

## 3.4.2 STAGES OF CELLULAR RESPIRATION

### Introduction

Cellular respiration occurs through several coordinated stages that gradually release energy stored in glucose molecules. Each stage contributes to ATP production.

### Glycolysis

Glycolysis is the first stage of respiration and occurs in the cytoplasm. During this process, one glucose molecule is broken into two pyruvate molecules. A small amount of ATP and NADH are produced.

### Importance of Glycolysis

Glycolysis provides intermediate compounds required for later stages of respiration. The process can occur in both aerobic and anaerobic conditions.

### Formation of Acetyl CoA

Before entering the Krebs cycle, pyruvate molecules move into mitochondria and convert into acetyl CoA. Carbon dioxide is released during this conversion.

### Krebs Cycle

The Krebs cycle occurs in the mitochondrial matrix. Acetyl CoA undergoes a series of reactions that release carbon dioxide and produce NADH, FADH<sub>2</sub>, and ATP.

### Importance of Krebs Cycle

This stage transfers high-energy electrons to carrier molecules and prepares them for the electron transport chain.

### Electron Transport Chain

The electron transport chain occurs on the inner mitochondrial membrane called cristae. Electrons move through transport proteins and release energy used to produce large amounts of ATP.

## Role of Oxygen

Oxygen acts as the final electron acceptor during the electron transport chain. Water forms when oxygen combines with electrons and hydrogen ions.

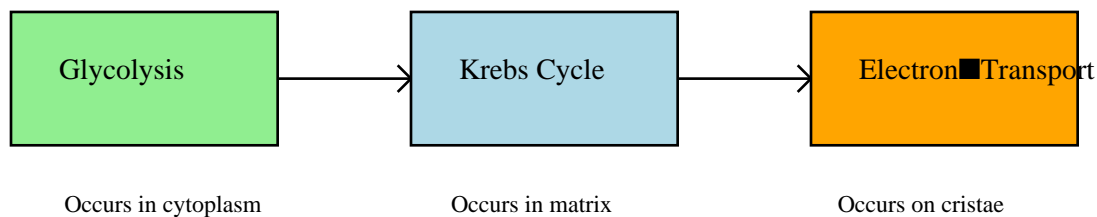
## ATP Production

Most ATP molecules generated during aerobic respiration form during the electron transport stage.

## Overall Importance

The stages of respiration ensure efficient extraction of energy from food molecules for cellular functions.

## Figure: Main Stages of Cellular Respiration



## Summary Table of Respiration Stages

Stage	Location	Main Products
Glycolysis	Cytoplasm	Pyruvate, ATP, NADH
Krebs Cycle	Matrix	CO <sub>2</sub> , ATP, NADH, FADH <sub>2</sub>
Electron Transport	Cristae	Large amount of ATP

## Summary

Cellular respiration consists of glycolysis, the Krebs cycle, and the electron transport chain. These stages gradually release energy from glucose and convert it into ATP. Aerobic respiration depends on oxygen and occurs mainly inside mitochondria.

## Questions and Answers

**What is the first stage of respiration?**

Glycolysis is the first stage.

**Where does the Krebs cycle occur?**

It occurs in the mitochondrial matrix.

**Which stage produces most ATP?**

The electron transport chain produces most ATP.

**Why is oxygen important?**

It acts as the final electron acceptor.

**What forms at the end of glycolysis?**

Two pyruvate molecules are formed.

## Study Notes

- Glycolysis occurs in the cytoplasm.
- Pyruvate enters mitochondria after glycolysis.
- The Krebs cycle releases carbon dioxide.
- NADH and FADH<sub>2</sub> carry high-energy electrons.
- Cristae contain electron transport proteins.
- Oxygen supports ATP formation.
- Water forms at the end of electron transport.
- Respiration provides energy for metabolism.

## Energy Efficiency

Aerobic respiration extracts much more energy from glucose compared with anaerobic respiration. This efficiency allows organisms to perform demanding activities.

## Respiration and Exercise

During intense exercise, oxygen supply may become insufficient, leading to temporary anaerobic respiration in muscles.

## Importance in Plants

Plants use respiration energy for transport, growth, and synthesis of biological compounds.

## Importance in Human Body

Brain cells, heart muscles, and active tissues require constant ATP supply generated through respiration.