



WATERWORLD adventure

LEARNING APPROACH

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Index

1	<i>The Ocean and The Ocean Literacy</i>	3
2	<i>Research on Ocean Literacy</i>	4
3	<i>The Essential Principles</i>	6
4	<i>The Fundamental Concepts</i>	7
4.1	The Earth has one big ocean with many features	7
4.2	The ocean and life in the ocean shape the features of Earth	8
4.3	The ocean is a major influence on weather and climate.....	9
4.4	The ocean made Earth habitable.....	10
4.5	The ocean supports a great diversity of life and ecosystems.....	10
4.6	The ocean and humans are inextricably interconnected	11
4.7	The ocean is largely unexplored	12
5	<i>The Fundamental Concepts for Pre-Schoolers</i>	14
6	<i>The Ocean Literacy Framework and Campaign</i>	22
7	<i>From USA to Europe</i>	24
8	<i>The case of Portugal</i>	25
9	<i>The use of digital children stories for promoting Ocean Literacy</i>	26
10	<i>Participatory Digital Ocean Communities</i>	28
11	<i>References</i>	29

Index of Tables

Table 1: The fundamental concepts for pre-schoolers.....	14
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1 THE OCEAN AND THE OCEAN LITERACY

According to Ocean Literacy (2013) the term ‘ocean literacy’ focuses on an understanding of the ocean’s influence on people and people’s influence on the ocean. An ocean-literate person understands the Essential Principles and Fundamental Concepts about the ocean; can communicate about the ocean in a meaningful way and is able to make informed and responsible decisions regarding the ocean and its resources.

By the term ‘The Ocean’ is defined the whole of the five interconnected ocean basins, namely: the Atlantic, Pacific, Indian, Arctic and Southern, which make up the only ocean in our solar system. The ocean contains totally 97 % of Earth’s water. It has been proved through many different scientific approaches that life in earth exists because of the ocean and of course depends on it. For this reason people and especially young generations’ awareness concerning the ocean is an urgent need for our future existence.

2 RESEARCH ON OCEAN LITERACY

The educational research on ocean and aquatic literature is limited and this is a main reason that the public has low knowledge and awareness of the concepts and environmental issues pertaining to ocean and aquatic ecosystems (The Ocean Project 2009). The literature review about understanding of ocean sciences concepts leads to researches as that of Brody and Koch (1990, in Tran, L., Payne, D. and Whitley, L., 2010: 22) who reported that more than 86% of the students they studied (elementary, middle, and high school students) did not know concepts essential to understanding ocean science and ocean resources.

In 1998, The Ocean Project carried out a research, using focus groups, and a national telephone survey (n=1500) in order to investigate the public knowledge level on ocean issues. Among the main findings of the research were perceptions and attitudes such as: the ocean is viewed as powerful, vast, relaxing, and fun; little awareness exists of ocean health, especially beyond the beach; protecting the oceans is seen as important but not urgent; while they have only superficial knowledge of the oceans and their functions, Americans strongly agree that the health of the oceans is essential to human survival (The Ocean Project, 2015).

In 2008 the Ocean Project, in collaboration with other partners organized a new research, with a bigger sample than the previous one (22,000 responses obtained primarily online) focusing on Ocean Literacy. The results were not encouraging, as the survey showed that most of the top five findings from the previous (1999) research still held true. While the public continued to express awe and appreciation for the ocean, they still had little awareness (let alone knowledge) of the ocean or the issues affecting ocean health, and still did not appear to see a strong need for ocean conservation (The Ocean Project, 2015).

The most recent round of same the research of the Ocean Project (with a sample of over 11,000 respondents) was carried out in 2014 through online, telephone and in-person surveys. Among the main findings of that research is that the public remains inspired by the ocean. While people feel that they are well informed about environmental issues (gradually increased since 2008), they remain largely unaware

of actual ocean issues. Most people are unwilling to accept that the ocean as a whole is in trouble, and most still do not make the link between climate change and the oceans. Increasingly, people recognize that climate change is an important issue, but they still tend to see it as more of a long-term and distant problem. The public remains interested in being “green.” People are especially keen on the idea of teaching the youngest generations’ ways to be “green,” and see taking a child to an aquarium or zoo as a way to give that child an advantage in their academic development (The Ocean Project, 2015).

Another research focusing on Ocean Literacy, this time carried out in South Africa (Ballantyne, 2004; in Tran, L., Payne, D. and Whitley, L., 2010: 22), found that students had difficulties understanding ocean concepts, such as sources of salinity, wave propagation, and human impacts.

3 THE ESSENTIAL PRINCIPLES

As it is concluded in the researches mentioned above most people have limited understanding of the ocean. Of course it is not easy for everybody to understand the complex function of the ocean. That is why the role of education is especially significant as it can create the convenient context and opportunities in order to allow students from all school grades to approach the ocean both through knowledge and feelings. For doing this is essential the enrichment of school curriculum with dimensions of ocean literacy, the production of appropriate educational material for different ages and mainly the teachers training on ocean literacy. According to Ocean Literacy (2013:3) ‘engaging learners in experiences focused on the ocean helps them build personal connection to the ocean, coasts and Great Lakes that motivate them to become ocean literate and to act on behalf of the ocean’.

The Ocean Literacy (2013) focuses on the Essential Principles and the Fundamental Concepts about the Ocean which are proposed to be understood by the end of high school by all students. The Essential Principles are seven and they are:

1. The Earth has one big ocean with many features.
2. The Ocean and life in the ocean shape the feature of Earth.
3. The Ocean is a major influence in weather and climate.
4. The Ocean made Earth habitable.
5. The Ocean supports a great diversity of life and ecosystems
6. The Ocean and humans are inextricably interconnected
7. The ocean is largely unexplored.

The seven principles are supported and explained by 45 Fundamental Concepts which describe in details the dimensions of every principle.

4 THE FUNDAMENTAL CONCEPTS

Following are presented the Essential Principles and the Fundamental Concepts for each of them as they are written in Ocean Literacy (2013):

4.1 The Earth has one big ocean with many features

a. The ocean is the defining physical feature on our planet Earth—covering approximately 70% of the planet’s surface. There is one ocean with many ocean basins, such as the North Pacific, South Pacific, North Atlantic, South Atlantic, Indian, Southern, and Arctic.

b. Ocean basins are composed of the seafloor and all of its geological features (such as islands, trenches, mid-ocean ridges, and rift valleys) and vary in size, shape and features due to the movement of Earth’s crust (lithosphere). Earth’s highest peaks, deepest valleys and flattest plains are all in the ocean.

c. Throughout the ocean there is one interconnected circulation system powered by wind, tides, the force of Earth’s rotation (Coriolis Effect), the Sun and water density differences. The shape of ocean basins and adjacent land masses influence the path of circulation. This “global ocean conveyor belt” moves water throughout all of the ocean basins, transporting energy (heat), matter, and organisms around the ocean. Changes in ocean circulation have a large impact on the climate and cause changes in ecosystems.

d. Sea level is the average height of the ocean relative to the land, taking into account the differences caused by tides. Sea level changes as plate tectonics cause the volume of ocean basins and the height of the land to change. It changes as ice caps on land melt or grow. It also changes as sea water expands and contracts when ocean water warms and cools.

e. Most of Earth’s water (97%) is in the ocean. Seawater has unique properties. It is salty, its freezing point is slightly lower than fresh water, its density is slightly

higher, its electrical conductivity is much higher, and it is slightly basic. Balance of pH is vital for the health of marine ecosystems, and important in controlling the rate at which the ocean will absorb and buffer changes in atmospheric carbon dioxide.

f. The ocean is an integral part of the water cycle and is connected to all of Earth's water reservoirs via evaporation and precipitation processes.

g. The ocean is connected to major lakes, watersheds, and waterways because all major watersheds on Earth drain to the ocean. Rivers and streams transport nutrients, salts, sediments, and pollutants from watersheds to coastal estuaries and to the ocean.

h. Although the ocean is large, it is finite, and resources are limited.

4.2 The ocean and life in the ocean shape the features of Earth

a. Many earth materials and biogeochemical cycles originate in the ocean. Many of the sedimentary rocks now exposed on land were formed in the ocean. Ocean life laid down the vast volume of siliceous and carbonate rocks.

b. Sea level changes over time have expanded and contracted continental shelves, created and destroyed inland seas, and shaped the surface of land.

c. Erosion—the wearing away of rock, soil and other biotic and abiotic earth materials—occurs in coastal areas as wind, waves, and currents in rivers and the ocean, and the processes associated with plate tectonics move sediments. Most beach sand (tiny bits of animals, plants, rocks, and minerals) is eroded from land sources and carried to the coast by rivers; sand is also eroded from coastal sources by surf. Sand is redistributed seasonally by waves and coastal currents.

d. The ocean is the largest reservoir of rapidly cycling carbon on Earth. Many organisms use carbon dissolved in the ocean to form shells, other skeletal parts, and coral reefs.

e. Tectonic activity, sea level changes, and the force of waves influence the physical structure and landforms of the coast.

4.3 The ocean is a major influence on weather and climate

- a. The interaction of oceanic and atmospheric processes controls weather and climate by dominating the Earth's energy, water, and carbon systems.
- b. The ocean moderates global weather and climate by absorbing most of the solar radiation reaching Earth. Heat exchange between the ocean and atmosphere drives the water cycle and oceanic and atmospheric circulation.
- c. Heat exchange between the ocean and atmosphere can result in dramatic global and regional weather phenomena, impacting patterns of rain and drought. Significant examples include the El Niño Southern Oscillation and La Niña, which cause important changes in global weather patterns because they alter the sea surface temperature patterns in the Pacific.
- d. Condensation of water that evaporated from warm seas provides the energy for hurricanes and cyclones. Most rain that falls on land originally evaporated from the tropical ocean.
- e. The ocean dominates Earth's carbon cycle. Half of the primary productivity on Earth takes place in the sunlit layers of the ocean. The ocean absorbs roughly half of all carbon dioxide and methane that are added to the atmosphere.
- f. The ocean has had, and will continue to have, a significant influence on climate change by absorbing, storing, and moving heat, carbon, and water. Changes in the ocean's circulation have produced large, abrupt changes in climate during the last 50,000 years.
- g. Changes in the ocean-atmosphere system can result in changes to the climate that in turn, cause further changes to the ocean and atmosphere. These interactions have dramatic physical, chemical, biological, economic, and social consequences.

4.4 The ocean made Earth habitable

- a.** Most of the oxygen in the atmosphere originally came from the activities of photosynthetic organisms in the ocean. This accumulation of oxygen in Earth's atmosphere was necessary for life to develop and be sustained on land.
- b.** The ocean is the cradle of life; the earliest evidence of life is found in the ocean. The millions of different species of organisms on Earth today are related by descent from common ancestors that evolved in the ocean and continue to evolve today.
- c.** The ocean provided and continues to provide water, oxygen, and nutrients, and moderates the climate needed for life to exist on Earth (Essential Principles 1, 3, and 5).

4.5 The ocean supports a great diversity of life and ecosystems

- a.** Ocean life ranges in size from the smallest living things, microbes, to the largest animal on Earth, blue whales.
- b.** Most of the organisms and biomass in the ocean are microbes, which are the basis of all ocean food webs. Microbes are the most important primary producers in the ocean. They have extremely fast growth rates and life cycles, and produce a huge amount of the carbon and oxygen on Earth.
- c.** Most of the major groups that exist on Earth are found exclusively in the ocean and the diversity of major groups of organisms is much greater in the ocean than on land.
- d.** Ocean biology provides many unique examples of life cycles, adaptations, and important relationships among organisms (symbiosis, predator-prey dynamics, and energy transfer) that do not occur on land.
- e.** The ocean provides a vast living space with diverse and unique ecosystems from the surface through the water column and down to, and below, the seafloor. Most of the living space on Earth is in the ocean.

f. Ocean ecosystems are defined by environmental factors and the community of organisms living there. Ocean life is not evenly distributed through time or space due to differences in abiotic factors such as oxygen, salinity, temperature, pH, light, nutrients, pressure, substrate, and circulation. A few regions of the ocean support the most abundant life on Earth, while most of the ocean does not support much life.

g. There are deep ocean ecosystems that are independent of energy from sunlight and photosynthetic organisms. Hydrothermal vents, submarine hot springs, and methane cold seeps, rely only on chemical energy and chemosynthetic organisms to support life.

h. Tides, waves, predation, substrate, and/or other factors cause vertical zonation patterns along the coast; density, pressure, and light levels cause vertical zonation patterns in the open ocean. Zonation patterns influence organisms' distribution and diversity.

i. Estuaries provide important and productive nursery areas for many marine and aquatic species.

4.6 The ocean and humans are inextricably interconnected

a. The ocean affects every human life. It supplies freshwater (most rain comes from the ocean) and nearly all Earth's oxygen. The ocean moderates the Earth's climate, influences our weather, and affects human health.

b. The ocean provides food, medicines, and mineral and energy resources. It supports jobs and national economies, serves as a highway for transportation of goods and people, and plays a role in national security.

c. The ocean is a source of inspiration, recreation, rejuvenation, and discovery. It is also an important element in the heritage of many cultures.

d. Humans affect the ocean in a variety of ways. Laws, regulations, and resource management affect what is taken out and put into the ocean. Human development

and activity leads to pollution (point source, nonpoint source, and noise pollution), changes to ocean chemistry (ocean acidification), and physical modifications (changes to beaches, shores, and rivers). In addition, humans have removed most of the large vertebrates from the ocean.

e. Changes in ocean temperature and pH due to human activities can affect the survival of some organisms and impact biological diversity (coral bleaching due to increased temperature and inhibition of shell formation due to ocean acidification).

f. Much of the world's population lives in coastal areas. Coastal regions are susceptible to natural hazards (tsunamis, hurricanes, cyclones, sea level change, and storm surges).

g. Everyone is responsible for caring for the ocean. The ocean sustains life on Earth and humans must live in ways that sustain the ocean. Individual and collective actions are needed to effectively manage ocean resources for all.

4.7 The ocean is largely unexplored

a. The ocean is the largest unexplored place on Earth—less than 5% of it has been explored. The next generation of explorers and researchers will find great opportunities for discovery, innovation, and investigation.

b. Understanding the ocean is more than a matter of curiosity. Exploration, experimentation, and discovery are required to better understand ocean systems and processes. Our very survival hinges upon it.

c. Over the last 50 years, use of ocean resources has increased significantly; the future sustainability of ocean resources depends on our understanding of those resources and their potential.

d. New technologies, sensors, and tools are expanding our ability to explore the ocean. Scientists are relying more and more on satellites, drifters, buoys, subsea observatories, and unmanned submersibles.

e. Use of mathematical models is an essential part of understanding the ocean system. Models help us understand the complexity of the ocean and its interactions with Earth's interior, atmosphere, climate, and land masses.

f. Ocean exploration is truly interdisciplinary. It requires close collaboration among biologists, chemists, climatologists, computer programmers, engineers, geologists, meteorologists, physicists, animators, and illustrators. And these interactions foster new ideas and new perspectives for inquiries.

5 THE FUNDAMENTAL CONCEPTS FOR PRE-SCHOOLERS

In the following tablets are presented the fundamental concepts of Ocean Literacy which could be approached for pre-schoolers. They are divided in two different age groups: 3-5 and 5-6 years old.

Table 1 – The fundamental concepts for pre-schoolers

Principles	Fundamental concepts								
	a	b	c	d	e	f	g	h	i
1. The Earth has one big ocean with many features	x	x			x				
2. The ocean and life in the ocean shape the features of the Earth					x				
3. The ocean is a major influence on climate									
4. The ocean makes Earth habitable									
5. The ocean supports a great diversity of life and ecosystems	x	x	x		x			x	
6. The ocean and humans are inextricably interconnected		x			x	x			
7. The ocean is largely unexplored									

Principle	1. The Earth has one big ocean with many features
Fundamental concepts	a. The ocean is the defining physical feature on our planet Earth—covering approximately 70% of the planet’s surface. There is one ocean with many ocean basins, such as the North Pacific, South Pacific, North Atlantic, South Atlantic, Indian, Southern and Arctic.
Notions	The Ocean covers most of the Earth’s surface. The different parts of the Ocean have different names and are

	connected between them.
Goal 3-5 years old	Goal 1: The child identifies on the map the oceans and their features.
	Goal 2: The child recognises on a graphical representation of the Earth, the land parts.
	Goal 3: The child identifies elements from the aquatic environment.
Goal 5-6 years old	Goal 4: The child recognises that simplified maps are representations of the reality.
	Goal 5: The child recognises different ways of representing Earth and identifies, in those representations, some places
	Goal 6: The child identifies elements from the natural environment (e.g. water courses, orographic accidents...).

Principle	1. The Earth has one big ocean with many features
Fundamental concepts	b. Ocean basins are composed of the seafloor and all of its geological features (such as islands, trenches, mid-ocean ridges and rift valleys) and vary in size , shape and features due to the movement of Earth's crust (lithosphere)
Notions	The ocean floor has orographic features similar to those found in other parts of the planet that are not covered by water. The ocean floor has plains, valleys, mountains and volcanoes.
Goal 3-5 years old	Goal 1: The child identifies on the map the oceans and their features.
	Goal 2: The child recognizes on a graphical representation of the Earth, the land parts.
	Goal 3: The child identifies elements from the aquatic environment.
Goal 5-6 years old	Goal 4: The child recognizes that simplified maps are representations of the reality.
	Goal 5: The child recognizes different ways of representing Earth and identifies, in those representations, some places
	Goal 6: The child identifies elements from the natural environment (e.g. water courses, orographic accidents...).

Principle	1. The Earth has one big ocean with many features
Fundamental concepts	e. Most of Earth's water (97%) is in the ocean. Seawater has unique properties: it is saline, its freezing point is slightly lower than fresh water, its density is slightly higher, its electrical conductivity is much higher, and it is slightly basic. The salt in seawater comes from eroding land, volcanic emissions, reactions at the seafloor, and atmospheric deposition
Notions	Most part of the water in the Earth is on the ocean

Goal 3-5 years old	Ocean water has unique properties; the ocean water is salty
	Goal 1: The child identifies on the map the oceans and their features.
	Goal 2: The child recognizes on a graphical representation of the Earth, the land parts.
	Goal 3: The child identifies elements from the aquatic environment.
Goal 5-6 years old	Goal 4: The child describes the simple physical properties of a variety of everyday materials.
	Goal 5: The child recognizes that simplified maps are representations of the reality
	Goal 6: The child recognizes different ways of representing Earth and identifies, in those representations, some places
	Goal 7: The child identifies elements from the natural environment (e.g. water courses, orographic accidents...).
	Goal 8: The child establishes similarities and differences between materials and between materials and objects, according to simple properties (colour, smell, taste...)

Principle	2. The ocean and life in the ocean shape the features of the Earth
Fundamental concepts	e. Sand consists of tiny bits of animals, plants, rocks and minerals. Most beach sand is eroded from land sources and carried to the coast by rivers, but sand is also eroded from coastal sources by surf. Sand is redistributed by waves and coastal currents seasonally.
Notions	The waves can reach the coast, resulting in changes to its shape. The action of moving water is able to break rocks, sea-shells, coral, plants and other materials, turning them into sand.
Goal 3-5 years old	Goal 1: The child identifies elements from the aquatic environment.
	Goal 2: The child describes the simple physical properties of a variety of everyday materials.
	Goal 3: The child identifies and names a variety of everyday materials.
Goal 5-6 years old	Goal 4: The child identifies elements from the natural environment (e.g. water courses, orographic accidents...).
	Goal 5: The child establishes similarities and differences between materials and between materials and objects, according to simple properties (colour, smell, taste...)
	Goal 6: The child identifies the origin of certain materials of daily use (e.g. animal, vegetal, mineral)

Principle	5. The ocean supports a great diversity of life and ecosystems
Fundamental concepts	a. The ocean is three-dimensional, thus provides a vast living space with diverse and unique ecosystems from the surface through the water column and down to, and below, the seafloor. Most of the living space on Earth is in the ocean.
Notions	The ocean has a great variety of unique ecosystems where organisms live. These unique ecosystems can be found in different ocean areas (coast, high waters, surface, different depths, etc.)
Goal 3-5 years old	Goal.1: The child identifies elements from the aquatic environment.
Goal 5-6 years old	Goal 2: The child identifies elements from the natural (e.g. orographic accidents, rocks, water lines, etc.) and social environment (e.g. constructions, services, communication, routes etc.).

Principle	5. The ocean supports a great diversity of life and ecosystems
Fundamental concepts	b. Most of the major groups that exist on Earth are found exclusively in the ocean and the diversity of major groups of organisms is much greater in the ocean than on land.
Notions	There is a great variety of organisms in the ocean. There is a larger variety of organisms in the ocean than in other dry areas of the planet. Some of these organisms exist only on the ocean.
Goal 3-5 years old	Goal 1: The child identifies elements from the aquatic environment.
	Goal 2: The child identifies and names a variety of animals in their habitats, and groups them by their habitats.
	Goal 3: The child identifies the basic structure of a variety of animals.
Goal 5-6 years old	Goal 4: The child identifies elements from the natural (e.g. orographic accidents, rocks, water lines, etc.) and social environment (e.g. constructions, services, communication, routes etc.).
	Goal 5: The child verifies that animals have particular characteristics and that they can be grouped according to different criteria (e.g. coating, reproduction, locomotion, ...)
	Goal 6: The child identifies the different parts of the different types of animals and recognizes some aspects of their characteristics and way of life (e.g. ants, snails, crabs ...)

Principle	5. The ocean supports a great diversity of life and ecosystems
Fundamental concepts	c. Ocean life ranges in size from the smallest living things, microbes, to the largest animal that has lived on Earth, blue whales.
Notions	There is a great variety of organisms in the ocean. Life in the ocean varies from to smallest organisms on Earth to the larger animal on the planet.
Goal 3-5 years old	Goal 1: The child identifies elements from the aquatic environment.
	Goal 2: The child identifies and names a variety of animals in their habitats, and groups them by their habitats.
	Goal 3: The child identifies the basic structure of a variety of animals.
Goal 5-6 years old	Goal 4: The child identifies elements from the natural (e.g. orographic accidents, rocks, water lines, etc.) and social environment (e.g. constructions, services, communication, routes etc.).
	Goal 5: The child verifies that animals have particular characteristics and that they can be grouped according to different criteria (e.g. coating, reproduction, locomotion, ...)
	Goal 6: The child identifies the different parts of the different types of animals and recognizes some aspects of their characteristics and way of life (e.g. ants, snails, crabs, ...)

Principle	5. The ocean supports a great diversity of life and ecosystems
Fundamental concepts	e. Ocean ecosystems are defined by environmental factors. Ocean life is not evenly distributed through time or space due to differences in abiotic factors such as oxygen, salinity, temperature, pH, light, nutrients, pressure, substrate and circulation. A few regions of the ocean support the most abundant life on Earth, while most of the ocean does not support much life.
Notions	The ocean has a great variety of unique ecosystems where organisms live. These unique ecosystems can be found in different ocean areas (coast, high waters, surface, different depths, etc.)
	There is a great variety of organisms in the ocean. Life in the ocean varies from to smallest organisms on Earth to the larger animal on the planet.
Goal 3-5 years old	Goal 1: The child identifies elements from the aquatic environment.

	<p>Goal 2: The child identifies and describes the basic needs of humans, necessary for their survival.</p> <p>Goal 3: The child identifies and names a variety of animals in their habitats, and groups them by their habitats.</p> <p>Goal 4: The child identifies the basic structure of a variety of animals.</p>
Goal 5-6 years old	<p>Goal 5: The child identifies elements from the natural (e.g. orographic accidents, rocks, water lines, etc.) and social environment (e.g. constructions, services, communication, routes etc.).</p> <p>Goal 6: The child recognizes that the human being has physiologic necessities (e.g. thirst, hunger, rest...), security (shelter and protection), social, esteem, self-accomplishment, and that it goes through a process of growth and development that explain similarities and differences to other living things on Earth.</p> <p>Goal 7: The child verifies that animals have particular characteristics and that they can be grouped according to different criteria (e.g. coating, reproduction, locomotion, ...)</p> <p>Goal 8: The child identifies the different parts of the different types of animals and recognizes some aspects of their characteristics and way of life (e.g. ants, snails, crabs, ...)</p>

Principle	5. The ocean supports a great diversity of life and ecosystems
Fundamental concepts	h. Ocean biology provides many unique examples of life cycles, adaptations and important relationships among organisms (symbiosis, predator-prey dynamics, and energy transfer) that do not occur on land.
Notions	Organisms in the ocean show a variety of structures and behaviours that allow them to live (adapt) in that environment. The organisms live in different ecosystems in the ocean
Goal 3-5 years old	<p>Goal 1: The child identifies and describes the basic needs of humans, necessary for their survival.</p> <p>Goal 2: The child identifies and names a variety of animals in their habitats, and groups them by their habitats.</p> <p>Goal 3: The child identifies the basic structure of a variety of animals.</p>
Goal 5-6 years old	<p>Goal 4: The child recognizes that the human being has physiologic necessities (e.g. thirst, hunger, rest...), security (shelter and protection), social, esteem, self-accomplishment, and that it goes through a process of growth and development that explain similarities and differences to other living things on Earth.</p> <p>Goal 5: The child verifies that animals have particular</p>

	<p>characteristics and that they can be grouped according to different criteria (e.g. coating, reproduction, locomotion ...)</p> <p>Goal 6: The child identifies the different parts of the different types of animals and recognizes some aspects of their characteristics and way of life (e.g. ants, snails, crabs ...)</p>
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Principle	6. The ocean and humans are inextricably interconnected
Fundamental concepts	b. The ocean provides foods, medicines, and mineral and energy resources. It supports jobs and national economies, serves as a highway for transportation of goods and people, and plays a role in national security.
Notions	Human being benefit from the ocean. The ocean is provides much of the food we eat, it's the largest source of water in the water cycle, also providing water for the rain that is useful for plants and animals. The ocean is also a source for leisure activities.
Goal 3-5 years old	Goal 1: The child identifies the benefits that the environment gives to people.
Goal 5-6 years old	Goal 2: The child shows concern with the nature and environment preservation, identifying some good practices.

Principle	6. The ocean and humans are inextricably interconnected
Fundamental concepts	e. Humans affect the ocean in a variety of ways. Laws, regulations and resource management affect what is taken out and put into the ocean. Human development and activity leads to pollution and to physical modifications in beaches, shores and rivers.
Notions	People live in different areas on Earth, but most live by the ocean. Human beings have an impact on the ocean, and human activities can change the beaches and coastal areas, rivers, etc.
Goal 3-5 years old	<p>Goal 1: The child identifies activities developed by human for environmental care and protection.</p> <p>Goal 2: The child identifies the benefits that the environment gives to people.</p>
Goal 5-6 years old	Goal 3: The child is able to describe the importance of domestic waste sorting, identifying materials to deposit in each different waste container. .
	Goal 4: The child shows concern with the nature and environment preservation, identifying some good practices.

Principle	6. The ocean and humans are inextricably interconnected
Fundamental concepts	f. Coastal regions are susceptible to natural hazards (tsunamis, hurricanes, cyclones, sea level change, and storm surges).
Notions	People inhabit in much different areas on Earth, but the majority lives close to the ocean. Living close to the ocean has advantages, but has also risks with storms, etc.
Goal 3-5 years old	Goal 1: The child identifies a variety of changes on the environment.
Goal 5-6 years old	Goal 2: The child is able to identify sequences of life cycles of different phenomena related to daily life (e.g. state of the weather).

6 THE OCEAN LITERACY FRAMEWORK AND CAMPAIGN

One of the major associations focusing on the Ocean literature is the National Marine Educators Association (NMEA). In co-operation with other organizations as the National Science Teachers Association, NMEA brings together professionals with backgrounds in education, science, business, government, museums, aquariums, and marine research, among others. The NMEA's actions brought together people interested in the study and enjoyment of the world of water. In 2004, concerned by the lack of public awareness about the importance of the ocean and the absence of ocean topics in the U.S.A. science curriculum, the NMEA lead an Ocean Literacy Campaign. As it is described by Schoedinger, S., Tran, L.U. and Whitley, L. (2010: 3) the Ocean Literacy Campaign is 'a wide-ranging, collaborative and de-centralized effort by scientists and educators to create a more ocean literate society'. An important component of the Campaign is the education of K-12 students in ocean sciences. For the need of the Ocean Literacy Campaign were written two documents:

1. *Ocean Literacy: The Essential Principles of Ocean Sciences K-12*
2. *Ocean Literacy Scope and Sequence for Grades K-12*

These documents are known as the Ocean Literacy Framework. They provide educators, administrators, stakeholders and curriculum designers with all the essential elements that help them support the appropriate teaching and learning experiences for students from Kindergarten through 12th grade. According to Schoedinger, S., Tran, L.U. and Whitley, L. (2010) The Ocean Literacy Principles and the Ocean Literacy Scope and Sequence, is the first consensus set of documents to identify, articulate, and organize the core concepts of ocean sciences for educational purposes. The Ocean Literacy Scope and Sequence for Grades K-12 is an instructional tool that supports a systems approach for teaching and learning about the ocean. The conceptual flow diagrams for each principle guide users (including educators, curriculum and program developers, administrators etc) through a potential teaching and learning sequence. The ordering and building of these ideas across grade bands within each Ocean Literacy Principle illustrates how student

thinking can be scaffold from one developmental level to the next (Tran, L., Payne, D. and Whitley, L., 2010: 24).

The Ocean Literacy Framework helped educators to move the ocean topics from the margins to the center of science teaching and learning processes. Also, the documents helped teachers to approach the ocean literacy not only in the context of teaching science but and other disciplines in an integrated manner.

As Halversen and Tran (2010) underline, the Ocean Literacy Campaign worked as a vehicle where educators and scientists co-operated in order to promote ocean literacy among the public. They created a community of practice toward goals and purposes for disseminating the ocean literacy principles and creating an ocean literate populace. The vehicle for succeeding this is education, both formal and informal. Halversen and Tran (2010: 19) present the main principles for growing a community of practice among ocean scientists and educators on which the results of Ocean Literacy Campaign was based.

1. Draw on existing relationships and connections, and ask colleagues to contact their colleagues to join in the effort as well. It is helpful to select partners who have shared values, goals, and/or ideologies.
2. Think of knowledge and tools as assets to be shared, and that these can be built on and revised by the community. Encourage ownership of these assets among all the members of the community.
3. Cultivate mutual respect by encouraging a culture of honesty, open dialogue, careful listening and recognizing distributed expertise.
4. Define goals and processes clearly and, very importantly, have a shared activity around which all partners can do meaningful work together toward those goals.

7 FROM USA TO EUROPE

Although the important work on the ocean literacy has been done in USA, only very recently this concept has travelled across the Atlantic, with some organizations and research and education platforms trying to extend the effort initiated in the US to Europe. Ocean Literacy in Europe is low, as it is widely recognized in documents from official organizations as the European Marine Science Educators Association. According to them a more informed and concerned public will better understand the need to manage ocean resources and marine ecosystems in a sustainable way and indeed an ocean literate person is able to make informed and responsible decisions regarding the ocean and its resources (European Marine Science Educators Association, 2013: 3). The position paper of the European Marine Board “Navigating the Future IV” which outlines the most important marine thematic research priorities for Europe (2012-16) clearly states the urge for a European Consensus on Ocean Literacy.

Despite the fact that Ocean Literacy is a political priority to the EU, little has been done to improve Ocean Literacy for European citizens. The first Conference on Ocean Literacy in Europe was only held 2012 (now an annual event) and, with few exceptions (e.g. Portugal), Ocean Literacy topics are not present in European schools’ curricula.

8 THE CASE OF PORTUGAL

Portugal was the first European country to embrace the need to act with respect to ocean literacy, putting together the project ‘Knowing the Ocean’ intends to stimulate the citizens’ involvement with the ocean.

This initiative included the adaptation of the Ocean Literacy Framework developed in the US to different learning levels of the Portuguese school curriculum.

The project was led by Ciência Viva¹ and resulted from a wide consultation with scientific and educational entities and identified seven Main Principles about the Ocean.

Knowing the Ocean offers:

- Essential knowledge about marine sciences, adapted to the school curriculum;
- Educational Resources about the Ocean adapted to each learning level;
- Basic information on Portuguese Public Marine Policies;
- Basic information on research related to the Sea made in Portugal.

(Knowing the Ocean poster:

http://www.cienciaviva.pt/oceano/home/principiosematriz_posterA2.pdf)

Additionally, Ciência Viva offers courses for teachers in ocean related topics and promotes events and other initiatives on the ocean, like road shows, science cafes, etc.

¹ Ciência Viva is a national agency for the promotion of initiatives for the public awareness of Science and Technology in Portugal, whose associate bodies include public institutions and research laboratories. <http://www.cienciaviva.pt/home/>

9 THE USE OF DIGITAL CHILDREN STORIES FOR PROMOTING OCEAN LITERACY

According to the constructivism theories, children construct knowledge based on their own experiences (Choi & Ho, 2002). However, since knowledge is actively constructed by the learner, the teaching learning procedure ought to facilitate children re-approach their knowledge in their own way that is through procedures and practices which are meaningful for the students themselves (Estes, Gutman & Estes, 1989). Approaching knowledge about the ocean within such a frame, leads to the connection of the meaning of ocean literacy to that of critical literacy, as defined by Stables et al. (1999), which is the ability of the creation of individual interpretation and reflection for each message, and not just its passive acceptance. This process helps children to acquire a deeper knowledge on ocean issues which could transform the attitude of the passive person to an environmentally active young citizen.

In order ocean literacy to be promoted the choice of proper tools and means obtains special significance within an educational project. Besides the classical ways of teaching and learning ocean literacy could be promoted through digital literacy, since this approach constitutes an attractive way of learning especially for new generations. The frame created through the different digital tools, as internet, e-books etc, gives the children a great wealth of opportunities for environmental and cultural exchange. According to NAYEC (1996: 2) by access to the Internet or other on-line “user friendly” networks and resources, young children can not only acquire new knowledge but also collaborate with children in other classrooms, cities and even countries.

In the frame of digital literature the using of the appropriate children stories can enhance and enrich their respect for environment. When a child reads or listens to a story narrated by a person who has a deep knowledge and experience on environmental issues, it has the chance to enter a new field of experiences through, as Barton & Booth (1990) underlines, by becoming a part of the story. Stories written for children are mainly a fictional narrative, which contains a series of

successive episodes. Stories for children help them to learn new things in many different subjects and to choose new attitudes both politically and ecologically correct. At the same time they get an active attitude towards life, as the stories heroes usually do. Stories educate children in respecting both the natural and the human environment and the others and at the same time in accepting human and ecological values that do not change in time and place. Among these, the development of respect for Nature and Man has a great position, as it is an element often met in many stories. The development of respect is one of the most important goals of education, as it constitutes a necessary feature not only in order for the members of each society to coexist harmoniously but also for the harmonious coexistence between people and environment. Stories help children to familiarize with the environment and with the “other”, discover biological and cultural diversity around them and ascertain the many different dimensions of people’s life.

One of the main proposals to the teachers of Conference on Ocean Literacy which was held in 2006 in Aquarium of the Pacific, Long Beach, California was to become storytellers. This means to “make the ocean more personal and create a sense of excitement by telling stories about marine animals, biodiversity, shifting baselines, and climate change so as to create a better understanding of the individual’s role in nature” (Summary of Conference on Ocean Literacy, 2006)

10 PARTICIPATORY DIGITAL OCEAN COMMUNITIES

Using digital narrations about the ocean, new means which contribute to the promotion of ocean literacy are created. Digital storytelling is one of these means, which can be used very effectively in the education of young children. According to Tingoy et al. (2005) digital stories derive their power by weaving images, music, narrative and voice together, thereby giving deep dimension and vivid colour to characters, situations, experiences and insights. In addition to this, digital storytelling provides rich teachable moments in regards to helping students become more literate in diverse subjects. The study of the ocean could be one of the subjects.

Using digital ocean literacy children can also create digital “ocean communities”. Through them children can discuss, collaborate and share ideas, experiences and feelings about the ocean. When children exchange knowledge and information with groups of other children by using the multimedia, strong emotional bonds can be created among various groups as well as greater understanding (Komlodi et al., 2005). Moreover, according to Lemke (1998), participation in new communities means participation in new social practices, which can lead to the transformation of perception and attitudes concerning environmental and other practices. In this way through digital communities and exchange the young participants create a ‘participatory culture’ (Jenkins, 2006). A participatory ocean culture could broadly not only promote the awareness of children on ocean issues but also could motivate them to transform the role of the passive person to an active ocean ecologist.

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