

LIFE SCIENCE

Energy



**Secondary Education
Second year
Sciences Section**

Center for Educational Research and Development



National
Textbook

New Curricula

Republic of Lebanon

Ministry of Education and Higher Education

LIFE SCIENCE

Secondary Education

Second Year

Sciences Section

Center for Educational Research and Development





General Coordinator
Moustapha Yaghi

Consultant
Rima Slim

Translator
Nina Zeidan



LIFE SCIENCE

Secondary Education

Second Year
Sciences Section

Josette Dagher (Coordinator)

Zakia Hajjar

Samir Safi

Mouna SabeH

Center for Educational Research and Development



Educational Company

for Printing, Publishing and Distribution S.A.R.L.

Illustrations: Graphic Team ■ CRDP
Artistic and Technical Preparation: Technical Team ■ S.P.C
Édition and Distribution:  **Educational Company**
for Printing, Publishing and Distribution S.A.R.L.

Printing: Al ARZ Printing Press

© CERD 1999, Sin-EI-Fil, Lebanon, P.O.Box: 55264

All Rights Reserved for CERD

First Edition 1999 – 8th Impression 2010

The National Textbook Project

This is the second installment of textbooks completed by the Center as part of a three-stage effort to produce the books called for by the New Curricula. We are placing these books in the hands of students with the great hope that we are moving, step by step, toward the goal of acquiring sound and modern learning, using sophisticated educational means and up-to-date methodology that encourage and reinforce individual thinking and research, the acquisition of skills, the development of ethical and national attitudes, the feeling of national belonging as well as the feeling of belonging to humanity at large.

The on-going revolution in information, communication and educational technology has undoubtedly limited the role of the textbook and lowered the rank it used so recently to occupy. However, in our society and in many other societies, the textbook remains the basic means of education, and it is our duty to exert our utmost effort and care to come up with the best product as to form and content. Yet we should not lose sight of the fact that the textbook is not sufficient by itself but should rather be used as a stepping stone to access other sources of information. What is important is to keep a clear vision and maintain the right course toward our objective. The means should not turn into the end and the student should always remain the focus of the learning/teaching process.

No one ignores or denies the fact that textbook writing requires very high academic and educational qualifications and very wide field experience. The authors committees undeniably possess such qualifications and qualities, yet last year's textbooks did contain some faults and gaps which were duly pointed out by researchers in many articles, and, indeed, we have benefited from some of them. Such is the nature of human work, no matter how good the intentions or how great the effort exerted.

Constructive criticism is a real contribution to raising the standard of authorship, minimizing errors and filling gaps. We only hope that criticism will always be objective and motivated by a desire to enhance educational reform in order to achieve better products.

A favorite adage handed down from our old scholars: "He who criticizes you is as helpful as a co-author". Let all criticism directed at the Center be of this caliber.

In closing, we hope that we all will have benefited from our experience and that the textbooks of the third and final stage be closer to realizing our hopes and more beneficial to our students. We are now preparing ourselves to assess the parts so far achieved of the new curricula and to assure that our educational movement is proceeding on the right track for achieving the best results.

June 2, 1999

**President, National Center for Educational
Research and Development**

Nemer FRAYHA

PREFACE

Preface

The curriculum of the second year of the secondary cycle in Life Science, S series, focuses on three themes:

- functional characteristics of living things at the cellular level
- nutrition and health
- interdependence of living things and their relationships with the environment.

This textbook is conceived for science-oriented students. It favors discovery and reasoning. It presents varied didactic aids (graphics, photographs, documents, histograms) which lead the student from observation to conceptualisation. Guided by the teacher in the scientific procedure step, the student can acquire a critical thinking and an autonomy, which are the characteristics of a responsible citizen and a future researcher.

At the end of the second year of the secondary cycle, the student would have developed the following skills:

- to relate biological identity to genetic information
- to identify the functional characteristics of cells which allow the conversion of potential energy of organic matter into ATP which is used by the cells
- to identify the interdependence between living things within an environment
- to determine the responsibility of the human being in the control of ecosystems
- to relate good health to good eating habits

Each part of the book is divided into chapters which include:

- activities and their application to build up knowledge
- a “summing-up” that represents the main ideas
- a “concept-map” which summarizes the relationships between the main concepts of the chapters
- assessment exercises
- “supplementary information,” which deals usually with current issues

Supplementary files and a glossary complete the necessary information, which make this textbook a working tool and a reference. The authors hope that this textbook will be useful to the students and serve as a pedagogical aid for the teacher.

Sincere thanks and appreciation go to all those who helped us.

The Authors

USING THIS BOOK

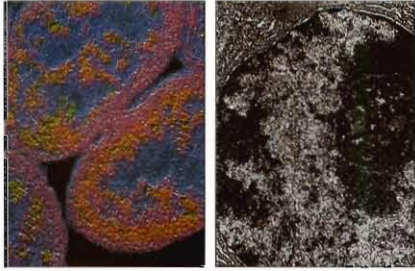
The chapter opening page

CHAPTER

1

Diversity of organisms and uniqueness of the individual

THE GENETIC INFORMATION PRESENT IN THE NUCLEUS OF THE EGG-CELL INCLUDES THE DEVELOPMENTAL PROGRAM OF EACH LIVING BEING AND THE RENEWAL PROCESSES OF ITS CELLS. THIS SPECIFIC INFORMATION DETERMINES THE UNIQUENESS OF THE INDIVIDUAL AND THE POLYMORPHISM OF THE SPECIES.



Problems to be solved:

- What are the criteria for classification of living beings?
- What is a biological identity?
- How does cellular renewal take place?

Activities

1. Diversity of the living world
2. Polymorphism within a population
3. Biological identity of organisms
4. Renewal of cells and maintenance of their characteristics

Title of the chapter

Presentation of the chapter

Problems to be solved and activities to understand

Activities to deduce the important notions

Title of the activity

Presentation of the activity

Documents to better understand

Probing the activity

Activity 1

THE DIVERSITY OF THE LIVING WORLD

The ecologist Robert Whittaker designed a classification system based on the degree of complexity of living things and their mode of nutrition.

A classification system is essential to understand the great diversity of living things in the biosphere. Biologists estimate the presence of at least to million different species, but up till now they have identified only about 1.5 million. What are the criteria for the classification of organisms?

1. Prokaryotes and eukaryotes

The biosphere is characterized by a great biodiversity in order to facilitate the study of living things in the biosphere, a classification system is set to arrange them into groups according to the criteria of resemblance.

The electron microscope allowed biologists to observe structural and fundamental differences between bacterial cells and the cells of higher organisms. Consequently, they classified the organisms into eukaryotes (from Greek karyon = nucleus, eu = real) and prokaryotes (pro = before).

PROKARYOTES	EUKARYOTES
<ul style="list-style-type: none"> • Cells that are 5 to 10µm in diameter with a single internal structure. • Fine chromosomes in the cytoplasm. • Cell division by binary fission. 	<ul style="list-style-type: none"> • Cells that are 10 to 100µm in diameter with a complex internal structure. • Linear chromosomes surrounded by a nuclear membrane. • Cell division by mitosis.

2. The concept of species

Many classification systems of living things currently exist. These systems are based on morphological, anatomical and biochemical criteria which allow us to understand the concept of species. A species is a group of similar individuals which share similar characteristics and are capable of cross-breeding.

Kingdom	Animal	Plant
phylum or division	chordates	spermatophytes gymnosperms*
class	mammalian	coniferophytes
order	carnivora	coniferales
family	canidae	abietales
genus	Canis	Cedrus
species	Canis amicus	Cedrus libani
common name	dog	cedar of libanon

Dec. # An example of prokaryotic classification of 1.964 (1970-1979)

PROBING THE ACTIVITY

- State the differences and the similarities between a prokaryotic and a eukaryotic cell.
- Use dec. 6 to classify the following organisms: paramecium, amoeba, frog, cat, banana tree, pine tree and bacteria.

Summing-up and concept map

Summing up to remember

SUMMING UP

THE DISTINCTION BETWEEN PROKARYOTES AND EUKARYOTES IS ONE OF THE MULTIPLE FACETS OF THE DIVERSITY OF THE LIVING WORLD. IN ADDITION TO THE POLYMORPHISM EXISTING BETWEEN POPULATIONS, WE OBSERVE DIFFERENCES BETWEEN INDIVIDUALS OF THE SAME SPECIES. THE BIOLOGICAL IDENTITY OF LIVING THINGS DEPENDS ON THE GENETIC INSTRUCTIONS LOCATED IN CHROMOSOMES. THESE INSTRUCTIONS ARE RESPONSIBLE FOR THE GROWTH OF THE ORGANISM, THE RENEWAL OF THE CELLS AND THE MAINTENANCE OF THEIR CHARACTERISTICS.

I - Diversity of living things

The present nomenclature and classification system of living things into five kingdoms, reflects their great diversity. This does not exclude the distinction established earlier between prokaryotes and eukaryotes.

- Prokaryotes are unicellular living things whose cell lacks a nuclear membrane which separates their chromosome from the cytoplasm.
- Eukaryotes are unicellular or multicellular living things whose cells have a nuclear membrane surrounding their hereditary material, thus separating it from the cytoplasm.

On the other hand, the species is always considered the basic unit of any classification. It is defined as a group of living things possessing morphological, anatomical and physiological resemblances and whose individuals are capable of cross-breeding.

II - Population polymorphism

Individuals within a species have traits that distinguish each from the others. In humans, the descendants of a couple (with the exception of identical twins) are different from each other and from their parents. Nevertheless, they show "family traits." This diversity could be extrapolated at the population level and even more at the species level.

At the **organism level**, the uniqueness of the individual is characterized by "phenotypic markers" such as skin pigmentation, hair color.

At the **cellular level**, biochemical characteristics allow to distinguish each of us from the others. This is the case for **red blood cell markers**, which are glycoproteins localized on their plasma membranes. These markers determine our blood group (A, B, AB and O). Other markers provide additional particularities to the individual. That is why tissue and organ transplantations succeed in identical twins but are rejected in fraternal twins. All of these markers define the individual and allow the establishment of a "molecular identity card" for each of us. The biological identity of an organism is determined by the specific traits (of the species) and by individual, morphological and molecular traits.

CONCEPT MAPPING

The concept map illustrates the flow of genetic information from the genome of an organism to the cellular level, leading to cellular renewal and the maintenance of genetic information. It also shows how genetic information influences the diversity of organisms and biological identity through phenotypic markers and biochemical characteristics.

The concept map illustrates by the image the essential notions.

Exercises to test acquired knowledge

EXERCISES

EXERCISE 1

Mark the true statements and correct the false ones.

- There are not two human beings with the same genetic program.
- Transplant rejection is caused by the similarity of markers between the donor and the recipient.
- The identity markers exist in all our cells.
- The bone marrow contains stem cells for red blood cells only.

EXERCISE 3

The seaweed *Acetabularia* is an algae consisting of a single giant cell. Various sectioning and grafting experiments were performed on this algae.

1. Analyse the above experiments.
2. What do you deduce?

Supplementary information

Species classification

Aristotle's system with two kingdoms

Plants	Animals
Terrestrial Plants Algae Fungi	Animals

Three kingdoms system depending on the distinction between prokaryotes and eukaryotes

Plants	Animals	Monera
Terrestrial Plants Algae Fungi	Protozoa	Animals Prokaryotes

Five-kingdom system

Mode of nutrition	Plants	Fungi	Animals	Protista	Prokaryotes
Photosynthesis	Terrestrial Plant and multicellular algae			Unicellular algae	Bacteria
Absorption		Fungi			
Ingestion			Animals	Protozoa	Bacteria

Supplementary information dealing with up to date issues

Assessment exercises

9

PART ONE:

FUNCTIONAL CHARACTERISTICS OF LIVING THINGS AT THE CELLULAR LEVEL

A-BIOLOGICAL IDENTITY AND GENETIC INFORMATION

Chapter 1. The diversity of organisms and the uniqueness of the individual p17



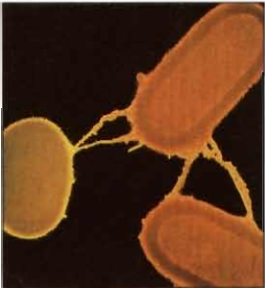
Activities

1. The diversity of the living world
2. Polymorphism within a population
3. The biological identity of organisms
4. Renewal of cells and maintenance of their characteristics

Summing up

Exercises

Chapter 2. DNA, genetic information and cell cycle p33



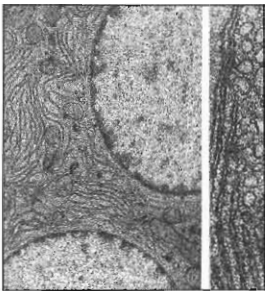
Activities

1. The karyotype
2. Mitosis, an equal division of the chromosomal set.
3. The structure and the chemical components of chromosomes
4. Identical reproduction and cell cycle

Summing up

Exercises

Chapter 3. Protein synthesis and enzymatic activity p49



Activities

1. Proteins, an association of amino acids.
2. The gene, structure and information unit
3. Transcription: first step of protein synthesis
4. Translation: second step of protein synthesis
5. Fate of synthesized proteins
6. Enzymes, proteinic biological catalysts
7. Reaction rate and optimum conditions
8. Specificity and mechanism of enzyme action

Summing up

Exercises

Chapter 4: Biological identity and genotype p75



Activities

1. Phenotypes and proteins
2. Genes and alleles
3. The genotype

Summing up

Exercises

B- MOLECULAR RENEWAL AND ENERGETIC METABOLISM

Chapter 5: Molecular renewal

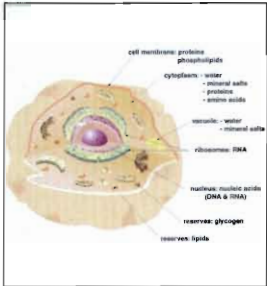
p89

Activities

1. The flow of matter in an organism
2. Mechanisms of molecular renewal

Summing up

Exercises



Chapter 6: Energy expenditure of organisms

p99

Activities

1. Evaluation of energy expenditure
2. Variations of energy expenditure
3. Basal metabolism

Summing up

Exercises



Chapter 7: Energy of the cell functioning

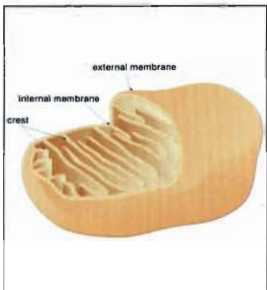
p111

Activities:

1. Cellular respiration
2. Fermentation
3. Conversion of the energy of metabolites
4. The mitochondrion, site of cellular oxidations

Summing up

Exercises



Chapter 8: Energetic metabolism in Man

p127

Activities

1. Nature of metabolites
2. Liver and the regulation of glycemia
3. The muscle fiber, a differentiated cell
4. The metabolism of muscle fibers.
5. The restoration of ATP

Summing up

Exercises



PART TWO:

NUTRITION AND HEALTH



Chapter 9: Diversity of feeding habits

p149

Activities:

1. Variation of nutrition according to regions and times
2. Foods: mixtures of the same constituents
3. Identification of the constituents of certain foods

Summing up

Exercises



Chapter 10: Basic principles for a balanced diet

p161

Activities:

1. Energy expenditure and quantitative needs
2. Qualitative needs: the building foods and the energetic foods
3. Qualitative needs: vitamins and minerals
4. A balanced diet

Summing up

Exercises



Chapter 11: Nutritional diseases

p176

Activities

1. Food deficiency diseases
2. Diseases of excessive food intake: cardiovascular diseases
3. Diseases of excessive food intake: obesity

Summing up

Exercises

PART THREE:

INTERDEPENDENCE OF LIVING THINGS AND THEIR RELATIONSHIPS WITH THE ENVIRONMENT



Chapter 12: Conversion of light energy to chemical energy

p191

Activities

1. Effect of light radiation on photosynthesis
2. Light radiation and chlorophyll
3. Chloroplasts, organelles of photosynthesis
4. Photochemical phase of photosynthesis
5. Chemical phase of photosynthesis

Summing up

Exercises



Chapter 13: Energy flow and the carbon cycle in ecosystems

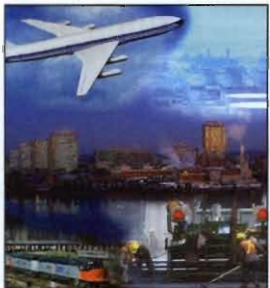
p209

Activities

1. Trophic organization of ecosystems
2. Ecological turnovers and productivities
3. Flow of energy in an ecosystem
4. Transfer of matter and the carbon cycle

Summing up

Exercises



Chapter 14: Man and the carbon cycle

p227

Activities

1. The biogeochemical cycle of carbon
2. Human activities and the carbon cycle
3. Greenhouse effect and global warming

Summing up

Exercises

Methodology files

p241

Technical files

p244

Glossary

p249