CHAPTER 9
RESPIRATION

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- BIOL. 1AB

I. RESPIRATION

- A. DEFINITION-THE TOTAL CHEMICAL BREAK DOWN OF GLUCOSE WITH OXYGEN

II. ENERGY FOR LIFE

- ALL THE ENERGY FOR LIFE COMES FROM THE METABOLISM OF GLUCOSE

A. AUTOTROPHS-

- THESE ORGANISMS USE THE SUN TO PRODUCE THEIR OWN FOOD AND THEREFOR THEIR OWN ENERGY
- EXAMPLE: PLANTS

B. HETEROTROPHS-

- MUST OBTAIN ENERGY FROM A SECONDARY SOURCE
- EXAMPLE: ANIMALS

Work and the need for energy

- Active transport, cell division, movement of flagella or cilia, and the production, transport, and storage of proteins are some examples of cell processes that require energy.
- There is a molecule in your cells that is a quick source of energy for any organelle in the cell that needs it.

III. ADENOSINE TRIPHOSPHATE (ATP)

- A. DEFINITION- THE NUMBER ONE ENERGY MOLECULE USE BY ALL LIVING ORGANISMS
- RELEASES A MINIMUM OF 7.3 KCAL OF ENERGY

B. THREE PARTS OF ATP

- 1.ADENOSINE BASE
- 2.THREE PHOSPHATES
- 3.RIBOSE SUGAR

Forming and Breaking Down ATP

- The charged phosphate groups act like the positive poles of two magnets.
- Bonding three phosphate groups to form adenosine triphosphate requires considerable energy.

Forming and Breaking Down ATP

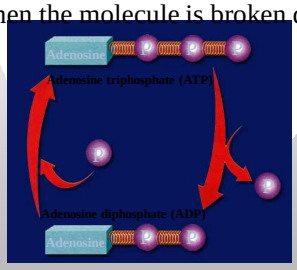
- When only one phosphate group bonds, a small amount of energy is required and the chemical bond does not store much energy. This molecule is called adenosine monophosphate (AMP).
- When a second phosphate group is added, more energy is required to force the two groups together. This molecule is called adenosine diphosphate, or ADP.

Forming and Breaking Down ATP

- An even greater amount of energy is required to force a third charged phosphate group close enough to the other two to form a bond. When this bond is broken, energy is released.

Forming and Breaking Down ATP

- The energy of ATP becomes available to a cell when the molecule is broken down.

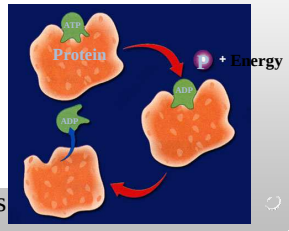


How cells tap into the energy stored in ATP

- When ATP is broken down and the energy is released, the energy must be captured and used efficiently by cells.
- Many proteins have a specific site where ATP can bind.

How cells tap into the energy stored in ATP

- Then, when the phosphate bond is broken and the energy released, the cell can use the energy for activities such as making a protein or transporting molecules through the plasma membrane.



How cells tap into the energy stored in ATP

- When ATP has been broken down to ADP, the ADP is released from the binding site in the protein and the binding site may then be filled by another ATP molecule.

C. PHOSPHORYLATION

- THE PROCESS OF ADDING PHOSPHATES TO ANY MOLECULE
- USUALLY DONE USING A CHEMO-OSMOTIC GRADIENT
- CAN ALSO BE DONE WITH SUBSTRATE LEVEL PHOSPHORYLATION

IV. RESPIRATION

- STEP BY STEP PROCESS TO SLOWLY BREAK DOWN GLUCOSE, TO UTILIZE AS MUCH ENERGY AS POSSIBLE
- 40% EFFICIENT, 60 % LOST AS HEAT

A. GLYCOLYSIS-

- OCCURS IN THE CYTOPLASM
- NO OXYGEN
- BEGINS THE PROCESS OF BREAKING DOWN GLUCOSE IN TO TWO PYRUVATES, 4 ATP, AND 2$NADH_2$

B. FERMENTATION-

- OCCURS IF NO OXYGEN IS PRESENT
- ALCOHOLIC = OCCURS IN PLANTS ONLY(YEAST)
- LACTIC ACID = OCCURS IN ANIMALS ONLY (SORE MUSCLES)

C. AEROBIC RESPIRATION-

- OCCURS ONLY IN THE PRESENCE OF OXYGEN

V. STEPS IN GLYCOLYSIS

- GLYCOLYSIS IS A STEPWISE PROCESS TO ACTIVATE AND SPLIT GLUCOSE
- OXYGEN IS NOT REQUIRED
- OCCURS IN THE CYTOPLASM

1.ACTIVATION OF GLUCOSE

- ATP IS SPLIT TO ADD A PHOSPHATE TO GLUCOSE

2. GLUCOSE ACTIVATION CONT....

- GLUCOSE IS ISOMERIZED TO FRUCTOSE AND A SECOND ATP IS SPLIT TO COMPLETELY ACTIVATE THE MOLECULE.

3.THE BREAK DOWN BEGINS

- FRUCTOSE 1,6 DIPHOSPHATE IS SPLIT IN TWO
- AN ADP IS PHOSPHOROLATED AND AN NAD IS REDUCED TO $NADH_2$

4.FORMATION OF PYRUVATE

- PYRUVATE IS FORMED AFTER A SECOND PAIR OF ADP ARE PHOSPHOROLATED
- A SIX CARBON GLUCOSE HAS NOW BEEN REDUCED INTO TWO THREE CARBON PYRUVATES

A. END PRODUCTS OF GLYCOLYSIS

- 4 ATP NET (ONLY 2 ARE USED BY THE BODY)
- 2 $NADH_2$
- AND 2 PYRUVATES

VI. FERMENTATION

- IF THERE IS NO OXYGEN PRESENT THE PYRUVATE WILL ENTER EITHER ALCOHOLIC OR LACTIC ACID FERMENTATION DEPENDING ON THE ORGANISM

A. ANAEROBIC FERMENTATION

- OCCURS IN THE ABSENCE OF OXYGEN

B. FUNCTION OF FERMENTATION-

- THE PURPOSE OF FERMENTATION IS TO RECYCLE THE ELECTRON CARRIER NAD

C. LACTIC ACID FERMENTATION-

- OCCURS IN ANIMALS
- END PRODUCTS ARE LACTIC ACID = SORE MUSCLES
- AND RECYCLED NAD

2. AFFECT OF LACTIC ACID ON MUSCLES?

- LACTIC ACID DESTROYS MUSCLE TISSUE AND CAUSES SORE MUSCLES

D. ALCOHOL FERMENTATION-

- DONE ONLY BY PLANTS RELEASES ETHANOL AND CARBON DIOXIDE
- USED IN THE PRODUCTION OF ALCOHOLIC BEVERAGES

1. EQUATION-

- $C_6H_{12}O_6 \rightarrow 2CH_3CH_2OH + 2CO_2 + ENERGY$
- (ENTHANOL)

VI. AEROBIC RESPIRATION

- A. WHERE DOES GLYCOLYSIS OCCUR?-
- B. WHERE DOES AEROBIC RESPIRATION OCCUR?-

C. KREB CYCLE

- 1. DEFINITION- ALSO KNOW AS THE CITRIC ACID CYCLE, IT IS A SERIES OF REACTIONS DESIGNED TO PRODUCE THE ELECTRON CARRIERS NEEDED TO PRODUCE ENERGY OR ATP IN THE ELECTRON TRANSPORT CHAIN

2. FOR EACH MOLECULE OF ACETYL COA THAT ENTER

- NADH + H ___4__ ?
- FADH2 ___1__ ?
- ATP ___1__ ?

D. ELECTRON TRANSPORT CHAIN

- PROCESS OF OXIDIZING THE ELECTRON CARRIERS PRODUCED BY CELL RESPIRATION
- ALSO PRODUCES THE MAJORITY OF THE ATP USED BY THE BODY FOR ENERGY

1. WHERE DOES IT OCCUR ?

- OCCURS IN THE INNER MEMBRANE OF THE MITOCHONDRIA (CRISTAE)
- SUPPORTS THE THEORY OF ENDOSYMBIOSIS

3. HOW MANY ATPS PRODUCED ?

- PRODUCES 34 ATP FROM $2FADH_2$, AND 10 $NADH_2$

D. ENERGY YIELD

- EACH ATP CAN DELIVER 7.3 KCAL OF ENERGY

1. MAXIMUM NUMBER OF ATP FOR AEROBIC RESPIRATION

- 38 ATP TOTAL ARE PRODUCED PER MOLECULE OF GLUCOSE
- 2 FROM GLYCOLYSIS, 2 FROM KREBS, AND 34 FROM ELECTRON TRANSPORT

2. EFFICIENCY

- AEROBIC RESPIRATION IS GENERALLY _19___ TIMES MORE EFFICIENT THAN ANAEROBIC RESPIRATION
- THE ATP PRODUCED REPRESENTS _40%__OF THE TOTAL ENERGY STORED IN A MOLECULE OF GLUCOSE