three phosphate groups in a linear chain

ATP; High energy bond:
The covalent bond connecting two phosphates is indicated by the tilde (~) and it is a high-energy bond. The energy in this bond is released as it breaks and inorganic phosphate (Pi) gets separated from ATP.

Energy released by breaking of one phosphate bond:
The breaking of one phosphate bond releases about 7.3 kcal energy per molecule as follows:

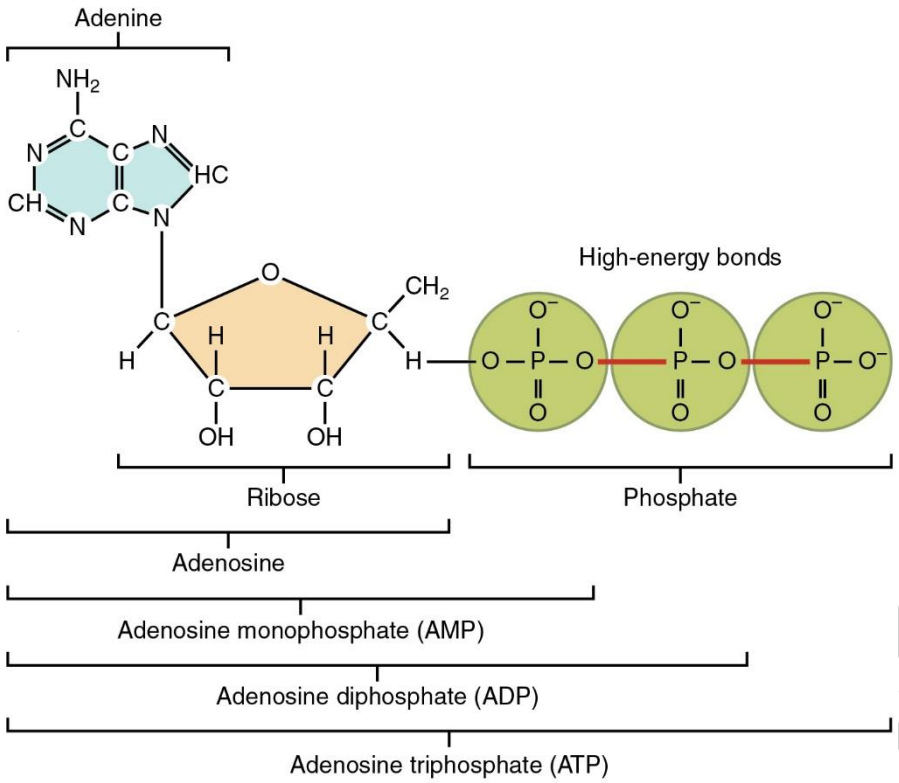
$$\mathbf{ATP + H_2O \rightarrow ADP + Pi + Energy\ (7.3\ kcal/mole)}$$

The energy from ATP is sufficient to drive most of the cell's energy-requiring reactions. In common energy reactions, only the outermost of the two high-energy bonds break. When this happens, ATP becomes ADP (adenosine diphosphate) and one pi is released. In some cases, ADP is further broken down to AMP (adenosine monophosphate) and P as follows:

$$\mathbf{ADP + H_2O \rightarrow AMP + Pi + energy\ (7.3\ kcal/mole)}$$

Recycling of ADP:
Cells constantly recycle ADP by recombining it with Pi to form ATP. The synthesis of ATP from ADP and P requires the expenditure of 7.3 kcal energy/mole. This energy is obtained from the oxidation of food. ATP is generated by energy-releasing processes and is broken down by energy consuming processes. In this way, ATP transfers energy between metabolic reactions.

What is the role of chlorophyll and light in photosynthesis?



Role of light in photosynthesis:

Sunlight energy is absorbed by chlorophyll. It is then converted into chemical energy, which drives the photosynthetic process. Not all the light falling on the leaves is absorbed. Only about one percent of the light falling on leaf surface is absorbed, the rest is reflected or transmitted.

The light rays of different wavelengths are not only differently absorbed by photosynthetic pigments but are also differently effective in photosynthesis. The blue and red light carry out more photosynthesis.

Function of chlorophyll:

When chlorophyll absorbs light, its electrons are excited and they leave chlorophyll molecule. The excited electrons are passed through an electron transport chain and their energy is captured for the formation of ATP and for reducing NADP to NADPH.

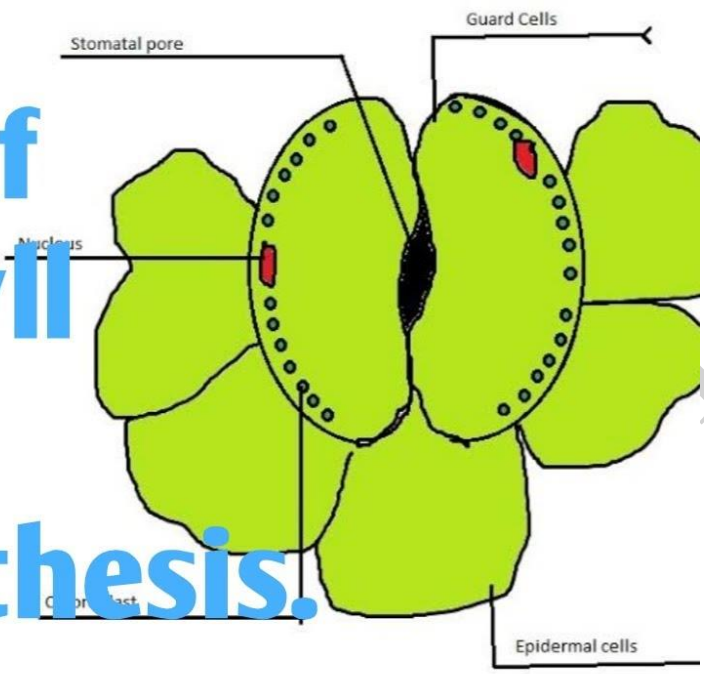
Role of chlorophyll in photosynthesis:

The photosynthetic pigments are organized in the form of clusters, called photosystems, in thylakoid membranes of chloroplasts.

Chlorophyll-a is the main photosynthetic pigment. Others are called accessory pigments and include chlorophyll-b and carotenoids.

Chlorophylls absorb mainly blue and red lights. Some wavelengths not absorbed by chlorophyll-a are very effectively absorbed by accessory pigments and vice versa.

The role of Chlorophyll in Photosynthesis.



Describe the processes involved in photosynthesis?

Photosynthesis:

"Photosynthesis is the process by which green plants and some other organisms use sunlight to synthesize nutrients from carbon dioxide and water. Photosynthesis in plants generally involves the green pigment chlorophyll and generates oxygen as a by-product."

Mechanism of photosynthesis:

Photosynthesis occurs in two phases.

1- Light Reactions:

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

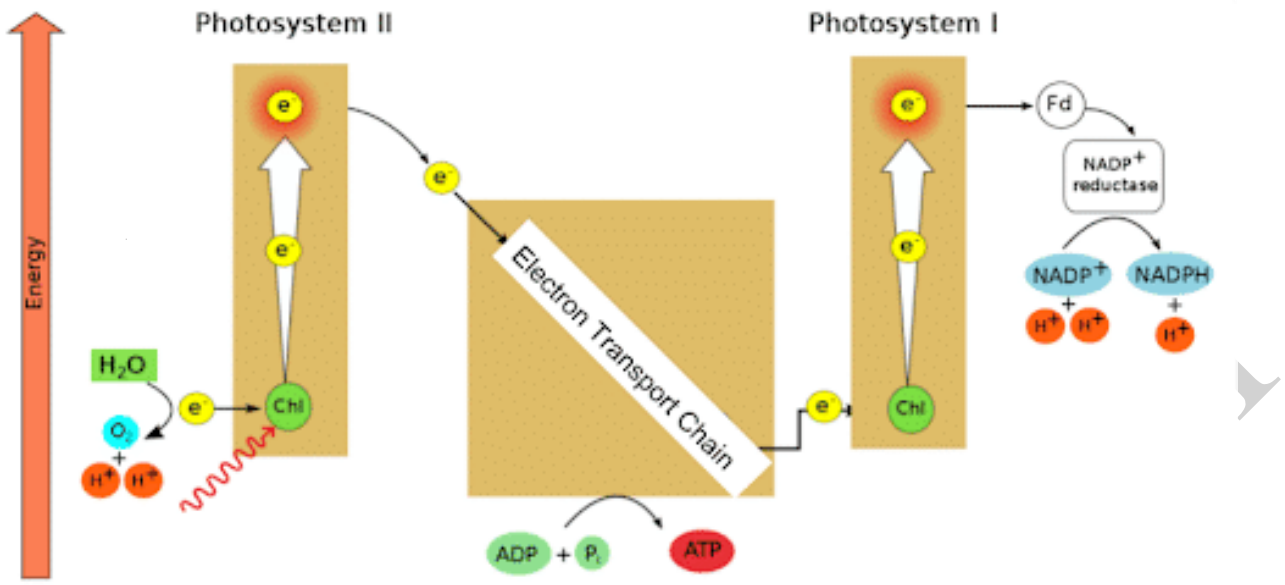
Site of light reaction:

The light reactions, take place on the thylakoid membranes of chloroplasts.

Steps of light reaction:

The summary of the events of light reactions is as follows:

- When chlorophyll molecules absorb light, their energy level increases and their electrons are emitted.
- Electrons are passed to an electron transport chain to produce ATP.
- Light also breaks the water molecule (photolysis) and oxygen is released. The hydrogen atoms of water give electrons to chlorophyll and become ions.
- The electrons of chlorophyll, after the production of ATP, and the hydrogen ions of water are used for the reduction of NAD^+ into NADPH



2- Dark Reactions:

"During the second phase, carbon dioxide is reduced to make glucose. The energy in the form of ATP is utilized in this process and produces ATP in the bonds of glucose. Since these reactions do not use light directly, they are known as dark reactions."

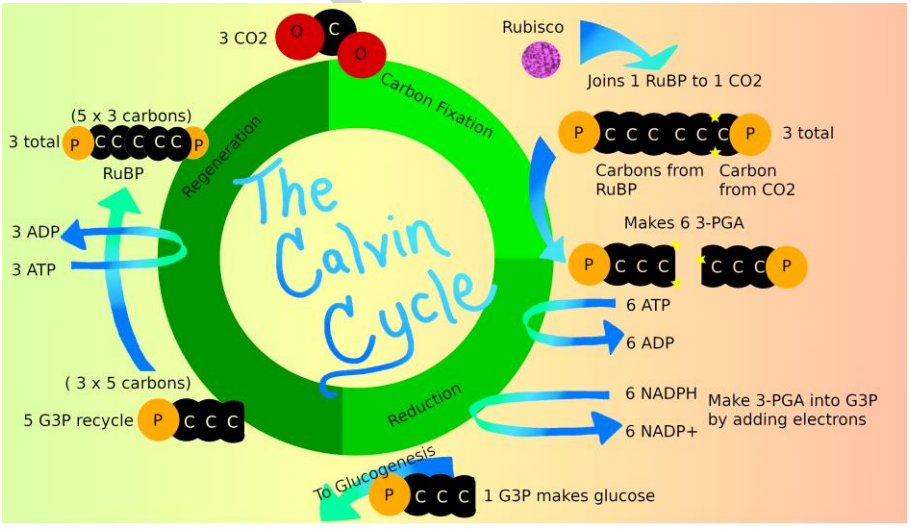
A site of Dark reaction:

The dark reactions take place in the stroma of chloroplasts.

Steps of Dark reaction:

The summary of the events of dark reaction, also known as the Calvin cycle is as follows;

- CO_2 molecules are combined with 5-carbon compounds to form temporary 6-carbon compounds, each of which splits into two 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 manufacture glucose.
- The 3-carbon carbohydrates are also used to regenerate the original 5-carbon compounds. This step also utilizes ATP.



State how the varying light intensity, carbon dioxide concentration, and temperature affect the rate of photosynthesis?

1- Effect of varying light intensity:

The rate of photosynthesis varies with light intensity. It decreases as the light intensity decreases and increases as the light intensity increases. However, at a much higher light intensity, the rate of photosynthesis becomes constant.

2- Effect of varying temperature:

The rate of photosynthesis decreases with a decrease in temperature. It increases as the temperature is increased over a limited range. But if the light intensity is low, increasing the temperature has little influence on the rate of photosynthesis.

3- Effect of varying carbon dioxide concentration:

As carbon dioxide concentration rises, the rate of photosynthesis goes on increasing until limited by other factors. The initial enzyme of dark reactions, which combines carbon dioxide with 5-carbon compound has a binding affinity for both carbon dioxide and oxygen. When the concentration of carbon dioxide is high, it will bind oxygen instead of carbon dioxide and there would be no photosynthesis. Increase in carbon dioxide beyond a threshold level causes closure of stomata and it decreases the rate of photosynthesis.

Outline the mechanism of respiration while defining glycolysis, Krebs oxidation-reduction electron transport chain.

Respiration:

"Cellular respiration is a set of metabolic reactions and processes that take place in the cells of organisms to convert biochemical energy from nutrients into adenosine triphosphate (ATP), and then release waste products."

Steps of aerobic respiration:

The process of respiration involves a complex series of reactions.

Aerobic respiration is a continuous process, but for convenience, it is divided into three main stages which are;

1- Glycolysis:

Glycolysis occurs in cytoplasm and oxygen is not involved in this stage. That is why it occurs in both types of respiration i.e. aerobic and anaerobic. In glycolysis, glucose (6C) molecule is broken into two molecules of pyruvic acid (3C).

2- Krebs cycle:

In the Krebs cycle, the pyruvic acid molecules are completely oxidized, along with the formation of ATP, NADH, and $FADH_2$. Before entering in Krebs cycle, pyruvic acid is changed into a 2-carbon compound called acetyl-CoA.

3- Electron transport chain:

Electron transport chain is the final step of cellular respiration. It is the transfer of electron on an electron transport chain. In this step, NADH, and $FADH_2$ release electrons and hydrogen ions.

These electrons are taken up by a series of electron carriers. When electrons move through the series of electron carriers they lose energy, which is used to synthesize ATP. At the end of the chain, electrons and hydrogen ions combine with molecular oxygen and form water.

Draw a comparison of aerobic and anaerobic respiration.

Properties	Aerobic respiration	Anaerobic respiration
Presence of oxygen	Yes	No
Number of ATP as net profit	36	2
Final products	CO_2, H_2O	Lactic acid, Ethanol + CO_2
Site of occurrence	Glycolysis takes place in the cytoplasm Krebs cycle and Electron transport chain in mitochondria	Anaerobic respiration takes place in the cytoplasm
Importance	A major source of energy for most organisms	Source of energy for anaerobic organisms Source of energy for aerobic organisms in short supply of O_2 Source of many products (ethanol, cheese etc)

How will you compare respiration with photosynthesis?

Characteristics	Photosynthesis	Respiration
Metabolism	Anabolism	Catabolism
Energy investment/ Production	Take light as a source of energy and store it in the form of bond energy (ATP)	Bond energy is transformed into chemical energy of ATP
Organisms capable of	Some bacteria, all algae, and all plants	All organisms
Site of occurrence	Chloroplast	In cytoplasm and mitochondria
Time of occurrence	In the daytime only and in the presence of light	All the time (24 hours)

Difference between photosynthesis and respiration

Short Questions

Q.1) Why is it said that all life forms are dependent on photosynthesis?

Answer:

Photosynthesis is the process by which plant utilizes the sunlight and oxygen to produce carbohydrates and eventually are the main source of energy for humans and all the consumers on earth. Humans and other animals are heterotrophic and cannot make their own food and must rely ultimately on the glucose produced by plants. Moreover, the oxygen humans and other animals breathe is the oxygen released during photosynthesis.

Q.2) What structures and phenomena are involved in the intake of carbon dioxide and water by plants?

Answer:

Structures and phenomena during intake of carbon dioxide and water by plants		
	Structure	**Phenomenon**
Carbon dioxide	Air enters the leaf through stomata	It occurs by diffusion
Water	The roots and xylem vessels transport water to the leaves	Osmosis and transpirational pull

Q.3) In what ways the respiratory energy is used in the body of organisms?

Answer:

Respiration is an anabolic process, during which C-H bonds (glucose) is broken down and this energy is utilized in making ATP which is the energy currency of the cell. ATP is the main energy source used in the majority of the cellular functions as a synthesis of macromolecules (DNA, RNA, and protein), movement, the transmission of nerve impulses, active transport, exocytosis, and endocytosis.

Q.4) What is the importance of anaerobic respiration?

Answer:

Importance of anaerobic respiration:

- Source of energy for anaerobic organisms like bacteria, yeast, and all prokaryotes.

- Source of energy for aerobic organisms in short supply of O_2. When the oxygen supply cannot keep pace with the energy demand, anaerobic respiration supplies the energy continuously by the breakdown of glucose to lactic acid.
- Source of many products (ethanol, cheese, and lactic acid etc) during alcoholic and lactic acid fermentation.

Chapter No.7 Bioenergetics Notes for Class 9th

Q1: Define Bioenergetics, Metabolism, type of Metabolism and also write the importance of Bioenergetics?

Ans: Bioenergetics;

Definition:

Bioenergetics is the study of energy relationships and energy transformations(conversations) in living organisms.

Metabolism:

Meaning:

The word metabolism is derived from a Greek word meaning "change".

History:

Concept of metabolism was first of all given by Ibn-e-Nafees.

Definition:

The sum of all Chemical reactions that takes place in living organisms is called metabolism.

Types of Metabolic reactions:

There are two types of metabolic reaction.

i) Endergonic reaction (anabolism)
ii) Exergonic reaction (catabolism)

i) **Endergonic reaction:**

Definition:

The reaction which required energy is called endergonic reaction. (**OR)**
The reaction in which energy is stored is called endergonic reaction.

Example: Respiration

Importance of Bioenergetics:

- Sun is the ultimate source of energy for all organisms.
- Energy is transforming from one form to another form within living organisms.
- Living organisms use energy for various life activities.
- The green plants capture solar energy and convert it into store chemical energy in the process of photosynthesis.
- This energy is then transformed to mechanical and heat energy during Respiration.

Q2. What is oxidation Reduction reaction? Write its importance.

Ans: Redox reaction:

Definition:

A chemical reaction is which both oxidation and reduction occurs called Redox reaction.

Oxidation:

Definition:

Addition of oxygen or loss of hydrogen or electron is called oxidation.

Reduction:

Definition:

The gaining or electron or hydrogen is called reduction.

Oxidation – reduction reaction:

Those reactions in which oxidation and reduction occur simultaneously is called oxidation-reduction or redox reaction.

Photosynthesis and respiration processes are basically oxidation-reduction processes. During photosynthesis energy of sunlight is absorbed by plants and use CO_2 and H_2O to make food molecule which involve oxidation-reduction reactions.

Respiration is also oxidation-reduction reaction during which food molecule are broken down into CO_2 and H_2O and energy is released in the form of ATP which are used by the cell for life activities.

Importance:

Due to redox reaction photosynthesis and respiration occur that produce energy which sustains life on earth.

Q3. What is ATP Molecule? Describe the structure of ATP Molecule?

Ans: ATP Molecule:-

The major energy currency for all cells is a nucleotide called ATP (Adenosine Tri Phosphate).

Discovery of ATP: ATP was discovered in 1929 by Karl Lohmann.

Structure:

The structure of ATP molecule consists of three components.

i. Adenine (Double ring nitrogenous base).
ii. Ribose sugar (5 carbon carbohydrate).
iii. Phosphate groups (three molecule of phosphoric acid).

In ATP Molecule the adenine is covalently bonded to ribose sugar to form a Molecule called
Adenosine to form ATP Molecule.

Bonds in ATP Molecules;

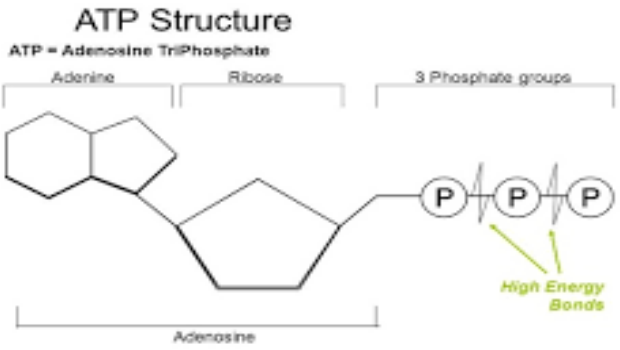
There are two types of phosphate bonds in ATP Molecules.

I. High energy bond:

These bonds are represented by symbol (~) and these bonds yield more energy (7.3 K.cal) on hydrolysis.

ii. Low energy phosphate bond:

These bonds are represented by straight line (------). And they yield less energy on hydrolysis.



Q4. Write note on the synthesis, breaking and recycling of ATP?

Ans: Adenine is a nitrogenous base when covalently bonded to five carbon Ribose making a
Molecule Adenosine.

Adenine + Ribose · Adenosine

i) When Phosphate Molecule bonded with Adenosine forming a nucleotide called AMP (Adenosine mono phosphate)

ii) By addition of phosphate with AMP molecules called ADP (Adenosine Di Phosphate)

AMP + Pi + energy --· ADP

iii)By the addition of another phosphate with ADP form ATP.

ADP + Pi + energy --· ATP

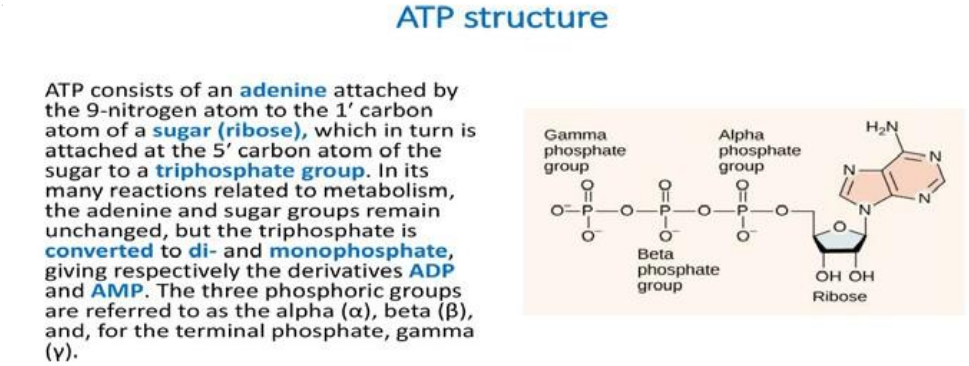
Breaking of ATP:

ATP + H_2O ----· ADP + Pi + energy (7.3 Kcal)

AMP cannot hydrolyze further.

Recycling:

ATP Molecules are constantly hydrolyzed by the cell into ADP and inorganic phosphate and energy is obtained for cellular functions.
At the same time ATP Molecules are constantly regenerated from ADP and phosphate using energy released from the breakdown of glucose Molecule in the process of Respiration. In this way a constant cycle of ATP broken down and reformation goes on in the living organism.



Q.5. Define photosynthesis? Write its importance.

Ans: Photosynthesis:

Terminology: -

The word photosynthesis is derived from two Greek words.

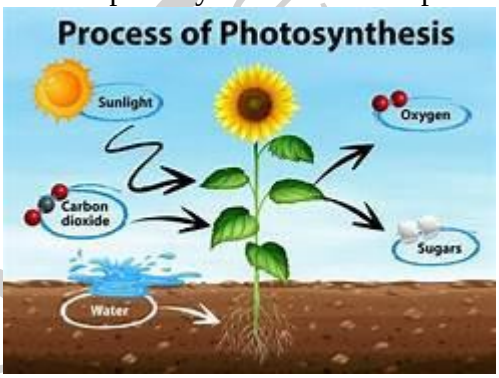
i) Photo mean light
ii) Synthesis mean manufacture

Definition:

The process by which green plants prepare their own food (carbohydrates) from carbon dioxide and water in the presence of sunlight and chlorophyll and releasing oxygen as by product is called Photosynthesis.

Chemical equation:

- Photosynthesis is energy storing process.
- Due to photosynthesis green plants prepare their own food hence they are called Autotrophic organisms.
- Heterotrophic organisms depend for their energy requirement on green plants.
- Without photosynthesis life is impossible.



Q.6. Write the Role of Chlorophyll and Sunlight in Photosynthesis?

Ans: Chlorophyll:

Definition: -

The organic Molecules which enable plants to capture light energy and convert it into chemical energy for the formation of glucose ($C_6H_6O_6$) is called chlorophyll.

Location:

In plants and algae chlorophyll is present in chloroplast while in photosynthetic prokaryotes it is present in the cell membrane.

Photosystem:

Photosynthetic Pigments are organized in the form of clusters in the thylakoid membranes of chloroplast called photosynthesis.

Types of chlorophyll:

There are many types of chlorophyll.
Chlorophyll a,b,c,d,e and Bacteriochlorophyll

Chlorophyll a,

It is the main pigment found in all green plants and Algae except bacteria.

Chlorophyll b,

It is a photosynthetic pigment found in all higher plants and green Algae.

Chlorophyll (c,d,e):

It is found in various groups of Algae.

Absorption of light,

Chlorophyll (a) absorb mainly blue and red portion of sunlight. The green portion is mainly reflected therefore chlorophyll appear green. Chlorophyll absorb blue light have wavelength 390-
430nm and red light have wavelength 670-700nm.

Role of light:

Sun is the main source of energy for all living organisms. Only a small amount of the total sunlight that strikes the green plants is used in the process of photosynthesis. This small portion of sun light sustains all life forms on earth.

Q.7. Describe the structure of chloroplast?

Ans: Chloroplast consist of three components

i. Outer membrane
ii. Grana
iii. Stroma

i. Outer membrane:

It is the double membrane covering that enclose the grana and stroma.

ii. Grana (sing . granum):

The granum is seen just like a pile of coins which is composed of stack of thylakoids.

Thylakoid: (Gr: thylakoid mean sac or pouch)

Function:

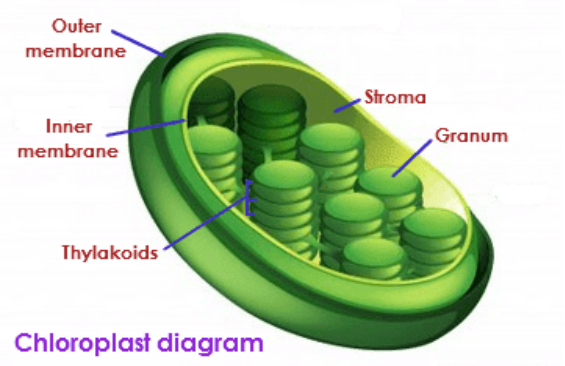
Light reaction of photosynthesis occurs in grana of chloroplast.

iii. Stroma:

It is central large space in chloroplast contain enzymes and gel like solution called matrix.

Function:

Dark reaction of photosynthesis occurs in stroma of chloroplast.



Q8. Write the process of intake of carbon dioxide and water?

Ans: Intake of CO_2:

CO_2 is present in air (0.03 %) and is one of the raw materials of photosynthesis. CO_2 is diffuse from outside air into the intercellular spaces of leaf through stomata. Stomata are small opening scattered particularly in the lower epidermis of leaf. Each stomata is guarded by two kidney shaped guards cell. Opening and closing of stomata regulates the diffusion of CO_2, water vapours, and O_2 between the intercellular spaces of leaf mesophyll and the external air. After diffusing into the intercellular spaces, CO_2 attaches to the wet surface of mesophyll cells. then it diffuses into the green cells and enters the stroma of chloroplasts. In the dark reaction of photosynthesis, CO_2 molecules are reduced to form glucose molecule.

Intake of water:

Water is also an essential requirement of photosynthesis. Water is absorbed by the roots of plants from the soil. It is then transported upward to their stem and leaves through xylem vessels. Most of this water is transpired from the leaves while a small portion is used in photosynthesis.

Q.9. Enlist the main events in mechanism of photosynthesis?

Ans: Mechanism of Photosynthesis:

The process of Photosynthesis is completed in two main steps.

i. Light reaction (light dependent reaction).
ii. Dark reaction (light independent reaction).

i. Light reaction (light dependent reaction)

- ✓ The reaction is also called light dependent reaction.
- ✓ Light reaction takes place in the grana of chloroplast.
- ✓ Chlorophyll molecules absorb light energy and converted into chemical energy.
- ✓ During light reaction photolysis take place.
- ✓ In photolysis water molecules are broken down into hydrogen and oxygen in the presence of specific enzymes.
- ✓ Oxygen is released while hydrogen atoms are used to reduce NADP into NADPH.
- ✓ In this process various kinds of energy producing compounds such as energy source.

Equation:

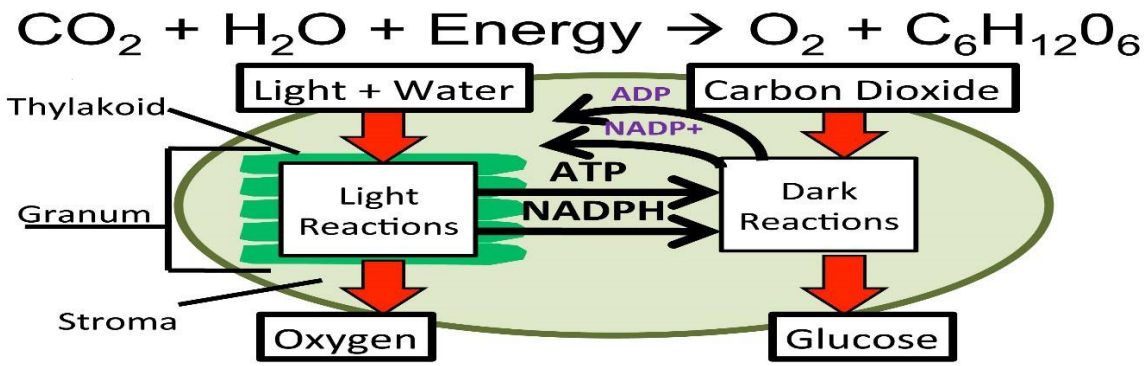
$$2H_2O + 2NADP^+ + 3ADP + 3P_i \cdot O_2 = 2NADPH = 3ATP$$

ii. Dark reaction (Calvin Cycle):

- Dark reactions were discovered by Melvin Calvin. That way this reaction is also called Calvin Cycle.
- This is also called light independent reaction.
- Dark reaction takes place in the stroma of chloroplast.
- Chemical energy from the light reaction is used to reduce carbon dioxide for the synthesis of carbohydrates.

Equation:

$6CO_2 + 24H + \text{Chemical energy} \cdot C_6h_6O_{12} + 6H_2O$



Q.10. What is limiting factor? Write the concept of limiting factors in photosynthesis.

Ans: Limiting factor:

The concept of limiting factor was stated by leibig's law of limiting factors.

This law states that,

"When a chemical process is controlled by more than one factor then the rate of the chemical process will be limited by the factor which is present in minimum quantity in relation to other".

Simple definition:

The absence or deficiency of any environmental factor which can decrease the rate of a metabolic reaction is called limiting factor.

Limiting factor for photosynthesis:

The process of photosynthesis is affected by many factors such as light, chlorophyll, Co_2, water and optimum temperature but the rate of photosynthesis is limited by the factor which is in
minimum value.

Example:

CO_2 is one of the requirements of photosynthesis. When all the other requirements for photosynthesis are optimum and only CO_2 is low. Then the low amount of CO_2 will lower the rate of photosynthesis and thus act as a limiting factor.

i. Effect of CO_2 Concentration:

CO_2 comes from the air there are 0.03% CO_2 atmosphere. Concentration of CO_2 almost remains constant in air because it is produced in respiration in the bodies of living organisms. When the stomata are closed, the concentration of CO_2 almost remains constant in air because it is produced in respiration in the bodies of living organisms. When the stomata are closed, the
concentration of CO_2 falls down in the Mesophyll tissues. This lower down the rate of photosynthesis. Without CO_2 photosynthesis does not occur.

iii. Effect of temperature:

The optimum temperature is necessary for normal photosynthesis. Generally, temperature ranging between $20C^o$ to $30C^o$ is most suitable temperature. When temperature exceeds $30C^o$, the rate of photosynthesis lower down and below $20C^o$the rate of photosynthesis decreases while on freezing temperature photosynthesis completely stops and at $45C^o$the photosynthesis becomes stop.

Q11: Define respiration and its types.

Ans; Respiration:

Oxidation reduction process by which organic food is broken down to carbon dioxide and water and release energy inside the cell is called respiration.

Glucose is the most common food used in this process. The purpose of respiration is to release energy for the living processes. Respiration is common to all living organisms because all of them need energy for life activates.

Types:

There are two main types of respiration.

i. Anaerobic respiration;

The breakdown of organic food molecules to release energy in the absence of oxygen is called anaerobic respiration.

It is also called fermentation. It involves incomplete breakdown of organic food molecules and only a small amount of energy is released. It occurs in the cytoplasm of the cell.

ii. Aerobic respiration;

The breakdown of organic food molecules to release energy in the presence of oxygen is called aerobic respiration.

i. Glycolysis
ii. Kreb cycle
iii. Electron transport Chain.

Q.12: Compare lactic acid fermentation with alcoholic fermentation?

Ans: Lactic Acid Fermentation:

It is called lactic Acid fermentation because the end product is Lactic Acid. It occurs in microorganisms just like bacteria during the fermentation of milk. It also occurs in muscle cells when the energy demand is high.

Steps:

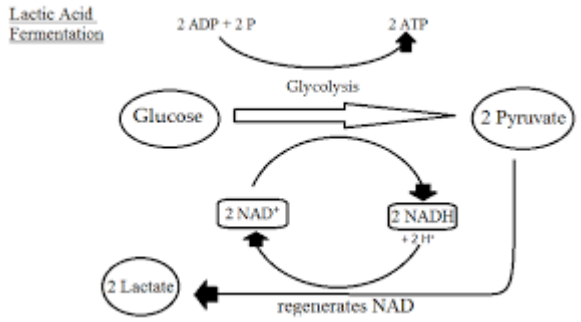
It is completed in two steps.

i. In this step glucose molecule are broken down into pyruvic Acid by the use of 2ATP Molecules and produce 4ATP Molecules So the net ATP produce in Glycolysis is 2ATP.

Glucose + 2ATP · 4ATP + 2 pyruvic Acid.

ii. In the second step pyruvic Acids is reduced by NADH+H (co-enzyme) and convert into lactic acid.

Pyruvic Acid + NADH · Lactic Acid + Co_2.



Alcoholic fermentation:

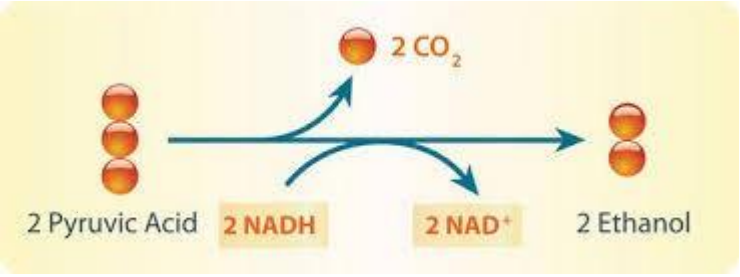
In alcoholic fermentation the end product is alcohol. It occurs in yeast and in some bacteria.

i. The first stop is Glycolysis

Glucose + 2ATP · 4 ATP + pyruvic Acid

ii. In the second step pyruvic Acid is reduced by NADH+H to ethyl Alcohol (ethanol).

In alcoholic fermentation also two ATP molecules are Pyruvic Acid + NADH · Alcohol+ CO_2.



Q.13: Describe various steps of Aerobic Respiration.

Ans: Aerobic respiration:

The breakdown of organic food molecules to release energy in the presence of oxygen is called aerobic respiration.

Reaction:

$C_6H_6O_{12} + 6O_2$ · $6CO_2\ 6H_2O + 36$ ATP.

Steps of aerobic respiration:

Aerobic respiration completes in three steps.

I. Glycolysis

II. Kreb cycle

III. Electron transport chain.

I.Glycolysis:

Meaning:

- Glyco mean glucose.
- lysis mean splitting.

Definition:

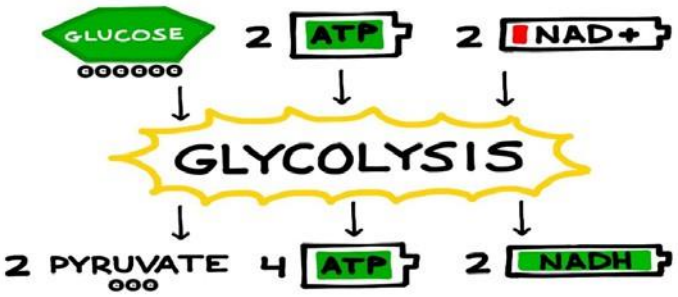
The stepwise enzymatic breakdown of glucose up to the formation of Pyruvic Acid is called glycolysis.

Location:

It takes place in cytoplasm.

Explanation:

In this step a glucose molecule (6-c) is broken into two molecules of pyruvic acid (3-C). In this process two ATP molecules are used and four are produced. So, the net gain of two ATP molecules.



ii. Krebs cycle:

Definition:

The cyclic process in which high energy pyruvic acids are completely oxidized into CO_2 and

H_2O is called kreb cycle.

Location:

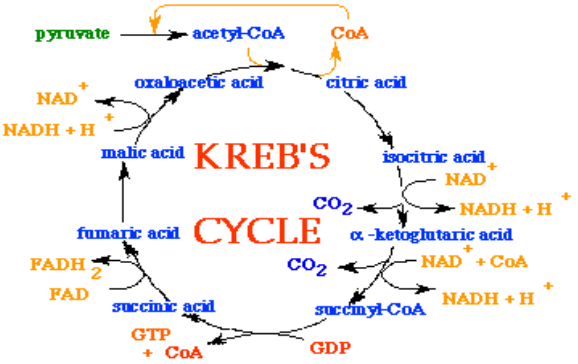
It occurs in mitochondria because inside mitochondrial necessary enzymes are present for reaction.

Discovery:

This step was first discovered by sir Hans krebs therefore named after his name kreb cycle.

Explanation:

Before entering to kreb cycle, pyruvic acid is changed into a 2-Carbon compound called acetyl-Coenzyme A. It then goes through a series of reaction in which it is completely oxidized. These reactions produced CO_2 along with ATP, NAD and FAD, NAD and FAD are also reduced into



NADH and FADH respectively.

iii. Electron transport chain:

Definition:

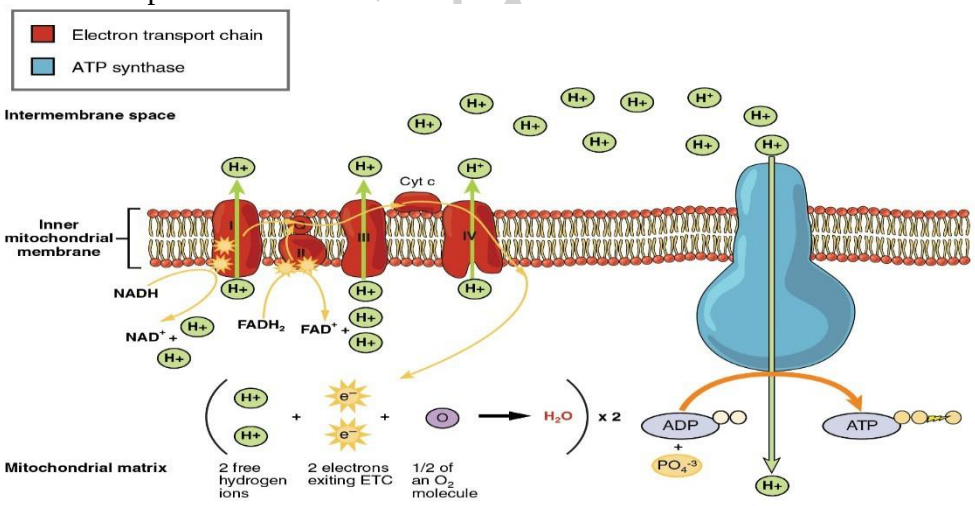
The final step of aerobic respiration in which the oxidation of reduced Coenzyme NADH and FADH take place that produce in glycolysis and kreb cycle.

Location:

It is the last step of aerobic respiration that occurs in mitochondria.

Explanation:

During this step two electrons are released from NADH and FADH. These electrons are than pass a series of electron carrier called cytochrome. During the transport from one cytochrome to the other electron loss energy. This energy is used to form ATP from ADP and P_i. it the end, oxygen molecule accept electron to form water.



Q.14: How much energy is produced during respiration?

Ans: The complete oxidation of one molecule of glucose into CO_2 and water generate 38 ATP. During glycolysis, two ATP molecules are also used. So, there is net gain of 36 ATP from one glucose molecule. These ATP are generated step wise some during glycolysis, some during kreb cycle and many are generated during electron transport chain. Each NADH generates 3 ATP molecules and each FADH molecule produce 2 ATP molecule.

Q.15: Compare Aerobic respiration with anaerobic respiration?

Properties	**Aerobic Respiration**	**Anaerobic Respiration**
Presence of Oxygen	Yes	No
Number of ATP as net profit	36	2
Location	It takes place in cytoplasm and mitochondria	It takes place only in cytoplasm
Food breakdown	Complete breakdown of food molecules occurs	Incomplete break down of food molecules occurs
Importance	Major source of energy for most organism	Source of energy for anaerobic organisms. Source of many products like ethanol and cheese etc.

Q.16: Compare photosynthesis with respiration.		
Properties	**Photosynthesis**	**Respiration**
Metabolism	Anabolism	Catabolism
Energy used/ production	Used of light energy to store it in the form of bond energy	Bond energy transformed into chemical energy of ATP
Site of occurrence	Chloroplast	In cytoplasm and mitochondria
Time of occurrence	In daytime only, in the presence of light.	All the time
CO_2 and H_2O	CO_2 and H_2O are used as a raw material	CO_2 and H_2O are produced as a waste product
Oxygen	Oxygen is produced as a by product	Oxygen is required for Aerobic Respiration.

SHORT QUESTIONS

Q1. Why ATP is regarded as the currency of the living cells?

Ans: Adenosine triphosphate (ATP) is energy rich molecules. ATP is hydrolyzed by the cells into ADP and inorganic phosphate during which 7.3 K Cal energy is obtained. This energy is used by living organisms for all cellular activities.

ATP is constantly regenerated from ADP and phosphate for which energy is obtained from the breakdown of glucose molecule in the process of respiration.

Since ATP is the main source of energy therefore it is known as currency of living cells.

Q2: What is the role of pigment during photosynthesis?

Ans: Pigments are the complex organic substances that absorb visible light and convert it into chemical energy for the formation of carbohydrates. Different pigments absorb light of different wavelength (different colours). Chlorophyll (a) is the main photosynthetic pigment.

Chlorophyll (a) absorb mainly blue and red portion of light. The wave length of blue light is 390-430 nm and the wave length of red light is 670 – 700 nm.

Q3: Draw the structure of ATP molecule?

Ans: See Q.3.

Q4: Compare lactic acid fermentation with alcoholic fermentation?

Ans: Comparison of Lactic acid fermentation with alcoholic fermentation:

No	Lactic acid fermentation	Alcoholic fermentation
1	It is the type of fermentation in which the end product is lactic acid	In this type the end product is ethyl alcohol and CO_2.
2	It occurs in two steps first step is glycolysis and in second step pyruvic acid is reduced into lactic acid.	It also occurs in two steps. After glycolysis the pyruvic acid is converted into ethyl alcohol and CO_2.
3	Yogurt is formed by bacterial fermentation of milk	It occurs in yeast and other bacteria
4	It also occur in human muscles	It also occurs in plants.
5	$C_6H_{12}O_6 + 2ATP \dashrightarrow 2(C_3H_6O_3) + 4ATP$ $2(C_3H_4O_3) \dashrightarrow 2(C_3H_6O_3)+2CO_2$	$C_6H_{12}O_6 + 2ATP \dashrightarrow 2(C_3H_6O_3) + 4ATP$ $2(C_3H_4O_3) \dashrightarrow 2(C_3H_5OH)+2CO_2$

Q 5: Why are oxidation and reduction important for plants?

Ans: See Q No. 2.

Long Question

C. Give detailed Answers to the following Question.

Q1: Explain the mechanism of photosynthesis?

Ans: See Q No.9

Q2: What is the concept of limiting factor? What are the different limiting factors for photosynthesis?

Ans: See Q No. 10

Q3: Why aerobic respiration is considered as to be more efficient then anaerobic respiration?

Ans: Aerobic respiration is considered to be more efficient then an aerobic respiration because during aerobic respiration complete breakdown of glucose molecules occurs in the release of all energy stored in the bond of glucose.

During aerobic respiration one glucose molecule gives 36 ATP molecules.

Anaerobic respiration is less efficient then aerobic respiration because Anaerobic Respiration is the incomplete break down of glucose molecule. In the reaction of anaerobic respiration one glucose molecule release only 2 ATP molecules.

Q4: Aerobic respiration generates more ATP molecules than an aerobic process. Which processes of aerobic respiration are responsible for this higher generation of ATP and how?

Ans: Aerobic respiration generates more ATP molecule than anaerobic respiration. Because in aerobic respiration 36 ATP generated while in anaerobic respiration only 2 ATP molecules are producing.

In aerobic respiration ATP molecules are produced stepwise in glycolysis, kreb cycle and electron transport chain. Higher ATP formation takes place in electron transport chain which is the last and final step of cellular respiration.

ETC occurs in the innermost membrane of mitochondria. In this process oxygen is utilized therefore these reactions are called oxidative phosphorylation.

At the end of the ETC, water (H_2O) and ATP is made. Depending on how many NADH molecules are available the electron transport chain makes a total of 32 or 34 ATP. These 32-34 ATP combined with 2 ATP from glycolysis and 2 ATP form the Krebs Cycle means that one molecule of glucose (sugar) can make a total of 36-38 ATP.