Orient BlackSwan

Inspired BIOLOGY

For the CISCE curriculum

7

NEP Compliant inside

WITH APP

Inspired BIOLOGY

7

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Inspired Biology

has been developed in accordance with the CISCE Upper Primary Science (Biology) curriculum. Its aims are:

- to enable students to relate their daily life experiences and science by following a practical, thematic approach
- to focus on the development of scientific temper through skill and process development
- to encourage knowledge construction through information collection, organisation and reflection

Students' book

- complete syllabus coverage
- carefully graded text
- appropriate, well-labelled illustrations and photographs
- appropriate activities and exercises

Let's learn

Learning outcomes
encourage students to take responsibility for their learning

Get going
helps focus and direct students' attention to the lesson

Activities
help students learn through practical exercises

Stop and check
provides checkpoints for teachers and students to evaluate progress

Spotlight
focuses on important topics in greater detail

Go further
provides additional, interesting, relevant information

SciTech
links scientific concepts with real-life occurrences and applications

Eco corner
presents issues that are an environmental concern

Let's revise

In a nutshell
is a comprehensive revision corner

Concept map
is a graphic presentation of concepts linked logically

Summary
lists the main points of the lesson briefly

Keywords
lists important words and their definitions

Glossary
presents important words for quick revision at the end of the book

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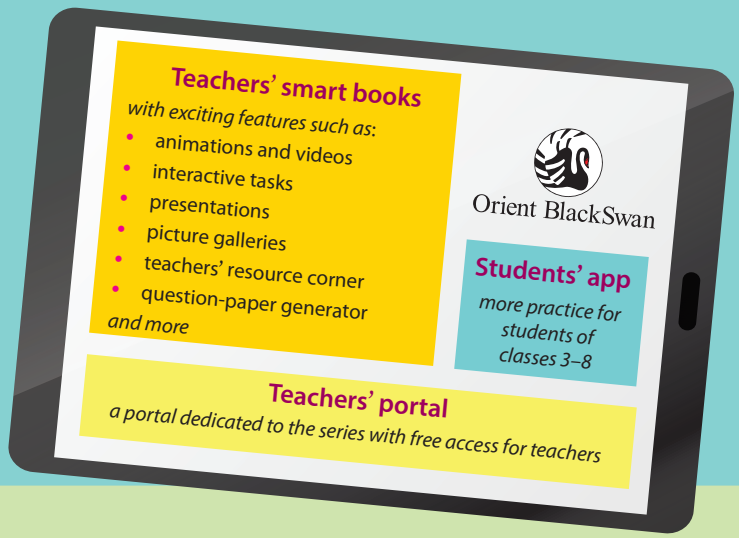
Teachers' resource packs

- lesson plans
- question bank with answers
- worksheets with answer key
- question papers with answer key
- answer key to the exercises in the students' book



Let's apply

Checkpoint
covers a variety of exercises (objective type, short answer and long answer)

Think and answer
encourages students to develop higher-order thinking skills necessary for the 21st century

Picture study
offers picture-based questions that encourage students to observe, identify and relate concepts to real life

Hands-on
offers a variety of projects that reinforce 21st century skills through experiments, model-making, discussion, role play, research work, report writing and so on

Subject integration
presents additional activities explicitly linking multiple subjects

Life skills and values
help children develop skills needed for everyday life and values needed to be well-adjusted members of society

Let's know more

Scientist in focus
describes the life and work of famous scientists to inspire students

Heritage corner
presents exciting and accurate information on India's scientific heritage

Internet links
provides sources for further study and research

Career watch
presents novel ideas for a career in science and technology

Let's work

- *Worksheets* a workbook corner with worksheets covering all lessons
- *Test papers* based on the ICSE pattern

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CONTENTS

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3 Plant Life

Learning outcomes

By the end of this theme, you will be able to:

- describe photosynthesis and its significance
- explain the factors that affect photosynthesis
- describe respiration in plants
- differentiate between aerobic and anaerobic respiration
- differentiate between photosynthesis and respiration

Get going

You have learnt that plants make their own food.

What do plant need to make their food? What is this process called? What are the products of this process?

INTRODUCTION

You know that plants make simple carbohydrates (such as glucose) from the carbon dioxide in air and water absorbed through their roots. Plants use chlorophyll molecules to carry out this process in the presence of sunlight. Most plants prepare their own food, they are called **autotrophs** (*auto* is 'self', and *trophos* is 'feeder'). This type of nutrition is called **autotrophic nutrition**.

PHOTOSYNTHESIS

Photosynthesis *is the process by which some organisms use the energy in sunlight to produce carbohydrates from carbon dioxide and water.* Oxygen is released during photosynthesis.

Photosynthesis can be written simply as:

$$\text{carbon dioxide + water} \xrightarrow[\text{sunlight}]{\text{chlorophyll}} \text{glucose + oxygen}$$

Photosynthesis consists of a series of complex chemical reactions that you will learn about in higher classes.

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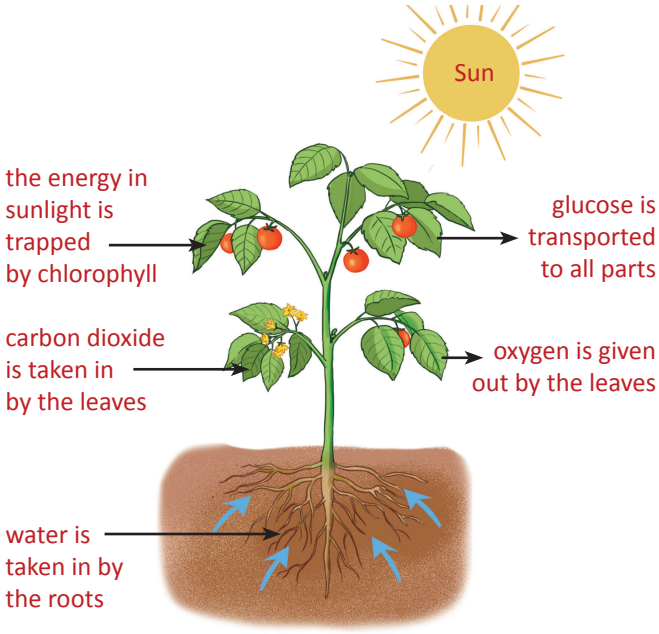

Fig. 3.1 Photosynthesis

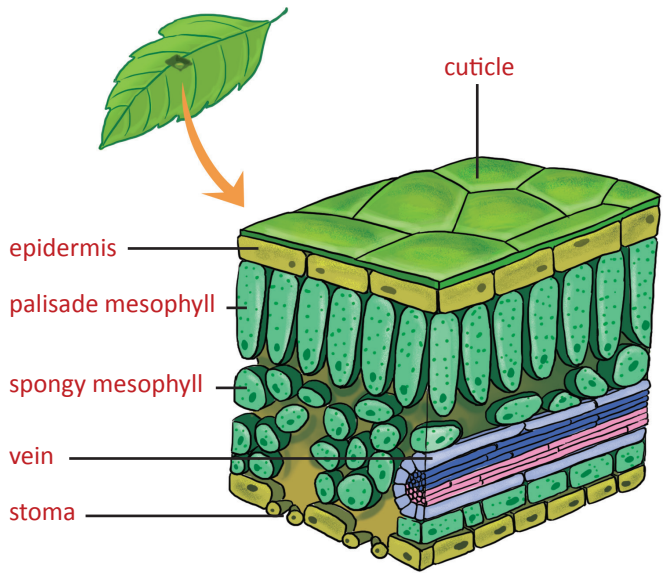

Fig. 3.2 Cross-section of a leaf

The Significance of Photosynthesis

The process of photosynthesis is critical for life on Earth.

- The excess carbohydrates that are formed are stored in different parts of the plant as **starch**. These parts, when eaten, serve to pass energy and nutrients to other organisms.
- The oxygen that is released during photosynthesis helps to maintain the percentage of oxygen in the atmosphere. Oxygen is essential for respiration in most organisms.

The Structure of the Leaf

The entire structure of the plant is designed in such a way that photosynthesis can be carried out efficiently. The leaf is the part where photosynthesis is usually carried out. Let us learn a little bit about the structure of the leaf.

- Leaves usually have a broad surface so that plenty of sunlight can fall on them.
- They are thin to allow sunlight to penetrate well inside them.
- They have a thin layer (epidermis) that protects the cells.
- The epidermis contains **stomata**, which allow air to enter and exit the leaves. Stomata are usually present in greater number on the lower surface of leaves than the upper surface.
- The bulk of the leaf is made of **palisade mesophyll cells** (parenchyma cells) which have large spaces between them to allow air to diffuse everywhere. The palisade mesophyll cells contain green-coloured plastids called **chloroplasts**. Chloroplasts contain the green pigment chlorophyll, and this is where photosynthesis occurs.
- The leaves also contain xylem, which brings water and minerals from the

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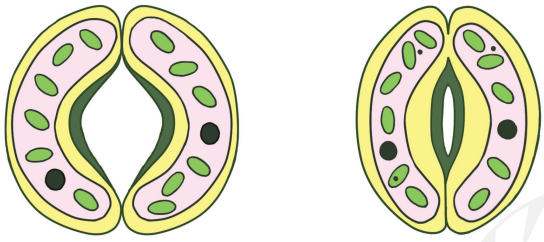
root, and phloem, which transports the food produced in the leaf to other parts of the plant.

The structure of stomata

The stomata (*singular*: **stoma**) are tiny openings in the leaf epidermis. Each opening is surrounded by a pair of bean-shaped cells called **guard cells**, which, as the name suggests, guard the movement of gases in and out of the leaf.



a. open stoma b. closed stoma

Fig. 3.3 Opening and closing of stoma

The inner walls of the guard cells are thicker than the outer walls. When the guard cells fill with water, they become **turgid** and bulge outwards. This causes the stoma to open. When the guard cells lose water, they become **flaccid** and the stoma closes.

Activity 3.1

Observing stomata

Take a green leaf and tear it in such a way that you can see a thin, transparent part near the tear. Use a pair of forceps to tear this part and place it on a glass slide. Observe the specimen under a microscope.

You will notice many stomata that are surrounded by guard cells. You will also see cells with green chloroplasts inside them.

The structure of a chloroplast

Each leaf cell may contain around 100 chloroplasts. Chloroplasts are enclosed by two membranes. The inner membrane of the chloroplast is folded to form discs called **thylakoids**. Chlorophyll is present inside the thylakoids. The thylakoids are arranged in stacks called **grana** (*singular*: **granum**). The grana are surrounded by a gel-like **stroma**.

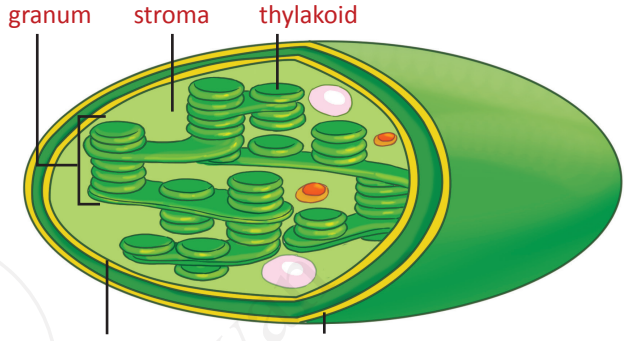


Fig. 3.4 The structure of a chloroplast

The Process of Photosynthesis

Plants need carbon dioxide and water to carry out photosynthesis. Carbon dioxide diffuses into the leaf through the stomata, and water is absorbed by the roots and carried to the leaf through the xylem. Plants use chlorophyll to trap the energy in sunlight.

- The energy in sunlight is used to split molecules of water. Oxygen molecules (O_2) are released during this process.
- The hydrogen produced by the splitting of water combines with carbon dioxide (CO_2) molecules to ultimately form glucose molecules ($C_6H_{12}O_6$).

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The end products of photosynthesis are oxygen and glucose. The oxygen diffuses out through the stomata. Glucose is used by all parts of the plant. Glucose is produced rapidly during photosynthesis and is not transported at an equal speed. So, many glucose molecules are linked together to form a complex carbohydrate called **starch** and stored temporarily. In the night, starch is converted to soluble sugars like sucrose and **translocated** to all parts of the plant. Excess starch is stored in some parts of the plant to be used later.

Career Watch

Plant Biochemist

*The branch of science that deals with the chemical reactions that happen in plants is called **plant biochemistry**. A scientist who studies chemical reactions in plants is called a **plant biochemist**.*

Plant biochemists study the various chemical reactions like photosynthesis, transport of materials in and outside the cells, storage and so on in plants.

Factors Affecting Photosynthesis

The rate of photosynthesis depends on the amount of light, the carbon dioxide available, the water available and the temperature.

If the temperature is less than 10 °C or higher than 40 °C, the enzymes involved in photosynthesis cannot work. (Enzymes do not work at low temperatures and are destroyed at high temperatures.) Thus, the optimum range of temperature for photosynthesis is 20–30 °C. Plants that grow in the tundra have special ways to photosynthesise at low temperatures.

If the availability of water is low, the stomata close and photosynthesis does not occur.

All these factors are limiting, that is, even if three of them are in excess and one is limited, the rate of photosynthesis will be low. For example, if the amount of light available is low, then no amount of carbon dioxide or optimal temperature or water will increase the rate of photosynthesis.

Activity 3.2

Aim: To show that starch is produced during photosynthesis and that chlorophyll is necessary for photosynthesis to occur

Materials required: beaker, water, forceps, tripod, Bunsen burner, green leaf, *Coleus* leaf (variegated), white tile, test tube, alcohol, iodine

Method

1. Place the green leaf in boiling water for three minutes. This breaks open the cell membranes.
2. Then, place the leaf in a test tube filled with alcohol and place the test tube in a boiling water bath for a few minutes. The leaf will become bleached (lose its green colour).
3. Remove the bleached leaf and place it on a white tile. Add a few drops of iodine to the leaf.

You can carry out the same experiment with the variegated *Coleus* leaf.

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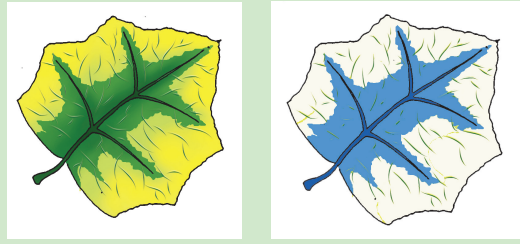
Observations and conclusions

The leaf will turn blue-black in colour showing the presence of starch.

Only the green coloured areas on the variegated leaf turn blue-black in colour showing that starch is produced in only the areas that contain chlorophyll.



a. original leaf b. leaf with iodine

Fig. 3.5 Testing a variegated leaf for the presence of starch

Activity 3.3

Aim: To show that light is needed for photosynthesis

Materials required: black paper, potted plant

Method

1. Select a well-watered potted plant and keep it in a dark room for two or three days.
2. Select a healthy leaf from the plant and cover part of it with thick black paper.
3. Now, place the potted plant in a place where it gets sunlight for a few hours.
4. Pluck the leaf that has been partly covered and test it for starch as described in Activity 3.2.

Observations and conclusions

You will notice that the covered part of the leaf does not turn blue-black. This shows that light is needed for photosynthesis.

Activity 3.4

Aim: To show that oxygen is given out during photosynthesis

Materials required: beaker, water, test tube, funnel, *Hydrilla*

Method: Take a beaker that is 3/4 filled with water. Place a few stems of *Hydrilla* inside the water with the stems facing up. Place an inverted funnel over the *Hydrilla*. Then, invert a test tube full of water over the stem of the funnel. Leave this setup in sunlight for some time.

Observations and conclusions

You will notice that bubbles of gas rise from the stem and collect in the inverted test tube. When you insert a burning splint in this gas it burns brightly, showing that the gas collected is oxygen.

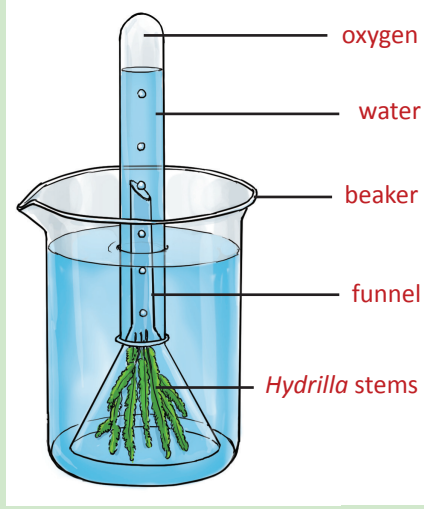


Fig. 3.6 Evolution of oxygen

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Stop and check

Say if the statements are true or false.

1. The palisade mesophyll cells contain chloroplasts.
2. The amount of water in the guard cells determines if the stomata are open or closed.
3. When oxygen and light are in excess, even if the temperature is low, photosynthesis occurs at a fast rate.

RESPIRATION

Plants need energy to carry out all their life processes including growth, transport, and the development of flowers and fruits. They get this energy from the break down of glucose during **respiration**. *Respiration is the process by which organisms break down food to release energy.*

Types of Respiration

Aerobic respiration

Aerobic respiration *uses oxygen to break down glucose to release energy.* It generates **adenosine triphosphate** (**ATP**) molecules, which when broken down release energy. Each glucose molecule produces 38 ATP molecules.

glucose + oxygen ⟶ carbon dioxide + water + energy (38 ATP)

SciTech

ATP molecules transport energy within the cell and the body. When energy is needed for any function, ATP molecules are broken down to release energy. ATP molecules are constantly being broken down and generated in the body of living things.

Anaerobic respiration

Anaerobic respiration does not use oxygen to break down glucose to release energy. The breakdown of glucose is incomplete and forms ethanol or lactic acid, carbon dioxide and only 2 ATP molecules.

glucose ⟶ ethanol/lactic acid + carbon dioxide + energy (2 ATP)

Table 3.1 Differences between aerobic respiration and anaerobic respiration

Aerobic respiration	Anaerobic respiration
Takes place in the presence of oxygen	Takes place in the absence of oxygen
Glucose is completely broken down.	Glucose is incompletely broken down.
Carbon dioxide, water and ATP are formed.	Ethanol or lactic acid, carbon dioxide and ATP are formed.
More energy (38 ATP molecules) is released.	Less energy (2 ATP molecules) is released.

PHOTOSYNTHESIS AND RESPIRATION

Photosynthesis and respiration are completely opposite to each other. Photosynthesis produces food (glucose molecules) from carbon dioxide and

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water, whereas respiration breaks down glucose molecules to release carbon dioxide and water. During photosynthesis, energy is trapped from sunlight using chlorophyll, whereas energy is released from food during respiration.

Table 3.2 Differences between photosynthesis and respiration

Photosynthesis	Respiration
Occurs only in the presence of light, that is, during the day.	Occurs at all times, during the day and night.
Occurs only in cells that contain chlorophyll molecules (plants, some prokaryotes and some protists).	Occurs in the cells of all living things.
Oxygen is a product that is released into the atmosphere.	Carbon dioxide is a product that is released into the atmosphere.
Glucose is formed in this process.	Glucose is broken down in this process.

Activity 3.5

Aim: To show that carbon dioxide is released during respiration by germinating seeds

Materials required: glass jar with rubber bung, *channa* seeds (that have just sprouted), small beaker, limewater

Method: Set up the apparatus as shown in the figure and leave it undisturbed for some days.

Observations and conclusions

The limewater in the beaker will turn milky showing the presence of carbon dioxide.

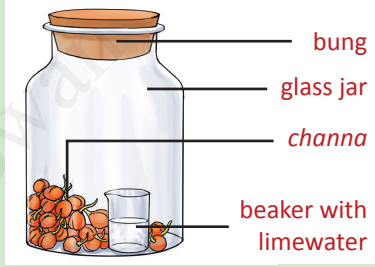

Fig. 3.7 Evolution of CO_2

Go further...

Anaerobic respiration is observed in yeast, bacteria and intestinal parasites. Human muscle cells respire anaerobically during exercise. Glucose is broken down incompletely to form lactic acid. The lactic acid is stored and gets completely broken down when the cells get the required oxygen.

CHECKPOINT

A. Choose the correct option.

1. Which of the following in the leaf traps the energy in sunlight?
   a) water b) xylem
   c) chlorophyll d) phloem

2. The type of organelle that contains chlorophyll and is involved in photosynthesis is the _____.
   a) mitochondrion b) vacuole
   c) cytoplasm d) plastid

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3. Which of these is **not** a factor that affects photosynthesis?
   a) water b) oxygen
   c) light d) temperature
4. Which of these substances is **not** released during aerobic respiration?
   a) ethanol b) carbon dioxide
   c) water d) ATP

B. Fill in the blanks.

1. _____ and carbon dioxide are the reactants that are needed for photosynthesis.
2. Plants break down _____ during respiration to get the energy they require to carry out all their life processes.
3. The two types of respiration are _____ respiration and _____ respiration.
4. _____, _____ and energy are produced during aerobic respiration.

C. Differentiate between the following.

1. Aerobic respiration and anaerobic respiration
2. Photosynthesis and respiration

D. Short-answer questions

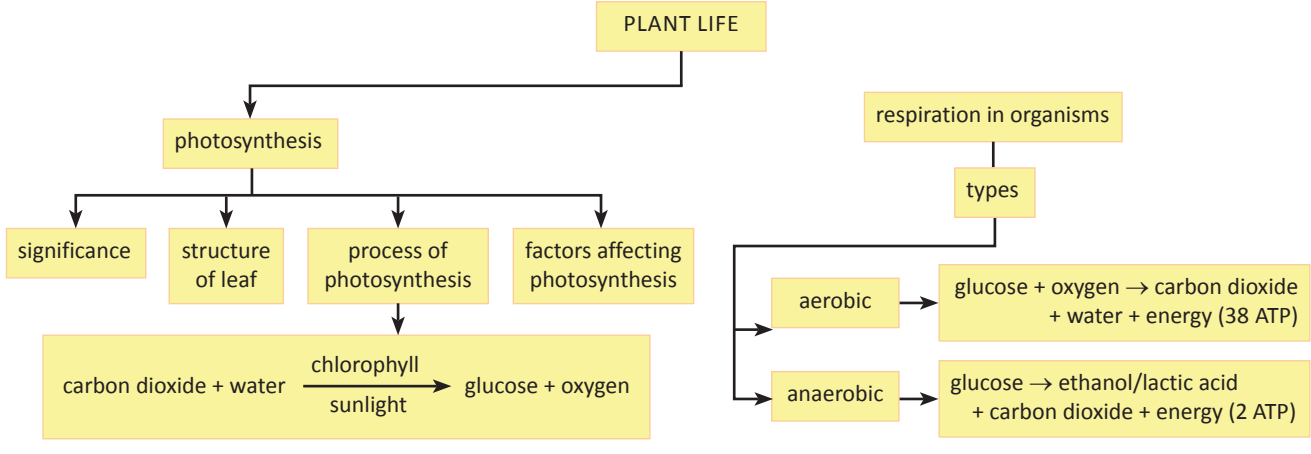
1. Name the products of photosynthesis.
2. What happens to the excess glucose that is formed during photosynthesis?
3. Draw diagrams of an open stoma and a closed stoma.
4. Which molecule produced during respiration releases energy when broken down?
5. Which type of respiration is also called incomplete respiration?

E. Long-answer questions

1. The structures of a leaf are perfectly suited for photosynthesis. Justify this statement.
2. Briefly describe the process of photosynthesis.
3. Briefly describe the structure of the chloroplast.
4. How do the factors required for photosynthesis affect the rate of photosynthesis?
5. What is respiration? Why is it important for plants and animals?
6. Photosynthesis and respiration are opposite chemical processes. Justify this statement.
7. Describe an experiment to show that oxygen is produced during photosynthesis.

In a nutshell

CONCEPT MAP



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SUMMARY

- Photosynthesis is the process by which some organisms use the energy in sunlight to produce carbohydrates from carbon dioxide and water. It takes place in the presence of chlorophyll.
- Oxygen is produced and released by the plant during photosynthesis.
- Excess glucose that is produced during photosynthesis is stored as starch. Oxygen that is released helps to maintain the percentage of oxygen in the atmosphere.
- The structure of plants is designed in such a way that photosynthesis can be carried out efficiently.
- Air enters the leaves through stomata present mostly on the lower surface of the leaves. A pair of guard cells controls the opening and closing of the stomata.
- During photosynthesis, the energy in sunlight is used to split molecules of water and release oxygen molecules. The remaining hydrogen combines with carbon dioxide to form glucose ($C_6H_{12}O_6$).
- The rate of photosynthesis depends on the amount of light and carbon dioxide available, the amount of water available and the temperature of the surroundings.
- Respiration is the process by which organisms break down food to release energy.
- Respiration is of two types: aerobic respiration and anaerobic respiration.
- Aerobic respiration uses oxygen to break down glucose to release energy. It generates 38 ATP molecules. Carbon dioxide and water are released during this process.
- Anaerobic respiration does not use oxygen to break down glucose to release energy. It generates 2 ATP molecules. Ethanol (or lactic acid) and carbon dioxide are released during this process.

KEYWORDS

aerobic requiring the presence of oxygen
anaerobic requiring the absence of oxygen
chloroplast a kind of plastid that contains chlorophyll
photosynthesis the process by which plants make glucose from carbon dioxide and water
plastid an organelle found in plant cells that sometimes contains coloured substances
respiration the process by which organisms break down food to release energy
stoma a small opening, usually on the lower surface of the leaf, through which air enters and exits the leaf

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Think and Answer

The guard cells become turgid only when the plant has sufficient amounts of water in its body. How does this help in controlling the rate of photosynthesis?

Life Skills and Values

1. Some plants like the bamboo palm, chrysanthemum, peace lily and gerbera can remove some harmful substances from the air. So, you can grow plants on terraces, balconies and inside the house to make sure that the air you breathe is clean and rich in oxygen. *Note*: Make sure that the plants that are grown inside the house are exposed to sunlight for a few hours every day.

2. Make sure that you do not pluck the leaves off plants. The plants need the leaves to carry out photosynthesis to make their own food.

Picture Study

Draw arrows to show the gases taken in or released during the day in orange, and the gases that are taken in or released during the night in dark blue for both the human and the plant.

Hands-on

1. Collect the leaves of some plants that have non-green coloured leaves. Stick the leaves in your notebook. Under each leaf, write the name of the plant from which it was collected.
2. Use permanent slides of the epidermis of leaves or of *Hydrilla* leaves to study chloroplasts. Draw diagrams of the chloroplasts in your notebook.

Scientist in Focus

Hans Adolf Krebs

Hans Adolf Krebs (1900–1981) was a German scientist who moved to England before the Second World War. He discovered the series of reactions that occur in the body when glucose is broken down in the mitochondria to release energy. This set of reactions is called the tricarboxylic acid cycle or the Krebs cycle after him. Krebs was awarded the Nobel Prize in Physiology or Medicine in 1953 for this discovery.

Internet Links

https://photosynthesiseducation.com/photosynthesis-for-kids/
https://www.pthorticulture.com/en/training-center/basics-of-plant-respiration/

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Inspired BIOLOGY

For the CISCE curriculum
CLASS 7

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The National Education Policy (NEP) 2020 emphasises certain crucial parameters based on content and pedagogy. The Inspired Biology series provides a rich range of exercises and activities for each of the parameters. Here is a quick reference guide to some of the examples in this book.

The Inspired Biology series is mapped perfectly to the National Education Policy 2020.

21st Century Skills

A broad set of skills, knowledge, work habits and character traits that are important for success in the 21st century

The NEP parameters	Features	Page nos.
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	Life Skills and Values	65
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	Hands-on	38

Experiential/ Constructivist Approach

Learners construct their knowledge, based on what they already know, through experience or by doing and reflection

The NEP parameters	Features	Page nos.
Experiential/Constructivist Approach	Activity	43
	Hands-on	14
	Activity	5

Integrated Approach

An approach to teaching and learning that works by connecting knowledge and skills across the curriculum, by bringing real life examples to the classroom

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India Knowledge

A strong focus on ancient knowledge from India, traditional values, modern developments and future aspirations

Digital Integration

The use of digital tools to enhance and support the teaching–learning process

ICT/Digital resources

Orient BlackSwan Smart App - Interactive Tasks and Games for Practice and Revision

Teachers' Smart Book - Flipbook, Animations, Videos, Presentations, Picture Galleries, Interactive Tasks, Embedded Questions, Lesson Plans, Students' Book Answer Key, Worksheets with Answer Key, Question Paper Generator

Teacher Empowerment

Teachers' Resource Pack - Lesson Plans, Students' Book Answer Key, Question Bank with Answer Key, Worksheets with Answer Key, Test Papers

Teachers' Portal - Chapter e-Book, Presentations, Picture Galleries, Animations, Videos, Students' Book Answer Key, Worksheets with Answer Key, Interactive Tasks, Lesson Plans, Question Bank with Answer Key

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3-6-752 Himayatnagar, Hyderabad 500 029, Telangana, INDIA
customercare@orientblackswan.com | www.orientblackswan.com