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THE METHODOLOGICAL FRAMEWORK OF THE DEVELOPMENT OF THE EDUCATIONAL PACKAGE "WATER IN THE MEDITERRANEAN"

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ABSTRACT: The methodological framework for the development of the educational package "Water in the Mediterranean" is presented. This material has been prepared to facilitate the educators' work in the closely related fields of *Environmental Education (EE)* or *Education for Environment & Sustainability* (*EfES*) or *Education for Sustainable Development (ESD)* and it was designed mainly for secondary school students. The AASS Project 2061 criteria for the evaluation of the middle grades science textbooks were taken into account for the development of the scientific part of the material. The necessary interdisciplinary approach was based on two foundations: (a) the contribution from an interdisciplinary network of professionals involved in its preparation, originating from various scientific fields, working in the sector of formal and non-formal education, and (b) the use of water as a cross-cutting thematic module, which permeates all aspects of life. The package is designed to be a flexible resource guide for the work of educators, having as main objectives for the students to gain basic knowledge, enhance understanding on major water issues and also to introduce them in a constructive way to the complexity and interdependence of the various economic, social and environmental factors linked with water on one hand and sustainable development on the other. Furthermore, the material aims at the development of problem-solving and decision making skills, in order to stimulate the responsible behaviour of students, and their ability to undertake action in favour of the environment and natural resources as individuals and collectively, as members of a team. A brief evaluation based on the NAAEE Guidelines for Excellence for EE materials is included as well. [*Chem. Educ. Res. Pract.*: 2004, *5*, 185-206]

KEY WORDS: *environmental education (EE); education for environment and sustainability (EfES), education for sustainable development (ESD); educational materials; quality criteria and characteristics of educational materials; interdisciplinarity; networking; water; Mediterranean*

INTRODUCTION

It is common knowledge that the environmental education area has been flooded with educational materials of various types during the last years. Quite frequently these materials receive heavy criticism for various reasons, e.g. for having inaccurate content, for not following the current educational methodologies or current trends in global environmental or sustainable development policies and strategies, for not engaging enough the students, for not developing and using properly scientific and/or pedagogical theory, experience and practice. At the same time, it has been also recognised repeatedly that good educational

materials provide powerful tools in the hands of a teacher. Moreover, there is encouragement for production and use of such materials of good quality, repeated in all major relevant international conferences and documents (Agenda 21, 1992; UNESCO, 1997; UNECE, 2003).

The educational package "Water in the Mediterranean" was developed having in mind all the above, in an attempt to present a coherent process, combining current sustainability strategies and education theory and practice with the initiatives and inputs from competent bodies, dealing with the various aspects of the issue of water, in order to facilitate all those working for *Environmental Education* (EE). For the development of the package an interdisciplinary approach was followed in order to keep in line with the current theories and standards for the production of an educational material of good quality.

1. THEORIES OF LEARNING: CONSTRUCTIVISM AND ENVIRONMENTAL EDUCATION

Environmental educators and researchers using theories of learning to plan interventions and/or to evaluate programmes should pay attention to the call for a pragmatic social constructivist perspective – recognising that knowledge is constructed socially and both teachers and learners have a role in mediating the process (Dillon, 2003). The active, constructive involvement of the learner is essential for the learning process. Every day practice and research indicate that people learn best when they participate in activities that are perceived to be useful in real life and at the same time culturally acceptable. This is even more the case when the activity is also considered socially useful.

Understanding the learning process is a crucial component for curriculum development. Cognitive psychologists point out that "lasting" knowledge is not gained by simply reading phrases in a text or listening to words in a lecture. Instead, lasting knowledge occurs when the learner attempts to make sense of the new information by applying it to his/her already perceived notions about the topic. Once the new information is assimilated in the learner's established knowledge and "conceptual structure", comprehension takes place (Lord, 1999). During the assimilation process "perturbations" develop in the mind of the learners, as they try to create the appropriate links between the new information and their conceptual structure. After this cognitive procedure, the new information is transformed into a new concept and it is "put" in the conceptual "building" (structure) of the individual. It is evident that during the learning process mental processes take place on both the part of the deliverer and the receiver (Tsaparlis, 2000, ch. 1). This is the framework of the learning process provided by the theory of constructivism.

Klein & Merritt (1994) compared the goals of EE with the principles of constructivism and they suggested that "the learner actively constructs knowledge and does not passively receive information" and "learning is an adaptive process that organises one's experiences of the world and does not involve discovering an independent pre-existing world outside the mind of the learner". To this end, an educational methodology based on the principles of constructivism could involve: introduction of a real-life problem by the students or by the educator for the students to resolve; student-centred instruction facilitated by the educator; productive group interaction during the learning process; authentic assessment, in which educators determine whether students can use concepts and skills by requiring them to perform a task or create a "product"; and demonstration of student progress. The compatibility between the main general elements of the constructivist approach and the ones of EE are obvious. Nevertheless, students' involvement in their own cognitive procedure ("metacognition") and critical thinking are crucial elements for both EE and constructivism.

Additionally, research has revealed that students following an environmental course or programme based on the principles of constructivism had a better understanding of the concepts elaborated within the course than did students following a "traditional", teacher-centred group. Furthermore, the majority of the "constructivist" group stated that they found the course interesting and enjoyable. They also claimed that the procedure helped them master the given material better and provided them with deeper insights into the topic than traditional instruction would have done (Klein & Merritt, 1994).

2. ENVIRONMENTAL EDUCATION VERSUS SCIENCE EDUCATION IN CURRICULA DEVELOPMENT

In the 1960s, during the EE's early formulations, its explicit aims were often concerned with stimulating a sense of individual responsibility for the physical and aesthetic quality of the total environment based on the knowledge of general ecological principles, an understanding of the impact of human society on the biosphere, and an awareness of the problems inherent in the environmental change. Within this notion, an important role was attributed to Science Education (SE) within the framework of EE (Gough, 2002). However, during the 70s, forums such as the Belgrade Workshop (1975) and the Tbilisi Conference (1977) resulted in a shift in the goals and objectives of EE to emphasize more explicitly values and attitudes clarification, decision making skills and an action component (Gough, 2002).

Of course, after the Moscow Conference (1987) and the publication of the Brundtland report, EE started to be linked also to the emerging concept of sustainable development (Alampei, 2002). After the UN Conference on Environment and Development (Rio, 1992) and the International Conference on Environment and Society: Education and Public Awareness for Sustainability (Thessaloniki, 1997), the need for reorienting EE towards sustainability emerged (Scoullos, 1998), while after the World Summit on Sustainable Development (Johannesburg, 2002) the promotion of Education for Sustainable Development (ESD) was recognised as an urgent need.

According to current educational trends: *"There is need to reorient many existing educational policies, programmes & practices, so that they build the concepts, skills, motivation and commitment needed for sustainable development"* (UNESCO, 2002). During the last 30 years some educators questioned the relationship between EE and SE, while others argued for, or envisaged, a stronger connection between them. Today governments, worldwide, struggle to find the best way to combine the various aspects of EE, whereas some researchers claim that SE is in stronger position (Littledyke, 1997; Dillons, 2002). This is not at all our view, judging also from the current development of the UNECE Strategy on ESD which shows that on pragmatic grounds there is a need for a mutually beneficial relationship between ESD and SE, based of course on certain prerequisites already recognised earlier (Jenkins, 1994; Gough, 2002).

According to recent research (Gough, 2002), there is a widespread concern about decreasing students' participation in upper secondary science courses in Australia and elsewhere in the western world. On the other hand, there is a widely acknowledged interest of the youth in environmental issues combined with generally positive environmental attitudes (i.e. Zimmermann, 1996; Kuhlemeier et al., 1999; Ma & Bateson, 1999; Rickinson, 2001). Meanwhile, despite all the recommendations found in research and literature to make science education more relevant to the needs of the society for a scientifically literate citizenry, as well as for meeting students' interests, in most cases SE practices remain basically the same during the past 25 years. This is due to a number of reasons such as: the inflexibility of the curriculum which does not allow teachers plan their own schemes of

work; the strong influence of scientists in drafting the curriculum including their own priorities; the view by many educators of EE as yet another "pressure" in an already overloaded curriculum; the persistence of some science teachers in their own discipline rather than the interdisciplinary approach; and finally the commonly superficial understanding of EE by many of those responsible for the science curriculum (Gough, 2002). The risk of EE being squeezed out by the demands of the extensive knowledge-centred and assessment-driven content of core science is also recognised (Littledike, 1997).

On the other hand, several studies have reported that seldom do students see the multiple connections that science concepts have to the real world (Brody, 1994). In this context, Gough (2002) suggests that SE needs EE to reassert itself in the curriculum by making science seem appropriate and more culturally and socially relevant, while EE needs SE to underpin the achievement of its objectives and to provide it with a legitimate space in the curriculum (Tsaparlis, 2003). Moreover, Ma & Bateson's study (1999) reported that students who had a favourable attitude toward the environment also showed a favourable attitude toward science. This is a notion that should be also taken into account by environmental and science educators.

Finally, Jenkins (1994) argues that a *science education for action* is fundamental for students and he puts emphasis in the concept of a local context or community component in the practice to make the experience genuine, since without it the activity is reduced to its technical dimension. The local context has, in most cases, an environmental character in shifting SE to EE and provides the opportunity for generation of local knowledge informing and empowering action.

It is obvious that there is a mutual benefit for a balanced merging of SE and EE, without overloading the latter exclusively with scientific inputs. This was taken seriously into account in the preparation of the package "Water in the Mediterranean", which includes many activities clearly referred to SE but linked to local action, value clarification as well as to problem solving student-centred learning.

3. THE INTERDISCIPLINARY CONTEXT FOR THE DEVELOPMENT OF THE EDUCATIONAL PACKAGE "WATER IN THE MEDITERRANEAN"

The imperative need for reorienting education towards sustainability requires working at the interface of many disciplines in order to address the complex issues of today's world. On the other hand, the international experience and practice in designing educational science curricula underpins the importance of interdisciplinary subjects and processes. Such themes provide the appropriate ground allowing curricula to link and integrate isolated subjects, reflecting the complexity of real situations, and developing students' skills, and in particular higher cognitive skills, to deal with them (Lord, 1999; Bargellini, 2000). *Interdisciplinarity* implies the cooperation and integration of the contributing disciplines, seeking to create a common and single framework shared by all the disciplines involved (UNESCO, 1985; D'Hainaut, 1986). The knowledge and methods from the different disciplines "bend" and deviate from the "departure" disciplines, to "meet" or even "merge", through an "osmosis" procedure, in order to examine in a systematic way the specific issue. In this way a common shared vision is obtained. The teaching methods and programmes within EE are, by nature, interdisciplinary, since they adopt a holistic approach and encompass the various ecological, social, cultural and economic aspects of the environmental issues (UNESCO, 1985). According to the European Community Resolution (24 May 1988):*"Environmental education is an interdisciplinary subject of relevance to many fields of teaching"*. Following the developments since the International Conference of Thessaloniki (1997) it was made quite clear that just as there is a wholeness and

interdependence to life in all its forms, so must there be a unity and wholeness to the endeavours to understand it and ensure its durability (UNESCO, 1997). Nevertheless, meaningful EE is envisioned as a teaching and learning approach with interdisciplinary, critical thinking, problem-solving, and decision-making orientations, leading to the capacity of transfer beyond the specificity of each and every subject or discipline (Zoller, 2000).

Various approaches have been developed for the practical implementation of interdisciplinarity in EE and ESD programmes, among which "*projects*" and *"modules*" are the most commonly accepted as promoting it in an efficient and sufficient way. Within projects, the barriers between disciplines "break down". This is an imperative need because such an educational methodology is directed towards problem-solving on issues closely related to students' actual experiences (UNESCO, 1980, 1985). Modules are based on unified teaching in the context of a *cross-cutting* theme (also called "transversal"), which implies the contribution and integration of different disciplines (disciplines related conceptually or methodologically or with common research ground). There is an increasing trend in the European countries to use "modules" when implementing ESD or EE programmes. From the existing rather limited statistical data we know that the percentage of European secondary schools implementing EE by using thematic modules on transversal topics (e.g. water, waste, sustainable consumption patterns, etc.) is relatively high (approximately 44%) (Stokes, 2001).

The educational package "Water in the Mediterranean" is an attempt to provide a concrete example of interdisciplinary approach. Its design was based on two foundations: (a) the inputs from an interdisciplinary network of formal and non-formal educators with varying background that were involved in its preparation, and (b) the use of a cross-cutting topic, the one of freshwater, as the "vehicle" which permeates all aspects of life. Both are presented in the following sections (3A and 3B).

3A. Network of educators and Non-governmental organisations (NGOs): Interdisciplinary collaboration

It is common knowledge that no sector or group of professionals is in sole possession of experience, resources and authority, to deal with all environmental and sustainable development issues and very few educational problems have only one possible solution. Recognising and addressing environmental and sustainable development problems requires interdisciplinary thinking. On the other hand, diversity of efforts in preparing relevant education materials without particular efforts for integration of the separate individual inputs leads to poor and scattered results.

"Water in the Mediterranean" was conceived and produced as the result of a long process characterised by commitment to collaboration from the partners involved, which operationally meant sharing "know how", experiences, and information among many formal and non-formal educators, who were addressing the same or related subjects, all around the "delicate" issue of freshwater. According to literature, the informal context evidence base seems to offer potentially useful information for those developing curricula in the domain of EE on understanding of the design and efficacy of a range of pedagogic strategies, primarily ones which involve direct, hands-on experience with an object or situation (Dillon, 2003).

Interdisciplinary collaboration also entails recruiting partners that come from various different educational fields (Niesenbaum & Gorka, 2001). In the present case, this was achieved by the close collaboration of university teachers, with formal and non-formal educators having a wide variety of disciplines in their backgrounds, e.g. natural sciences, humanistic sciences and literature. Actually, apart from having different educational background, the people involved in this process have been actually raised in different

cultures and natural settings. Most of them, however, had previous experience in interdisciplinary programmes and they had worked already to some extent with educators having natural sciences background.

Research shows that as a result of involvement in long term-partnerships with natural resource professionals and teachers, the latter tend to demonstrate more knowledge and understanding of environmental science and greater confidence in their ability to teach EE effectively. Furthermore, such partnerships improve considerably the quality of EE and SE (Bainer et *al.*, 2001). In the same context, partnerships between academic institutions and non-governmental organisations (NGOs) can become an effective vehicle for improving the quality of EE by making it more socially relevant and by bringing it closer to both global thinking and local conditions.

To this end, the educational material "Water in the Mediterranean" was the result of a coherent "merging" process, in an attempt to combine the current educational theory and practice: On one hand, its formulation was based on the current theories of learning, and on the other, it was grounded on inputs from all possible sources and competent bodies (such as teachers, university professors, environmentalists, postgraduate students, etc.), some of which originated from a rather different scientific field, but all of whom had adequate experience and knowledge as well as mutual interest to work together.

The process, which resulted to the final publication, started with the collaboration between MIO-ECSDE[1] and the University of Athens, with a group of educators-postgraduate students of the Chemical Education and New Educational Technologies Programme (DiCheNET). All relevant material from UNESCO, UNEP, EEA, GWP/GWP-Med were used as sources of information, together with basic references and the outcomes of UNECSO Conferences, such as the one held in Thessaloniki (1997), etc.

The process was carried out as a cooperative effort among the postgraduate students, MIO-ECSDE and a group of seven collaborating NGOs – members of MIO-ECSDE, with long experience in EE projects, coming from seven Mediterranean countries (Cyprus, Egypt, Greece, Israel, Morocco, Tunisia, and Turkey).[2] This partnership was designed as such, in order to leverage all the possible resources of every cooperating partner toward the preparation of an educational package that would be useful and meaningful for formal, non-formal and informal educational settings, across the Mediterranean.

Parts of the Greek version of the package were tested by the authors in a number of schools in Athens. The draft English version was presented during the "Mediterranean Conference of Water Stakeholders and Decision-Makers: Towards a Core Action Plan" (Athens, 2-4 November 2000) and it was introduced to formal and non-formal educators of the collaborating NGOs. It is stressed again that the educators that contributed to the compilation of the package stemmed from both natural and humanistic sciences. Their first comments and suggestions were collected by the authors during a workshop, organised by MIO-ECSDE in Athens, in November 2000.

Following this workshop, the draft package was distributed further to groups of educators in the abovementioned seven countries for experimental application and

[1] MIO-ECSDE (*Mediterranean Information Office for Environment, Culture & Sustainable Development*) is a Federation of Mediterranean NGOs for Environment and Sustainable Development, having as one of its basic activities drafting and promoting of common NGO policies: research; awareness raising; capacity building and public participation; and, environmental education.

[2] The seven collaborating NGOs were the following: Arab Office for Youth and Environment (AOYE); Association for the Protection of Nature and Environment Kairouan (APNEK); Hellenic Society for the Protection of the Environment and Cultural Heritage (EE); Club Marocain d' Education en Matiere de Population et d' Environnement (CMEPE); Federation of Environmental and Ecological Organisations of Cyprus (FEEOC); Green Steps for Environmental Literacy (GSEL); Society for the Protection of Nature Israel (SPNI).

comments. More specifically, for the cases of Turkey, Morocco, and Egypt, the educational package was evaluated during workshops and consultation meetings, which resulted to detailed reports with useful comments, enriching remarks and amendments on the content and the format of the package (Faculté des Sciences de l' Education, 2000; AOYE, 2001; GSEL, 2001).

Furthermore, a research (see also section 4) that was conducted in April 2002 aiming to identify Greek high school students' attitudes and knowledge related to environmental matters, revealed a number of misconceptions and deficiencies in students' knowledge in approaching some of the issues included in the package (Alampei, 2002; Boulouxi, 2002; Malotidi, 2002; Vazeou, 2002). The results from this research were useful input and along with additional recommendations received from educators that participated in the process, were incorporated to the original material and a thoroughly amended final version was produced.

3B. Water: the thematic vehicle of the educational package

Nowadays, particularly after the adoption of the *Millennium Development Goals* (2000) and the *Plan of Implementation of the World Summit on Sustainable Development* (Johannesburg, 2002), water issues are in the centre of public interest. Nevertheless, the need for awareness raising and education of citizens and, in particular, of young people on water issues is worldwide acknowledged as not yet adequate. This is extremely important given the fact that water is not only the subject of immediate concern, but also the vehicle employed, in order to introduce young people to the entire cluster of sustainability concepts, principles and practices. It is noteworthy that within the framework of the *UN Decade of Education for Sustainable Development* (foreseen for the period 2005-2014), water issues are identified as of key-priority and importance among the issues related to *Education for Sustainable Development* (ESD) (UNESCO-Connect, 2003). Educational experience, even in more sectoral approaches, makes the latter evident: programmes for teaching Science, such as *"Chemistry in Context"*, Schwartz, 1997; *"CHEMCOM",* Chemistry in the Community, 1998; *"Environmental Chemistry in the Modern Socio-Technological Context",* Zoller, 1995, all include water issues in their curriculum (Tsaparlis, 2000, ch. 9).

What is also noteworthy is that surveys of young people in various countries reveal that water related issues, such as water pollution, acid rain, etc., are placed very high in their list of environmental concerns (Rickinson's review, 2001). In this sense, developing an educational package relevant to water issues would reflect on some of student's reported main environmental concerns. And of course, the promotion of water conservation practices in regions facing water shortage problems (such as in many parts of the Mediterranean region) is an obvious necessity (Middlestadt *et al.*, 2001).

The educational package "Water in the Mediterranean" was developed in the form of a "module" having freshwater as its cross-cutting thematic focus. This topic, and especially the aspect of integrated water resources management (IWRM), provides the opportunity to bridge the so-called traditional disciplines, including science. The concept of water might serve as one of the most integral among all those related to life and earth and thus, it is critical for achieving an understanding of the complexity and interrelatedness of natural systems (Lord, 1999).

In fact, the educational module integrated not only EE with SE, but also with social sciences, history, literature and the arts. In this way, an interdisciplinary context for addressing water issues was developed by attempting to optimise the contribution of the different disciplines, and also by taking into account the various parameters involved, such as technological innovations, social values, human and technical resources, etc. To this end,

the package "Water in the Mediterranean" integrates almost all school subjects in both its Parts: Theory and Activities (see also section 6 and Annex 3). Particular effort was made to avoid simple gathering of elements from the various disciplines, but rather to incorporate several of these elements in a logical creative and simple way. For the development of each activity the relevant elements of the school subjects and those elements deriving from various domains - economy, society and environment - were combined, by selecting and using any strong existing links between them. The common ground for achieving that was offered by the theme of the activity in each case (e.g. comparison of water consumption between developed and developing countries in activity 4f which is annexed). The theoretical part as well as the majority of the activities of the package were structured as a "painting by mixing colours". When the latter was not possible, the "mosaic technique" was used, meaning that the various elements deriving from each discipline were used as "small stones" contributing to the formation of the "final image".

4. RESEARCH ON GREEK HIGH SCHOOL STUDENTS

In general, surveys carried out on young people in several countries report that low levels of factual knowledge relating to environmental issues, are often coupled with poor understanding of such matters (i.e. Brody, 1994; Gambo & Switzky, 1996; Zimmermann, 1996; Kuhleimeier, Van den Bergh, & Lagerweij, 1999). More detailed investigations of students' ideas about scientific phenomena report considerable misunderstanding of the science of these issues (Gambo & Switzky, 1996; Rickinson's review, 2001).

The results of a research conducted in 2002 on 1774 Greek high school students (12-15 years old) investigating, among others, their knowledge on several aspects of water issues, concluded that in general they have a rather good level of knowledge on these issues. The examined topics were categorised into the four following thematic domains: *"water cycle", "water in ecosystems", "water in agriculture & industry"* and *"potable water & domestic wastewater"*. However, the research revealed also a series of misconceptions and deficiencies in the understanding of the relevant topics among students, such as: alternative ideas about the processes of water cycle, especially about the phenomenon of condensation (Vazeou, 2002); misconceptions regarding the food chains in aquatic ecosystems (Boulouxi, 2002), the process of acid rain formation, the process of soil erosion and the use of fertilisers (Alampei, 2002); confusion about freshwater characteristics and misconceptions related to the wastewater treatment (Malotidi, 2002). These findings were taken into account while preparing the final version of the educational package, and both the theoretical and the activities part were amended properly.

In addition, in all four thematic domains of the research, significant positive correlation was found between students' school performance and their knowledge on these themes, indicating that students with higher school marks had better, statistically significant performance than students with average and low school marks. The latter confirms the need of enhancing and improving general education in combination to environmental topics, such as freshwater and other relevant issues.

5. IMPORTANCE AND QUALITY CRITERIA FOR STUDENTS TEXTBOOKS

In today's classrooms, educational materials and textbooks in particular serve as a major tool. Teachers throughout the world use texts to guide their instructions, so textbooks and written material greatly influence how content is delivered. They actually play an important role in making the leap from intentions and plans to education practice, by selecting and organising the content and by setting out learning tasks in a form designed to

be appealing to students (Kulm, Roseman, & Treistmann, 1999). In many cases they have an enormous influence on what is taught in lower secondary school classes - referring especially to science and mathematics - and how it is taught. Research shows that the majority of teachers use textbooks as their principal curriculum guide and source of lessons, while new and inexperienced teachers, or those lacking of time for lesson planning, may actually teach from the first page to the last (Roseman, Kulm, & Shuttleworth, 2001). In this context, it is imperative that textbooks and any other educational material used during instruction should provide appropriate content and instructional support.

In the field of EE, educators usually have to choose from a wide range of printed materials. However, since EE is closely linked to science education, and due to the fact that the latter certainly encompasses various environmental issues and aspects, we would like to make reference and suggest the optional pilot use of the recent research-based criteria developed for the evaluation of middle grades Science Textbooks by Project 2061, carried out by the American Association for the Advancement of Science (AAAS, 1993). These criteria were also applied experimentally in order to design "Water in the Mediterranean" (see section 6) and they are presented in Annex 1. The application of these criteria to the final version of the package was undoubtedly useful in making its scientific part more concrete and better focused.

On the other hand, it should be stressed that this set of criteria does not secure the interdisciplinary balance needed for any material dealing with EE and even less for Education for Sustainable Development (ESD). That is why the criteria proposed by the North American Association for Environmental Education (NAAEE) for EE materials were also used to evaluate the particular educational material. NAAEE has developed the *Guidelines for Excellence* which is a set of recommendations for developing and selecting EE materials. A summary of these criteria is annexed in the present paper (Annex 2). In the following section an evaluation of the "Water in the Mediterranean" material using these criteria is also presented.

6. "WATER IN THE MEDITERRANEAN": AIMS, CONTENT AND BASIC CHARACTERISTICS OF THE EDUCATIONAL MATERIAL

The main purpose of the development of the Water Package was to obtain a "practical" product, useful for the Mediterranean educators and students of the first years of the secondary school (approx. 11-15 years old). Its main objectives are for students to gain basic knowledge and comprehension on water issues, and also a good understanding of the complexity and interdependence of a variety of environmental, economic and social factors linked to these issues. Furthermore, to develop the necessary abilities to analyse, synthesise, and assess information useful for the protection and the management of the environment as a whole, and of water resources in particular. The appropriate implementation of the material may eventually contribute to the adoption of positive behaviour and attitudes towards the conservation of water resources and the environment in general, and the adoption of values of respect for nature, tolerance, interdependence, synergy, collaboration and peace. Nevertheless, one of the most "ambitious" objectives of the package is for students to develop the skills of problem solving, to learn about "action strategies" in order to undertake environmental action, and to be involved in a gentle but active way to the endeavours related to sustainable development.

The package is comprised of two parts: theory and activities. The theoretical part covers issues from the evolution of life, the cycle of water and its properties, to modern uses and abuses of water, with an emphasis given to examples and case studies from the

Mediterranean countries. This part is addressed mainly to the educator to support his/her understanding on the abovementioned issues, as is necessary for teaching the material. Alternatively, it can be used also by the students themselves. The second part of the material contains 45 activities, divided in 10 thematic sections that aim to develop basic concepts related to water. Students are stimulated to discover the role of water in living organisms, water's unique properties, its cycle in nature, its importance in wetlands, its uses in agriculture and industry, as well as, the domestic ones. Furthermore, students are presented with challenging issues, such as the right of access to water, the maintenance of resources, and the conflicts over different uses and users/stakeholders. The complete list of contents of the theoretical and the activities part of the educational package is included in Annex 3.

It is a fact that the national educational curricula of the Mediterranean countries vary greatly, and this affects also the status of EE in each one of them (Filho, 1996; Giolitto, 1997; Stokes, 2001). Designing an educational material for the entire region that would match perfectly the school programmes of each and every Mediterranean country would have been an impossible task.

Therefore, this educational package was created in the context of not being necessarily an end in itself, but intended to serve mainly as a flexible corpus of material, open to educators' contributions and adjustments, in order to fit the topics and concepts of their national curriculum, or to address issues of particular importance in a given site. That is why formal and non-formal educators who may use it are encouraged to exploit their own knowledge and experience of the local community traditions and culture, geomorphology, biodiversity, economy, and so on, in order to add texture and to introduce a higher degree of relevance into their teaching. In other words, the package aims to facilitate educators to better plan and perform their own schemes of work.

"Water in the Mediterranean" can be used and integrated into a curriculum by using either the *Interdisciplinary Model* - when EE is implemented as a single school subject- or the *Multidisciplinary Model* - when EE is approached within the various complementary subjects. In the latter case it is expected that the material will be utilised at least in part, within the contexts of the various disciplines. Each one of the 45 activities could be used as a context for developing knowledge and understanding in several curriculum subjects, such as science, mathematics, sociology, history, literature and arts. Each activity, as a whole or parts of it, may be implemented in a number of subjects within the curriculum.

The 10 thematic sections of activities examine 10 different aspects of water. However, the successive sections and the activities included do not necessarily follow a logical sequence. In fact, a certain activity could be conducted in more than one section and in most cases it could be jointly implemented with relevant activities from other sections, depending on the objectives of a specific instruction or project. The educational package itself is in the form of a folder with separate activity sheets, so that the educators may attempt several combinations, depending on the aims of their instruction, their personal preferences and skills and the classrooms' needs. What is important is that this implementation, in many cases, implies the coordination and cooperation of two or more educators, with different scientific backgrounds.

In the following sub-sections we attempt to evaluate the educational material "Water in the Mediterranean" using both the NAAEE as well as the AASS criteria, listed in Annexes 2 and 1 respectively.

6A. Evaluation of "Water in the Mediterranean" using the NAAEE Guidelines for Excellence

The first characteristic of the NAAEE guidelines for evaluating EE materials which is about "*fairness and accuracy*" of the content is covered to a great extent by the water package, since a number of criteria are satisfied: the data included in the water package were drawn from current and verified primary and secondary sources of information. Additionally, a team of experts in the appropriate fields (professors, teachers, environmentalists) reviewed the various versions of the material and participated in its development (as explained in section 3A). This secured also the balanced presentation of differing viewpoints and theories. Furthermore, students are encouraged to explore different perspectives of certain issues through e.g. discussions with experts, contacting interviews, etc. The material includes activities for exploring personal and social values within the context of water issues, enabling an environment of respect for different opinions, through the inquiry activities for collecting and analyzing primary and secondary information and comparing it with similar data from the rest of the Mediterranean countries. Additionally, the material offers readings and additional resources e.g. case studies that present concepts and perspectives from the various Mediterranean cultures.

Regarding the second criterion on "*depth*", the package integrates certainly various issues and concepts relevant to water, such as the water cycle, pollution, wetland integrity, water demand and shortage, integrated water resources management, etc. These concepts are presented and "built" in a logical sequence and context in the appropriate thematic sections, and are highlighted in each activity in the relevant box of "key-words". Attention was paid for learners to be provided with opportunities to examine multiple perspectives on the issues studied, and to gain understanding of their complexity in terms of investigating the interrelationships between the environmental, social and economic aspects of the water issues and topics studied in the material. Additionally the authors have tried to link these concepts and to the experience of students and to the life of the community, as well.

As far as the third characteristic on "*building skills*" is concerned, the material provides students the opportunity to develop critical and creative thinking processes through e.g. forming models, using analogies, questioning, collecting-analyzing-synthesizing information, and drawing conclusions. In order to practice action skills, the package encourages students to develop their own solutions to issues and undertake action, mainly at local level, e.g. in school, neighbourhood, municipality, etc. In some cases, a list of organisations and further resources is provided for the students. Students are prompted to practice interpersonal and communication skills, including oral and written communication, group cooperation and conflict resolution.

Regarding the forth characteristic, the material encompasses an "*action orientation*" perspective, highlighting the sense of personal responsibility in certain issues (e.g. water consumption), and giving emphasis on the impact of the various types of behaviours, conveying the idea that many individual and, in most cases, daily actions have cumulative effects, both in creating and addressing environmental problems. Similarly, attention was given to strengthen students' self efficacy, that is, perception on their ability to influence the outcome of a situation: e.g. learners are challenged to apply their thinking, reflect and undertake decisions, act on their conclusions and they are repeatedly encouraged to communicate the results of their activities with their local community.

Coming to the fifth characteristic of the "*instructional soundness*", as we have already discussed the water package is based on a student-centered perspective, and it includes a range of educational methods for instruction. Many opportunities are provided for students to learn from expression and experience, e.g. using arts, literature, drama or

involving parents and the community in their actions and there are many links to their everyday lives. On the other hand, the material suggests a diverse environment beyond the classroom boundaries, including the school yard, laboratory, field settings, community and other settings. Additionally, according to Rickinson's review (2001), many surveys suggest that learning outcomes can be facilitated by certain educational processes (such as role modeling, direct experience outdoors, collaborative group discussion, etc.), all of which are included and elaborated in the package. On the other hand, extended discussion has been presented already on the concept of interdisciplinarity of the package, in section 3. In each activity there is clear indication on the disciplines integrated, and suggested tie-ins with other subject areas, e.g. science, social studies, arts, physical education, etc. Furthermore, in each activity the objectives for learner outcomes, classified under Bloom's taxonomy are clearly stated.

We have previously commented on the form of the educational material that was designed as a folder in order to be functional and have the maxim "*usability*" (sixth characteristic of NAAEE Guidelines). The grade level, disciplines and concepts covered, equipment and time needed, instructions, suggestions for assessment and follow up activities are clearly indicated. Finally, the material is adaptable to the needs of the class or teacher.

6B. Evaluation of "Water in the Mediterranean" using the AASS Criteria

Although we have explained that the AASS criteria are not sufficient for the designing of material for EE/ESD they were taken into account in order to elaborate and improve further basically the scientific part of the material. Examining the "Water in the Mediterranean" from the viewpoint of these criteria, one could say that this educational package fulfils most of them.

Firstly, in terms of providing a sense of purpose to students, apart from the general aims of the package that are presented in the introductory part, the specific objectives of each activity are presented in a clear and motivating way for the students, classified according to Bloom's taxonomy as *cognitive, psychomotor,* and *affective* (Bloom *et al.*, 1956).

Fostering comprehension in students requires knowing the ideas they already possess, especially when referring to the natural environment. It is important to take into account students' misconceptions, as well as their correct ideas that may serve as a foundation for subsequent learning. Although "Water in the Mediterranean" does not specify prerequisite knowledge or skills of students that are necessary before implementing a certain activity, the results of the relevant national research (briefly mentioned in section 4) were taken into account. That is why many activities include specific questions, tasks and/or metaphors aiming to reveal certain misconceptions and alternative ideas of students. The educational material urges repeatedly students to express, elaborate and, when necessary, reshape their ideas. It also provides a framework and guidance for the interpretation and reasoning of experiences they already have, while it also provides many opportunities for first hand experiences with phenomena including "indoor" activitie (e.g. experiments, models, etc.), as well as "outdoor" activities (e.g. field work, local community action, etc). As far as the indoor activities are concerned, in most cases, the necessary equipment is simple, cheap and easy to find, even for those who do not have the opportunity to use a school laboratory.

Finally and very briefly the very important issue of evaluation should be mentioned, which is a very crucial element for every educational activity. The sixth criterion of Project 2061 for the evaluation of science textbooks by the AAAS refers to the assessment of progress. There is no detailed assessment tests included in "Water in the Mediterranean". However, in the case of several activities, evaluation can be accomplished by certain

assessment tasks for students, that would require the application of their inquired ideas. Such tasks that are proposed but not presented in a scrutinising way in the package are, for example, diaries, portfolios, exhibitions, etc.

Currently, the modalities of assessment of such tasks, as well as, the forms for assessing teachers' feedback (questionnaire) are explored and under development, within the so-called MEdIES Initiative (*Mediterranean Education Initiative for Environment and Sustainability*). MEdIES is an Initiative based on educators' electronic network which is facilitated by its interactive web-page (www.medies.net). The educational package constitutes an essential component of MEdIES and it is available online for the members of the network already in four languages (English, French, Italian, and Greek).

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ANNEX 1: THE *AASS* CRITERIA FOR SCIENCE TEXTBOOKS

The following research-based criteria were developed for the evaluation of middle grades Science Textbooks by Project 2061, carried out by the American Association for the Advancement of Science (AAAS, 1993). These criteria are organised in seven categories, each one of which focuses on a specific aspect of instructional support.

I. *Providing a sense of purpose*: These criteria determine whether a certain curriculum material attempts to make its purposes explicit and meaningful to the students. An educational material should convey an overall sense of purpose and direction that is understandable and motivating to the students.
II. *Taking account of students' ideas*: Fostering understanding in students requires attending to the ideas they already have, both ideas that are incorrect (misconceptions) and ideas that can serve as a foundation for subsequent learning. It is important for an educational material to contain specific suggestions for identifying and addressing students' ideas.
III. *Engaging students with relevant phenomena*: The criteria in this category examine whether a material links and compares important scientific ideas to a range of relevant natural phenomena and provides either firsthand experiences about the phenomena or a vicarious sense of the phenomena that are not presented firsthand.
IV. *Developing and using scientific ideas:* These criteria are used to determine whether a material expresses and develops key ideas in ways that are acceptable and intelligible to students, and whether the application of these ideas may allow students to explain successfully various phenomena of their everyday life.
V. *Promoting students' thinking about phenomena, experiences and knowledge*: These criteria that are supplementary to III and IV, examine whether the material provides students with opportunities to express, clarify, justify and, if necessary, reshape their ideas.
VI. *Assessing progress*: These criteria examine whether the material includes a variety of aligned assessments that apply the key ideas taught in the material.
VII. *Enhancing the science learning environment*: The material should help teachers improve their understanding of the examined concepts and phenomena. These criteria also examine whether a material encourages curiosity and questioning from each student.

ANNEX 2: THE *NAAEE* GUIDELINES FOR EXCELLENCE

The following criteria "*Guidelines for Excellence - Key Characteristics for EE materials*" were developed by the North American Association for Environmental Education (NAAEE). "*Guidelines for Excellence"* points out six key characteristics of high quality environmental education materials. For each of these characteristics, there are listed some guidelines for environmental education materials to follow.

1. Fairness and Accuracy

Environmental education materials should be fair and accurate in describing environmental problems, issues, and conditions, and in reflecting the diversity of perspectives on them.

1.1) Factual accuracy: Environmental education materials should reflect sound theories and well-documented facts about subjects and issues.
1.2) Balanced presentation of differing viewpoints and theories: Where there are differences of opinion or competing scientific explanations, the range of perspectives should be presented in a balanced way.
1.3) Openness to inquiry: Materials should encourage learners to explore different perspectives and form their own opinions.
1.4) Reflection of diversity: Different cultures, races, genders, social groups, ages, etc., are included with respect and equity.

2. Depth

Environmental education materials should foster awareness of the natural and built environment, an understanding of environmental concepts, conditions, and issues, and an awareness of the feelings, values, attitudes, and perceptions at the heart of environmental issues, as appropriate for different developmental levels.

2.1) Awareness: Materials should acknowledge that feelings, experiences, and attitudes shape environmental perceptions and issues.
2.2) Focus on concepts: Rather than presenting a series of facts, materials should use unifying themes and important concepts.
2.3) Concepts in context: Environmental concepts should be set in a context that includes social and economic as well as ecological aspects.
2.4) Attention to different scales: Environmental issues should be explored using a variety of scales as appropriate, such as short to long time spans, localized to global effects, and local to international community levels.

3. Emphasis on Skills Building

Environmental education materials should build lifelong skills that enable learners to address environmental issues.

3.1) Critical and creative thinking: Learners should be challenged to use and improve their critical thinking and creative skills.
3.2) Applying skills to issues: Students should learn to arrive at their own conclusions about what needs to be done based on thorough research and study, rather than being taught that a certain course of action is best.
3.3) Action skills: Learners should gain basic skills needed to participate in resolving environmental issues.

4. Action Orientation

Environmental education materials should promote civic responsibility, encouraging learners to use their knowledge, personal skills, and assessments of environmental issues as a basis for environmental problem solving and action.

4.1) Sense of personal stake and responsibility: Materials should encourage learners to examine the possible consequences of their behaviors on the environment and evaluate choices they can make which may help resolve environmental issues.
4.2) Self-efficacy: Materials should aim to strengthen learners' perception of their ability to influence the outcome of a situation.

5. Instructional Soundness

Environmental education materials should rely on instructional techniques that create an effective learning environment.

5.1) Learner-centred instruction: When appropriate, learning should he based on learner interest and on the learner's ability to construct knowledge to gain conceptual understanding.
5.2) Different ways of learning: Materials should offer opportunities for different modes of teaching and learning.
5.3) Connection to learners' everyday lives: Materials should present information and ideas in a way that is relevant to learners.
5.4) Expanded learning environment: Students should learn in environments that extend beyond the boundaries of the classroom.
5.5) Interdisciplinary: The materials should recognize the interdisciplinary nature of environmental education.
5.6) Goals and objectives: Goals and objectives for the materials should be clearly spelled out.
5.7) Appropriateness for specific learning settings: Claims about the material's appropriateness for the targeted grade level(s) and the implementation of the activity should be consistent with the experience of educators.
5.8) Assessment: A variety of means for assessing learner progress should be included in the materials.

6. Usability

Environmental education materials should be well designed and easy to use.

6.1) Clarity and logic: The overall structure (purpose, direction, and logic of presentation) should be clear to educators and learners.
6.2) Easy to use: Materials should be inviting and easy to use.
6.3) Long-lived: Materials should have a life span that extends beyond one use.
6.4) Adaptable: Materials should be adaptable to a range of learning situations.
6.5) Accompanied by instruction and support: Additional support and instruction should be provided to meet educators' needs.
6.6) Make substantiated claims: Materials should accomplish what they claim to accomplish.

ANNEX 3: CONTENTS OF THE EDUCATIONAL PACKAGE "WATER IN THE MEDITERRANEAN"

Part I: Theory

WATER ON EARTH: The origin of life - All life depends on water - Water's distribution on earth - The hydrological cycle - Climate change - Water in our tradition

THE MEDITERRANEAN: Geographic setting - Geological characteristics & morphology - Climate & water circulation - Biological & chemical characteristics - Pollution

USES AND ABUSES: Water consumption - Agricultural use of water (*Reservoirs, dams and pumps; Implications of irrigation on soil; Chemistry in the service of agriculture; Desertification*) - Water and industry (*Technological alternatives and innovations)* - Domestic use of water (*Water transportation; Water storage; Water treatment; Water distribution – leakage; Wastewater treatment; Baths, soaps and detergents)* - Water and health issues for humans & ecosystems - Tools and Methods to deal with water problems *(IWRM; WFD)*

APPENDIXES: Environmental changes associated with dams - Water and Ecosystems

Part II: Activities

1. *WATER: ALWAYS PRESENT*: (a) Water: our common cradle, (b) Water present «everywhere»
2. *UNIQUE PROPERTIES OF WATER*: (a) The three «faces» (phases) of water, (b) Ice floats on water; (c) Water: the universal solvent, (d) Water: the carrier of nutrients in plants, (e) Water: the sink of heat
3. *THE STORY OF A DROP OF WATER: THE WATER CYCLE*: (a) The «portrait» of the water cycle, (b) Create a mini water cycle, (c) Modelling Mediterranean Sea, (d) The unequal distribution of water
4. *OUR DRINKING WATER*: (a) Where does drinking water come from?, (b) Filtration, (4c) Disinfection of water, (4d) Water treatment, (e) Water lost in the city, (f) Striving for water, (g) Sewage treatment
5. *WATER & HEALTH*: (a) Germs are happy in water, (b) Deadly water
6. *WATER IN OUR HOME*: (a) How much water did you use today?, (b) Water lost in our home, (c) Excess cleaning products in water, (d) A water vessel from the Mediterranean
7. *WATER, SOIL & AGRICULTURE*: (a) Is there growth without water?, (b) The quality and quantity of water determines plant growth, (c) Eutrophication, (d) Salinization, (e) Erosion and Desertification of land, (f) Role-playing game: «If I were a farmer...», (g) The action process: Adopt a tree
8. *WATER, ENERGY & INDUSTRIES*: (a) Let's make a water-mill, (b) Dams, (c) Hydroelectric plant, (d) Water & Industry
9. *WETLANDS*: (a) Visiting a Wetland, (b) Wetland Research, (c) Foam on water bodies, (d) Investigating a coastal zone, (e) Once upon a time..., (f) The action process: Adopt a stream, a pond or a shore
10. *INSETS*: The article: High and Dry, The action process, The Newspaper: Water, Conflicts and collaborations, Integrated Water Resources Management (IWRM)

ANNEX 4: SAMPLES OF ACTIVITIES

In the following pages, three of the activities of the educational package "Water in the Mediterranean" are displayed as a sample.

Create a mini water cycle

Natural cycles exist in a fragile balance, which are disturbed if any of their elements is disrupted. It is important to conserve our natural resources and to protect natural cycles by not being wasteful.

Activity

A simple experiment will demonstrate how the water cycle works.

Materials/Equipment

- large glass bowl
- small dish
- transparent membrane
- rubber band
- small stone
- food colouring

Procedure

1. Place the small dish in the middle of the large bowl.
2. Pour water into the large bowl, making sure that no water gets into the small dish.
3. Cover the large bowl with a the membrane - making sure that it is firmly in place and that it seals the top completely.
4. Place the small stone in the centre of the plastic «lid», directly above the small dish.
5. Leave the bowl in the sun for a few hours.
6. Add one drop of food colouring in the large bowl and repeat the whole procedure. What do you observe?

The heat from the sun will cause the water in the large bowl to evaporate and turn into water vapour, just like water from rivers, dams and the sea evaporates in nature.

This water vapour will rise towards the underside of the plastic «lid», where it will form droplets and run down towards the centre of the membrane. The water will then drip into the small dish, just as rain falls from clouds.

If one of the elements of your experiment were disturbed, the experiment would fail. Imagine what would happen if there were a hole in the plastic «lid»: a certain amount of the water vapour would not condense and would spread into the air.

If the water cycle purifies water, why is pollution a problem?

Objectives

- To describe the hydrological cycle. (C)
- To set up experimental apparatus. (P)
- To acquire the ability to generalise while working on a microscale level. (P,C)
- To realise that any intervention in one part of the cycle will influence the complete cycle. (P,C)
- To adopt positive attitude against pollution. (A)

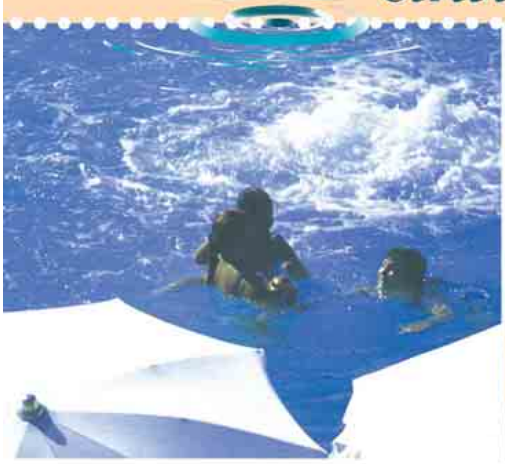
3b

2-3 hours

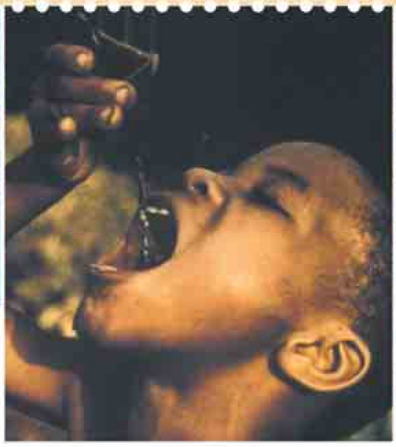
Physical Sciences (Physics), Life Sciences (Biology), Earth Sciences (Geography)

evaporation, condensation, human interventions in the hydrological cycle

Striving for water



It has been said that the degree of civilization, which humanity has achieved, can be measured by the amount of water consumption for domestic purposes. And yet, humanity actually faces tremendous water shortages in almost half of the planet. The most affected areas are the Middle East, the Sahel and North Africa.



Over 1 billion people lack access to minimum quantities of safe water.

Two thirds of the world population will be striving for water by 2025.

In desert and in semi-arid zones women invest valuable time and energy in the search for water.

Nearly 30% of the women in Egypt have to walk more than one hour a day, to reach the nearest water resource.

In Wayen and Burkina Faso, mothers walk daily for two or three hours to stagnant water holes 12 kilometres away, to return with only 25 litres of water carried on their head.

Activity

Use the pictures and the texts to start a discussion in class. Express your ideas and feelings towards the huge gap in water consumption between a child in a developed and a developing country. Try to analyse the consequences for the economy, social stability and peace as well as the impact on the state of the environment in both cases.
Collect information (from libraries, the Internet, etc.) on water consumption and water shortages in developed and developing countries.
Present your findings in class.
Suggest ways for a «wiser» model of water consumption throughout the world.

Objectives

((4f))

- To practise collecting data. (P)
- To comprehend the problem of water shortage in many parts of the planet. (C,A)
- To compare water consumption between developed and developing countries and analyse the consequences. (C,A)
- To gain an informed attitude towards conserving water. (A)
- To suggest ways for wiser models of water management in order to reduce the gaps between developed and developing countries. (C,A)

1-2 weeks

English, Earth Sciences (Geography), Social Studies, Economics

water consumption, water shortage, developed/ developing countries, sustainable management of water resources

Visiting a Wetland

Wetlands are areas which contain a lot of water but are not ponds or lakes. Wetlands such as **marshes**, **river deltas** and **coastal lagoons** are usually a refuge for many species of plants and animals. Usually, they nurture the region's fisheries while acting as «buffer» zones between water bodies of different properties e.g. riverine and marine waters. They prevent salinization and facilitate the cleansing of waters through natural processes such as biodegradation, flocculation, sedimentation and removal of nutrients and organics.

Materials/Equipment

((9a))

- measuring tape
- 4 poles
- pencils
- string
- millimetre paper

Procedure

1. Set your boundaries: mark the area you will work on, using string and poles. Make sure your marked area is representative of the total region.

EXAMINE THE FLORA

2. List the various types of trees and plants. For each species, measure the approximate height and note down their number in the table below:

h: tree = height

trees h>10m	trees 10<h<2m	trees h<2m

Objectives

- To participate in fieldwork. (P)
- To observe and discover the great variety of flora and fauna. (C,P)
- To practise collecting and classifying data in a scientific manner. (P)
- To practise drawing maps. (P)
- To comprehend and describe basic concepts referring to wetlands such as: flora, fauna, food chain. (C)
- To study and understand the delicate balance existing in an ecosystem. (C,P)
- To comprehend the importance of wetlands for natural water management. (C,A)
- To adopt a positive attitude towards protecting and conserving wetlands and their functions. (A)

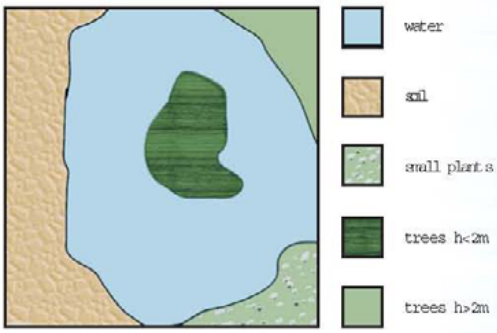
1 month

Life Sciences (Biology, Botany, Zoology), Earth Sciences (Geography), English, Arts, Maths

wetlands, marshes, river deltas, coastal lagoons, flora, fauna, food chain, biodiversity, ecosystem

Visiting a Wetland

3. Use the millimetre paper to record the coverage percentage of your area. See the example below.



((9a))

EXAMINE THE FAUNA

4. Identify and record the type and number of species of insects, reptiles or animals you come across. Make a list.

SET UP A WETLAND ROLE-PLAYING GAME

Collect information about the food chain and the interaction among the species you examined. Remember that some species are by far more vulnerable than others to enemies or pollution. Identify them using information from books and discussions with biologists-ecologists.

Set up a wetland role-playing game, in which each student represents one of the species you examined.

Use your imagination... The following questions may help you with your scenario:

- What happens when a particular species increases in number? How do the other species react?
- What happens when a species vanishes? Who profits?
- What happens when fresh water decreases dramatically?
- What happens when water gets slightly polluted?
- What happens when water gets severely polluted?

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