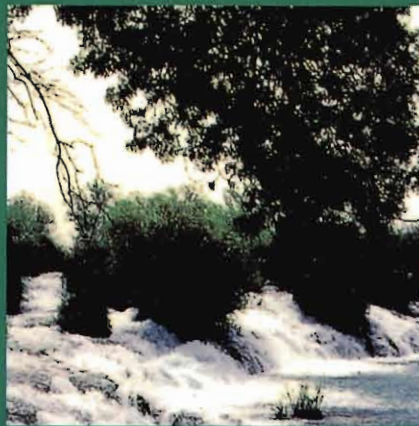


LIFE SCIENCE

SECONDARY EDUCATION
FIRST YEAR



SPECIMEN

REVISED EDITION

Center for Educational Research and Development



National
Textbook

New Curricula

Republic of Lebanon

Ministry of Education and Higher Education

LIFE SCIENCE

Secondary Education

First year

Center for Educational Research and Development





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LIFE SCIENCE

Secondary Education

First year

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Together We Build Through Education!

The Center for Educational Research and Development (CERD) has embarked on an extensive workshop for assessing and developing the educational framework and curricula which have been placed into effect more than three years ago. With full realization of the fact that the educational cycle must continue normally through its components, and until the development process attains its aspired objectives, we are placing in the hands of students, teachers and directors of public schools, this corrected version of textbooks issued by CERD as part of the National Textbook Series.

This version is an interim stage incorporating the corrected typographical and linguistic errors discovered by CERD specialists as well as teachers and students through their daily dealings with the books. The process of assessment and development of the framework and curricula will take into consideration all the comments that have been made, or will be made, in this regard.

It is expected that once the curricula are developed and aligned with the general and specific objectives set for them, the textbooks will be realigned with the new curricular and framework requirements, including tying the content of a course to the number of teaching hours set for it during the school year, taking into consideration vertical alignment within the same course as well as the horizontal alignment with the rest of the courses.

I take this opportunity to invite all school administrators, teachers and students and all officials concerned in public and private schools alike, to promptly send their comments on these curricula and books as their contribution to enrichment of this momentous national process.

This workshop, which was launched under the kind sponsorship of His Excellency the Minister of Education and Higher Education in implementation of Decree No. 10227 embodying the educational curricula and their objectives, fits in with CERD's proclaimed new motto "Together We Build Through Education".

It is our earnest desire to see this national, all-inclusive workshop attracting the greatest amount of interest and participation to define the safest and soundest educational options that directly affect our children, as we vow to continually modernize education and develop its ways and means to keep abreast of modern developments and progress in science and technology.

Dr. Leila MALEEHA
President CERD



P R E F A C E

The curriculum of the first year of the secondary cycle in Life Science focuses on the following themes:

- functional organization of living things
- plant production and environmental factors
- management and protection of the environment.

This textbook is conceived to put in the hands of the student a tool of work that he can use in class, as a source of documents for learning, and outside the class to carry out complementary work.

Our keen concern made us adopt a clear and logical presentation that includes:

- chapters that are activity centered
- rich illustrations that can be used as learning support.

A particular attention is paid to environmental and health education.

Organization of the textbook:

Each chapter includes:

- An opening page that poses very clearly the problems to be solved.
- “Activities” that include experiments and / or selected precise information (graphs, tables, drawings, concept maps, photographs, ...) that allow the student to find solutions to the problems posed.
- A “Summing-up” that represents the main ideas.
- The “Concept mapping” that relates the main concepts of the chapters.
- A “Solved exercise” that includes directions to help the student to answer correctly.
- “Exercises” that assess the acquired knowledge.
- “Supplementary information” that are in most of the times about current issues.

This book conforms with the desire of renovation of the new curriculum and respects its new spirit and trends.

We strongly hope that this textbook will gratify many of our colleagues. Many thanks to all those who helped us.

The authors

USING THIS TEXTBOOK


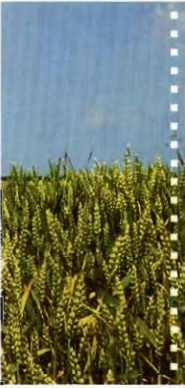
The chapter opening page

The chapter title

The chapter introduction

CHAPTER 1 AUTOTROPHY AND PHOTOSYNTHESIS

Certain living species obtain their food materials (mainly from substances manufactured by other organisms). They are called heterotrophs. Chlorophyllous plants use mineral materials to manufacture organic materials through photosynthesis; they are called autotrophs. What substances are necessary for the reaction of chlorophyllous plants? Where does photosynthesis take place?

PROBLEMS TO BE SOLVED

- How to prove the existence of photosynthesis?
- Where does photosynthesis take place?
- What are the necessary conditions for photosynthesis to take place?
- What are the necessary substances for the nutrition of chlorophyllous plants?

ACTIVITIES TO UNDERSTAND

1. Significance of autotrophy
2. Photosynthesis: special conditions
3. The chloroplast: site of photosynthesis
4. Photosynthesis: gas exchange

Problems to be solved

Activities to be done

Activities to deduce the important notions

The activity title

The activity introduction


Documents for a better understanding

ACTIVITY 1 SIGNIFICANCE OF AUTOTROPHY

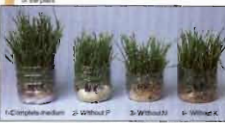
The chlorophyllous plants are capable of living in a strictly mineral medium and of elaborating their proper organic materials. How to determine the needs of minerals of a green plant? How to identify their chemical composition?

1. Importance of water and mineral ions

Doc. 1: Growing lettuce in water and a nutritive medium.



Doc. 2: Growing wheat grains on an absorbing cotton surface. Inevitably, seed is sprouted treated with a nutritive liquid (Knop's liquid for example), or lacking water mineral ions to test the importance of these minerals for the growth of the plant.

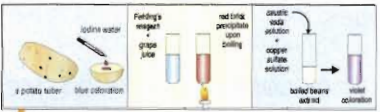


Doc. 3: Composition of Knop's liquid.

mineral salts	g.L ⁻¹
calcium nitrate	1
potassium nitrate	0.25
monophosphorus phosphate	0.25
magnesium sulfate	0.25
ferrous chloride	trace

such as glucose is added to the medium. The composition of fertilizers used in agricultural practice is very similar. In composition, to Knop's liquid. It contains nitrate, phosphate, and sulfate or a mixture of the three mineral salts.

2. Chemical composition of living materials



Doc. 4: Identification of some organic substances of living materials.

organic substance	principal chemical elements	examples
carbohydrates	C, H, O	glucose, sucrose, starch, lactose...
proteins	C, H, O, N	albumin, chlorophyll, amino acids...
lipids	C, H, O	olive oil, animal fat...

Doc. 5: Identification of a chemical element.

Doc. 6: Principal groups of organic substances.

To study the chemical composition of living materials, we burn a leafy twig or a piece of wood. After a certain time, water evaporates and the organic materials burn and leave a black precipitate. The ashes that remain at the end of the experiment are the mineral materials. The chemical analysis of the organic materials shows that they are principally constituted of these elements: C, H, O, N shown in the above table.

PROBING THE ACTIVITY

1. Using the experimental results of doc.2, describe the state of each lot of wheat plants. Deduce the importance of certain chemical elements for their development.
2. Wheat or raddish plants, exposed to light, can develop on Knop's liquid. Can fungi do the same? Formulate a hypothesis to explain the difference in the observed development.
3. What is the nature of the chemical substances identified in doc.4?
4. What is the chemical substance identified in doc.5? Justify your answer.
5. Due to the burning of leaves or a piece of wood, a black residue is formed. What does this residue contain?
6. Find out from the labels on fertilizers the form of nitrogen provided to plants?

Probing the activity

Summing up and concept mapping

Main ideas to retain

Summing Up

The Use of the Photosynthetic Products

The organic molecules that are produced by photosynthesis form a viscous solution called the elaborated sap. This sap is translocated in the vascular tissue of the plant.

I FORMATION OF THE ELABORATED SAP

The elaborated sap is a viscous organic solution. It contains many of the components of the crude sap and organic materials: carbohydrates, lipids, and proteins. These organic materials are synthesized from mineral ions and from sugars obtained from the hydrolysis of starch in tubers. The elaborated sap is a nutritive fluid that contains all the necessary nutrients in the cells to maintain life.

Water needs are ensured by the companion cells that are connected with the sieve elements by plasmodesmata. Together, the sieve elements and the companion cells form the **sieve tube**.

In this way, the plant assimilates with the phloem whereas they are supported in the stem.

III THE USE OF THE SYNTHESIZED SUBSTANCES

The organic materials ensure the **nutrition** of both chlorophyllous and non chlorophyllous cells. They provide the energy necessary for the metabolic reactions and for the synthesis of new molecules that are used in the building up of cells and tissues. Therefore, they cause the **growth** of the plant.

The excess of organic materials is stored in different organs of reserve: seeds, fruit, stem, root... thus, providing a long term use.

The materials in reserve are later consumed to ensure the **development** of the plant. During germination, for example, the reserves in the seed ensure the metabolism of the embryo and its development into an autonomous plant.

The organs of reserve are a main source of nutrient for man and many animals as well.

II TRANSLOCATION OF THE ELABORATED SAP

The elaborated sap moves in the different plant organs. The movement is done in special structures called the sieve vessels which are the conducting vessels of the phloem.

The longitudinal and transversal sections of roots, stems or leaves treated with the double cellulose technique shows void to the lignified vessels that are formed from vessels with cellulose walls that are covered pink by cambium stain dye. These are the **phloem vessels**.

The phloem vessels are made up of a series of elongated living cells whose transverse walls are sieved, thus forming a continuous tube. During the formation of the **sieved elements** the cells lose their nucleus and cytoplasmic contents. Their

CONCEPT MAPPING

FUNCTIONAL ORGANIZATION OF A CHLOROPHYLLIC VASCULAR PLANT

The diagram illustrates the functional organization of a chlorophyllous vascular plant. It shows the leaf, stem, and root. The leaf has stomata and guard cells. The stem has vascular bundles with xylem and phloem. The root has vascular tissue and root hairs. Arrows indicate the movement of water and nutrients.

Schematic concept mapping relating the main concepts

Exercises to assess the acquired knowledge

Solved exercise to help the student answer correctly

SOLVED Exercise

Two microorganisms X and Y cultured in the same chemical medium of water and mineral ions.

After one week, we notice that only organisms in tube B have increased in number.

40 Questions

1. What mode of nutrition does X have?
2. Why did it make the Y organisms multiply and change better conditions of the experiment?
3. We place C in darkness. No multiplication.

To answer correctly

- Identify the variables studied in each experiment.
- Compare A and B and identify the factor to be studied.
- Determine the factor that causes the change in the multiplication of Y.
- Draw an adequate conclusion taking into consideration all variables.

Proposed answers

- X are autotrophic, since they multiply in a mineral medium when exposed to light.
- Whether in light or in darkness, Y do not multiply in a mineral medium. This growth takes place when an organic substance is added to the culture. Y are therefore heterotrophic.

Exercise 6

The graph shows the volume of the oxygen released by a green algae exposed to a fraction of luminous intensity.

Characterize the graph and deduce the influence of luminous intensity on photosynthesis.

Exercise 7

The graph below represents the volume of oxygen produced by an alga placed in light, as a function of the amount of carbon dioxide present in water.

- Interpret the graph.
- The value 0.25% of carbon dioxide represents the amount present in air. How do the assimilations of a green alga evolve with carbon dioxide?
- Why do the algae grow better in the "light of the vessel"?

Exercise 8

Exposed to a radiation spectrum, a sprig of green algae, covered with a culture of aerobic bacteria, is observed under the microscope. The bacteria are found to be differently distributed around the sprig.

- Why do the bacteria approach the algae?
- Would the bacteria behave in the same way in darkness?
- What can be deduced from the different distribution of the bacteria?

Exercises

Supplementary INFORMATION

The intensity of photosynthesis and its importance in the biosphere.

The intensity of photosynthesis is defined by the release of oxygen (or by the absorption of the carbon dioxide) per unit time and mass of surface. It is 19 to 22 times greater than the intensity of the respiratory exchanges in plants; this is reflected by the excess of synthesis over the degradation, an excess that the animal organisms and man benefit from their nutrition.

The speed of photosynthesis increases with the intensity of light until a limiting value, above which a plateau of light saturation is attained. It may reach some rate of thousands kcal/m² plants adapted to live in sunlight, that is lower than the solar light which on bright days can exceed 7 10⁵ kcal/m².

The partial concentration of carbon dioxide in the atmosphere is equally a limiting factor. This concentration is weak in the air a lot more than three-tenthousandth in volume, we can accelerate photosynthesis by increasing it to a multiple of ten when we enrich the successive generations of cultures in addition to the carbon dioxide input.

But also in any mechanism related to the way that the speed is variable with temperature, it increases from 0°C to 35°C and decreases rapidly after the denaturation of the photosynthetic apparatus.

When two of the three external factors (light, temperature, partial concentration of carbon dioxide) are constant, the speed attains an absolute maximum which depends upon the pigmentation and the enzymatic equipment of the plant. Therefore, the factors determining the organism.

What the optimal rate is never obtained in natural conditions. Even when light and temperature are

most favorable, the partial concentration of carbon dioxide is limiting.

From an energetic point of view, the maximum rate of photosynthesis does not exceed 2% for forests and 1% on average for cultures.

Plants are thus far from using even during sunny days the solar light available, a great part of light energy is lost; however, the fixed quantities of carbon are impressive. One hectare of corn can give 120 000 kg of grain annually, a carbon corresponding to the synthesis of 1400 tons of 5% organic material.

The estimations are based on the harvest and the measure of the growth of these indicates that the terrestrial plants would annually fix around 15 billions of tons of carbon. For ocean plants, the measure concerning the photosynthetic rate: they range from 19 to 25 billions of tons. It should also recall the part origin of coal and of petroleum hydrocarbons in animal production.

The purification of the atmosphere by the uptake of carbon dioxide. The amount of carbon present on earth (or an equivalent) is passed many times through the photosynthetic mechanism like the average contained in the air and in the water.

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Supplementary information of selected current issues

CONTENTS

PART ONE

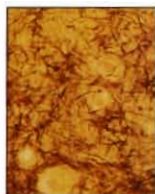
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