MED
EDUC

Pedagological refecence for educators

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The MED EDUC project is developed with the support of ERASMUS + from the European Commission. It is made up of an pedagogical guide, an activity guide, and an online resource center. Proposed activities are tested in class and are the subject of a training workshop.

The project is led by an educational center specializing in the environment: the CPIE Bastia - U marinu (France). The project also brings together two colleges and high schools in Mediterranean Europe (Giuseppe Garibaldi Institute in Italy and Osnovna škola Pučšiča in Croatia), two cooperative companies, one engaged in local development and heritage enhancement (MEDORO in Italy), the other in economic development linked to maritime and coastal activities (CDE Petra Patrimonia in France), a public research center in the field of the sea (HCMR in Greece) and finally a local authority developing missions to support activities environmental education in schools (Consell Insular de Mallorca in Spain).

Pedagogical references for educators was written by:

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CDE Petra Patrimonia – France
Helenic Centre for Marine Research – Greece
Consell Insular de Mallorca – Spain
Istituto Giuseppe Garibaldi – Italy
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PEDAGOGICAL FRAMEWORK

The Mediterranean Sea is an invaluable natural and economic resource in Europe and Africa, mainly for habitants living along the coast. Currently, students learn from textbooks or multimedia. Field activities are not common during school education. Thus, Mediterranean students have not the opportunity to gain additional familiarity with the marine environment. An analysis of the school curricula showed that some schools include subjects related to marine environments in their programs, but with inconsistence and discontinuity. This kind of approach makes difficult to consider the environment as a real and immediate life content, which impacts student's daily life and / or future. By analysing the distribution of individual content, in the curricula of all partner countries, we noticed that grouping the content and presenting it more clearly to teachers and educators would be easier for them to teach and for students to learn about the Mediterranean Sea and the littoral life. Therefore, we propose to look at these issues through the following sub-topics:

1. **Waste and pollution**
2. **Seawater quality**
3. **Coastline artificialization**
4. **Energy: production and resources**
5. **Martime Economy**
6. **Politics and governance**
7. **Cultural heritage**
8. **Natural Hazards in the Mediterranean Bassin**
9. **Biodiversity**
10. **Climate change**

Each topic can be addressed through one or more school disciplines, multidisciplinary or not, to students of different ages (11-17 years). The scope of the topic is determined by key concepts. As all topics are global, key concepts help to be focused on a major problem. These concepts are often integral component of a particular school discipline (Science, Geography, Physics, Chemistry, History, Art, etc.), but they can be also used in processing tools of other disciplines (Mathematics, Mother tongue, Foreign language, ICT, etc.). In this way, multiple school disciplines connect in multidisciplinary teaching, as recommended by recent pedagogical theories.

This Pedagogical framework, and the Educational Activities Guide, will facilitate the teaching and students will be able to establish a connection with their environment and to:

a) Understand the coexistence needed between the society and the marine environment throughout history and in the present;

b) Understand the knowledge needed to sustain the marine management;

c) Learn about the marine environment and the need to coexist with it;

d) Learn and understand the phenomena in the environment that result from the degradation of marine resources

(natural and economic);

e) Learn and understand the consequences of the degradation of the marine environment;

f) Understand the need to change the humans' habits and behaviour to protect the sea and its coast.

Our lifestyle and our engagement in a sustainable management of marine resources affect the visibility and recognition of the Mediterranean customs, skills and products that need to be understood and preserved.

The pedagogical material produced through this project is intended for teachers and educators who are open to innovative teaching models based on experiential and holistic learning.

The purpose of such teaching / learning is to:

- Connect the students to the environment;

- Strengthen students' motivation for learning and better understanding of teaching content;

- Link educational activities to real life;

- Provide students a specific knowledge about the marine environment that is otherwise not sufficiently represented in the school curricula of the Mediterranean countries;

- Encourage the development of student competences;

- Prepare students for responsible citizenship and coexistence with the sea.

TABLE DES MATIÈRES

INTRODUCTION

The Mediterranean Sea is located at the cross-roads of civilizations and accounts for 7% of the world population. This region is made up with varied economic, political and cultural characteristics. The Mediterranean Sea is also a 'hot spot' of biodiversity. It represents 8% of the world biodiversity and less than 1% of the ocean surface.

The Mediterranean Sea is connected to the Atlantic Ocean but it is considered to be a complete different water body. It is surrounded by the Mediterranean Basin which consists of Southern Europe, West Asia and North Africa. With some 2.5 million km² and a length of 3,860 km, it is the second largest inland sea in the world almost entirely enclosed by land. It is a relatively deep sea with an average depth of 1,500 m, with its deepest point being the Calypso Trench (West Greece in the Ionian Sea). Its waters bathe three peninsulas in Southern Europe: Iberian Peninsula, Italian Peninsula and Balkan Peninsula, as well as one in Asia (Anatolia). It is connected with the Atlantic Ocean through the Strait of Gibraltar, with the Black Sea through straits of the Bosphorus and the Dardanelles, and with the Red Sea through the Suez Canal. It has warm waters with the typical Mediterranean climate (according to the Köppen climate classification system there are six characteristic climates: Mediterranean, arid, tropical, continental, temperate and polar).

Concerning the population, the Mediterranean Basin has a large number of inhabitants and the coast is characterized by a high demographic density compared to the inland.

There are now about 400 million people living along the Mediterranean coast and their environmental impact on the ecosystems and the biodiversity species is very important. Water shortages and desertification are serious problems in most of the Mediterranean countries. Moreover, the rapid population growth and the spread of mechanized agriculture have driven to the replacement of biodiversity riendly means of cultivation with more intensive land management systems. Many existing and proposed protected areas suffer from pollution and water shortages. The establishment of reserves, promoting the sustainable use of land and resources, has proved successful in some areas where state authorities recognize their value.

The history of the Mediterranean region is an interaction between the various cultures that populate its coastal areas. The sea was the main transport route for commercial and cultural exchanges before the arrival of railroads and air transport.

The so-called Mediterranean civilisations are manifested in a largely common Mediterranean culture spanning over deep political and religious differences. In our contemporary era, this unity of culture and civilisation is affected by globalisation.

The Mediterranean Sea has been one of the most important mankind seas because it is not very deep and has few currents which facilitates the navigation. Its shores have a temperate climate with hot and dry summers and winters with enough frost and rainfalls for agriculture. Additionally, the islands are not far from the continental territories facilitating the contact between inhabitants as well as the transfer of goods and economic flows since the ancient times.

Nowadays, the highly industrialised Northern regions contrast with the Southern areas that are essentially agricultural in character. The well-being of the Mediterranean Sea and its coast is affected by activities that are causing pollution to the marine environment. 80% of the harm done to the Mediterranean Sea comes from the land-based sources of pollution. This affects the regional resources needed for both human beings and a large variety of marine organisms.

Moreover, the excessive pressure of the international sea-borne trade in the Mediterranean Sea impacts significantly the marine environment, such as water borne diseases. This is due to the introduction of harmful aquatic organisms including human pathogens, and ads up to the already known shipping issues like CO2 emissions, and substances causing indirect pollution incidents.

Finally, another extremely important threat posed to the Mediterranean comes from the impact of unrestrained development and the lack of its management.

Globalization is a source of many benefits but also of concerns about: the environmental impact of our linear economy (buy-consummate-throw), our unsustainable dependence on many natural resources, our ecological footprint that exceeds earth capacity, an environmental impact outsourced to the poorest countries, and the unequal distribution of social and ecological benefits that globalization can bring. In fact, the idea of what is living within the limits of our planet is something that is difficult to understand.

However, it is obvious that some systems have to be completely rethought as sea-borne trade, coastal development, energy and food. Opportunities and challenges are huge. They require a common aim, commitments, splits, efforts, ethics and investments on. Many decisions have to be taken today to offer a sustainable societal project to our students.

Part 1 – Thematic Chapters

Waste and Pollution

Topic summary:

This chapter deals with various environmental problems encountered in the Mediterranean Basin due to the impacts of pollution in terrestrial and marine ecosystems.

Main concepts covered:

* Plastic waste
* Shipping pollution
* Spillage – sewage
* Nutrient pollution

Transversal competences acquired:

* Communicating orally / writting in mother/foreign language
* Managing information
* Getting organized and planning
* Mobilizing reasoning

Definition of key notions:

Spillage:

In industrial pollution, it is the loss of production output due to production of a serie of defective or unacceptable products which must be rejected.

Sewage:

Is a type of wastewater that is produced by a community of people. It is characterized by volume or rate of flow, the physical condition, the chemical and toxic constituents, and its bacteriologic status.

Nutrient pollution:

Is the process where too many nutrients, mainly nitrogen and phosphorus, are added to bodies of water and can act like fertilizer, causing excessive growth of algae.

Eutrophication:

Is when a body of water becomes overly enriched with minerals and nutrients which induce excessive growth of algae.

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Introduction of the topic:

The well-being of the Mediterranean Sea and its coast is affected by activities causing pollution to the marine environment and the regional resources needed for both human beings and a large variety of marine organisms 80% of the pollution in the Mediterranean Sea comes from the inland. Moreover, the excessive international sea-borne trade has significant pressures to the marine environment of the region, such as water borne diseases. This is due to the introduction of harmful aquatic organisms including human pathogens, and ads up to the already known shipping issues like CO2 emissions, and substances causing indirect pollution incidents. Finally, another extremely important threat comes from the impact of the unrestrained development and the lack of management in the Mediterranean Sea.

To enable students to understand and learn about the impacts of pollution in the Mediterranean Basin, a series of themes are presented below. These themes refer to the various types of pollution that the Mediterranean region is facing as well as other issues relevant to the pollution prevention.

The student will be able to communicate more effectively about pollution issues such as soil, water, air pollution, pollution from plastics, pressures from nutrients, waste and oil spills, pollution prevention and treatment, etc.

Sustainable development issues identified in this topic:

Environmental pollution with its health impacts is a key issue for sustainable environment. Healthy oceans are productive oceans, and resilient marine and coastal ecosystems are essential to achieve sustainable development.

1. Industrial waste and oil Spills

During the high season (from May to September), and mainly as a result of intense tourism, the Mediterranean coastlines and beaches present 250,000 pieces of rubbish per day per square kilometre. This amount increases to 316,000 pieces of rubbish per day per square kilometre during July and August, to be compared with an average of 81,000 pieces per day during low season (EFEVERDE, 2018).

It is estimated that 80% of marine contamination originates on land, and 20% comes straight from direct discharges into the sea. The main land-based sources of waste are refuse from unprocessed water and storms. More precisely they are residue from landfills located near the coast or transported through waterways, and rubbish left behind by residents and tourists.

When the waste comes from sources of discharges and spills at sea, the main source is dumping from vessels (merchant vessels, ferries, cruise ships, recreational boats, fishing boats etc.) and oil platforms.

Furthermore, abandoned fishing gear is particularly damaging, such as pieces of drift nets, long lines, and so on.

Eutrophication is a process driven by enrichment of water by nutrients, especially compounds of nitrogen and/or phosphorus. It leads to: an increased growth of primary production and biomass of algae; changes in the balance of nutrients causing changes in the balance of organisms; and the water quality degradation. Seawaters depending on nutrient loading and phytoplankton growth are classified according to their level of eutrophication. Low nutrient/ phytoplankton levels characterize oligotrophic areas; water enriched in nutrients is characterized as mesotrophic; whereas water rich in nutrients and algal biomass is characterized as eutrophic. The Mediterranean is one of the most oligotrophic seas in the world and most of its biological productivity takes place in the euphotic zone (UNEP, 1989, UNEP/MAP, 2012).

Over the last period of time, countries throughout the world have experienced an intensive trend in problems associated with Harmful Algal Blooms (HABs) commonly known as “red tides”. Such impact mainly comes from anthropogenic inputs (for EU waters) or from upwelling of nutrients (U.S. waters), both of them being associated with eutrophication phenomena (Anderson et al., 2002, Smayda, 1989, 1990). Eutrophication has two modes of ecosystem impact, primary and secondary, with the impacts of nutrient disturbance further influenced by other habitat conditions (Smayda, 2004). Direct effect of nitrification influences phytoplankton (abundance and species) and the indirect effect impacts the upper trophic level. Impacts include: mass mortalities of wild and farmed fish and shellfish; human illness and death from contaminated fish or shellfish; death of marine mammals, seabirds, and other animals; and the alteration of marine habitats or trophic structure (EU-USA Scientific Initiative on Harmful Algal Blooms). HABs species despite being able to be resistant to a large range of grazing, they are still influenced by high nutrient input (eutrophication). The most important areas in marine ecosystems are the coastal ones where pollutants are released in huge amounts often without any

control or adequate treatment. The points that need to be considered especially in the Mediterranean waters are parameters such as high temperatures, small tidal regimes, eutrophication, primary production (phosphate limited waters), freshwater inputs (limited water exchange), biodiversity, and anthropogenic pressure (tourists) (Smayda, 1989). All these parameters make the Mediterranean Sea susceptible to anthropogenically induced substances.

2. Plastics waste

The Mediterranean Sea is the cradle of civilization and one of the most culturally diversified places on Earth. It is also characterized by one of the highest rates of plastic contamination found worldwide.

In the Mediterranean Sea, plastic accounts for 95% of waste found in the open sea, on the seabed and on the beaches. This amount of rubbish mainly comes from Turkey and Spain, followed by Italy, Egypt and France.

Even if the Mediterranean Sea only represents 1% of the water on the planet, it is a semi-enclosed sea that supports a large amount of human activity. As a result, it becomes a trap for plastic and holds 7% of all the microplastics present in the world (according to the WWF).

Larger pieces of plastic damage, choke and kill marine animals, including protected species and those near extinction, such as sea turtles. However, microplastics, being much smaller and treacherous, have reached a record level in the Mediterranean Sea. The concentration of microplastics is at least four times as high as in the rubbish island located in Northern Pacific. As these fragments enter into the food chain, they become a threat for an ever-increasing number of species as well as human beings.

These minuscule microplastics are ingested by fish and other organisms being later consumed by humans. On average, it is estimated that a European might eat some 11,000 pieces of microplastics in one year.

Finally, plastic is not biodegradable and consequently it remains in the environment for millions of years. Thus, this issue is considered as a global emergency.

3. Shipping and pollution in ports

Speaking of the global maritime transport, statistics on the international fleet state that there are about 100,000 vessels in 45,000 harbours around the world. This generates 900 million tons of CO2 emissions, corresponding to those of 200 coal-fired power plants – nearly 7% of the total CO2 emissions. However, they also emit SOx (sulphur oxide), NOx (nitrogen oxide) and particles into the atmosphere, substances that are highly toxic for the public health and dangerous for the environment.

Ships are the main producers of sulphur emissions, as they come from fuel. In fact, during the last 20 years they have produced more than twice the amount of greenhouse gases derived from airplanes. A study from ANSA revealed that air pollution produced by ships is responsible for the death of 6,000 people every year, while causing environmental damage (which is fatal in many cases). Adding to this, it is also responsible for the deterioration of our cultural heritage as it accelerates the acidification process.

Contamination of water in harbours and on the seabed, is caused by debris and oily sludge (heavy metals, petroleum hydrocarbons, nutrients, bacteria, chemical matter etc.) produced around ships at berth, repair and maintenance areas, loading and unloading areas, and so on.

Moreover, we also need to be take into account vibrations and noises associated with port works, such as boat engines running, shipyard activities, loading and unloading docks, among others. This creates an environment not hospitable and unpleasant for employees working there and the nearby residents. There is also to consider the traffic surrounding the harbours, apart from the high noise level which characterizes them.

Another big problem concerns the large cruise ships. They generate an enormous amount of solid waste to be added to the emissions mentioned previously.

The international legislation on the treatment and disposal of these wastes barely regulates the activities of cruise ships. That means that tonnes of waste end up in the ocean waters. Cruise ships can dump various kinds of organic waste and untreated waters when they are more than four miles from the coast.

Position of the topic in the school program:

	11	12	13	14	15	16	17
Mother / Foreign language / Litterature							
History							
Geography		X	X				
Mathematics							
Biology / Geology		X	X	X	X	X	
Physic / Chemistry		X	X	X			
Social Science / Economy / Law						X	X
Art / Musics							
Technology / Computer science							

Ressources:

- Mediterranean plastic report-LR.pdf: https://archivo-es.greenpeace.org/espana/Global/espana/2017/documentos/oceanos/Mediterranean%20plastic%20report-LR.pdf
- https://archivo-es.greenpeace.org/espana/Global/espana/2017/documentos/oceanos/Mediterranean%20plastic%20report-engLR.pdf
- Cruise ships: https://www.transportenvironment.org/what-we-do/shipping-and-environment/cruise-ships
- Reportaje: Vertidos rutinarios de hidrocarburos: https://eu.oceana.org/es/eu/prensa-e-informes/reportajes/vertidos-de-hidrocarburos

Seawater Quality

Topic summary:

This chapter deals with water quality issues and description of tools to assess the water status through monitoring of key parameters. The impact of the water quality is related to marine food, water sports and bathing issues.

Main concepts covered:

* Rapid investigation of water quality
* Key Parameters of the aquatic status
* Parameters affecting water quality

Transversal competencies acquired:

* Communicating orally / writting in mother/foreign language
* Managing information
* Mobilizing reasoning
* Mobilizing computer / digital skills

Definition of key notions:

Salinity of seawater:

Is the percentage of salty materials per thousand in a water solution.

Estuary:

Is the zone where freshwater of rivers is mixed with the coastal waters.

Beach:

Is narrow strip of land along a body of water where waves surge.

Turbidity:

Is the total suspended solids in the water.

pH:

Is a scale to specify how acidic or basic a water solution is.

Dissolved Oxygen (DO):

Refers to the level of free oxygen present in a water solution.

Nitrates and phosphates:

Are the nutrients contents in water.

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Introduction of the topic:

The Mediterranean Basin comprises a set of coastal and marine ecosystems that provides benefits to all coastal inhabitants. The Mediterranean Sea is relatively a small sea with limited exchange with the oceanic basins. The region enclosing the Mediterranean Sea is made up of the following parts: Europe and its Southern peninsulas to North, South-western Asia to the East, and Maghreb in Northern Africa to the South. Today 21 countries, with surface areas from 2 km2 to 2.4 million km2, have coastlines along the Mediterranean Sea. The Mediterranean Sea is the source of many harvested resources, as well as the conveyor line for trade. In order to analyse the environmental issues that affect the Mediterranean Sea including the coastal ecosystems, it is important to better understand the natural characteristics and to have an overview of its major drivers. Water quality is subject of investigation in the Mediterranean Sea due to the concentration of population along the coast and the economic activities (industry included).

Geography

A general overview of the physical geography of the Mediterranean region reveals an irregular, deeply indented coastline. Numerous islands correspond to isolated tectonic blocks, the summits of submarine ridges and the undersea volcanoes. The largest islands are Sicily, Sardinia, Corsica, Cyprus, and Crete, and the major island groups include the Balearics off the coast of Spain and the Ionian, Cyclades, and Dodecanese islands of Greece. Apart from the coastal plains and the deltaic zones of large rivers (Ebro, Rhone, Po and Nile), the coastlines are mostly rimmed by mountain ranges. Only the coastal plains from Eastern Tunisia to the Sinai Peninsula, bordered mainly by low-lying desert, are free of mountains. The basin expands up to 2.6 million km² with an average depth of 1,460m, and a maximum depth of 5,267m. The Mediterranean has narrow continental shelves and a large area of open sea. Therefore, a large part of the Mediterranean Basin can be classified as deep sea and includes some unusual features, such as variation of temperatures from 12.8°C–13.5°C in the Western basin to 13.5°C–15.5°C in the Eastern, and high salinity of 37.5–39.5 psu.

Social

Human needs water for many uses, not only for drinking. Water constitutes 50 to 90% of the weight of all living organisms and it is one of the most abundant and important substances on Earth. Easy to measure, the water quality parameters are the salinity and the temperature, the dissolved oxygen and pH which directly indicate how hospitable a body of water is to aquatic life. The combination of the values of these parameters supports significantly the method of assessing water quality. Typical questions could be: Are dissolved oxygen levels depended on the temperature of the water? Is pH levels affected by rain or snowmelt? How pH affects alkalinity? Developing a database of water measurements and corresponding know-how will allow us to answer the questions.

Sustainable development issues identified in this topic:

The issues raised by the proposed theme are given below:

a. Environmental Processes: The Hydrologic Cycle

b. Marine pollution

c. Parameters for water quality

d. Healthy Beaches – bathing areas

e. Marine life, food security

1. Environmental Processes: The Hydrologic Cycle

Water continually circulates between atmosphere and Earth surface and this water circulation is called the hydrologic or the water cycle. Water sources from oceans, rivers, lakes, soils and vegetation evaporates into the air and becomes water vapor. Then, the water vapor subsequently rises into the atmosphere to become clouds, cools, and it lately turns into liquid water or ice. Successively, water or ice droplets become larger and they fall back to the Earth surface. Part of the water infiltrates into the soil and is absorbed by plants or percolates downward to the groundwater reservoirs. The rest of the water, it runs off into streams, rivers and oceans. Part of this water evaporates and goes back to the atmosphere.

2. Marine pollution

At the current time, there is a continuous deterioration of coastal waters because of the pollution and ocean acidification which have an adverse effect on the quality of ecosystems. Marine protected areas need to be effectively managed and well-resourced and regulations need to be put in place to reduce marine pollution. Pollution can result from various discharges, litter, sources within the coastal watersheds as well as from products of various industrial activities (fertilizer, mining, oil, cement, etc.). The pollution may be produced from combined sewer overflows (CSOs), stormwater, trash and litter, fertilizers, pesticides, boat and sailing boat discharges, nitrates and phosphates, gases and metals.

Virtually, all the ocean areas in the world are affected by pollution. Pollution harms life in the sea, threatens human health and livelihoods, and reduces the availability of clean and healthy seafood.

Marine pollution is causing major ecological shifts, serious losses of biodiversity and reduced commercial yields. The amount of plastic litter in the ocean is rapidly increasing; wastewater is outflowing into the ocean resulting in areas without oxygen. Contaminants, such as heavy metals and radionuclides, directly affect the health of millions of people, or bacterial loads in coastal waters, because of their accumulation through the food chain. There are large areas of the ocean with an abundance of marine life and significant progress has been made in reducing the levels of some harmful substances. The diminution of nutrient inputs at coastal areas diminished the organic pollution. The implementation of good agriculture practices permit to an overall reduction of organic chemical inputs. However, action is needed to reduce pollution.

The typical parameters for assessing the water quality are fecal coliform (FC) bacteria, temperature (T),

salinity (S), pH, Turbidity (Tu), Dissolved Oxygen (DO), Phosphates (P) and Nitrates (N). They are regularly measured. The committed reference levels of nitrates and phosphate that will not cause eutrophication are 0.01-0.06 mg/L and 0.001-0.010 mg/L, respectively. However, the key worldwide monitored parameters of the water quality is the fecal coliform bacteria and the permitted level is less than 1 FC/100 ml of water. A very interesting task is the monitoring of the bathing waters quality since it is subject to a short term pollution. Short term pollution is caused when heavy rainfall or high tides wash fecal material into the sea from livestock, sewage and urban drainage through adjacent streams and river outputs. In such cases, the risk of having reduced water quality increases after rainfall and the aquatic system returns to reference values after 1-3 days. Furthermore, long term pollution is caused through the anthropogenic activities that may affect the water quality by the movement of the water masses.

3. Parameters for water quality (except T, S)

Dissolved oxygen

Dissolved oxygen is a natural impurity inwater. Marine life is strongly depended on the concentration of DO into the water. Fishes and zooplankton they feed on, breathe the oxygen molecules dissolved in the water. Dissolved oxygen levels below 3 mg/L are stressful to most aquatic organisms.

pH

pH is a measure of the acid content of water and it influences most of water chemical processes. Pure water with no impurities has a pH of 7. Also, water with impurities will have a pH of 7 when its acid and base content are equal. At pH values below 7 there is excess acid. At pH levels above 7 there is excess base.

Electrical conductivity

Pure water is a poor conductor of electricity. It is the ionic (charged) impurities in water, such as dissolved salts, that enable water to conduct electricity. Electrical conductivity is the measurement of the water passage in an electrical field. The more the water contains dissolved materials, the greater its electrical conductivity is.

Nitrate

There are three main nutrients sources for monitoring in both fresh and saline waters: carbon, nitrogen and phosphorus. Carbon is relatively abundant in the air as carbon dioxide. Carbon dioxide dissolves in water and so a lack of either nitrogen or phosphorus generally limits the growth of aquatic plants. Nitrogen exists in water bodies in numerous forms: dissolved molecular nitrogen (N2), organic compounds, ammonium (NH4+), nitrite (NO2) and nitrate (NO3).

4. Healthy beaches – bathing areas

Most of people live near coastal zone and many of them close to the beach. Some of them visit the beach for pleasure. The concentration of population has a significant effect on the health of the beaches (on land as well as in seawater). Pollution degrades and destroys unique beach habitat used by animals and plants. Polluted beaches are a public health risk. They can reduce existing property values and inhibit economic growth of the surrounding community.

5. Marine life, food security

Seafood is a major global food source which makes the oceans valuable for the global fish food. One billion people, largely in the developing countries, rely on seafood. Furthermore, millions of jobs around the world depend on fisheries, aquaculture and their global markets. Seafood is the most traded food commodity in the world, and an integral part of many people's livelihoods. However, marine pollution and habitat degradation are putting fish stocks under stress. The global food security, including the valuable commercial species and the marine ecosystems, are disappearing and impact negatively the quality of the seafood.

Position of the topic in the school program:

	11	12	13	14	15	16	17
Mother / Foreign language / Litterature							
History							
Geography	X	X	X				
Mathematics							
Biology / Geology	X	X	X	X	X	X	
Physic / Chemistry							
Social Science / Economy / Law						X	X
Art / Musics	X	X					
Technology / Computer science		X	X	X	X	X	

Ressources:

- Environmental Protection Agency, EPA

https://www.epa.ie/pubs/advice/water/quality/Water_Quality.pdf

- FONDRIEST Environmental Products:

https://www.fondriest.com/environmental-measurements/parameters/water-quality/

Coastline artificialization

Topic summary:

The Mediterranean coast is a rich environment (biological and mineral natural resources, human, cultural and historical), attractive (landscapes, biodiversity, climatic conditions) and accessible (multi services and multi activities). This space is particularly coveted and highly exposed to risks. It is the seat of many vital issues

Main concepts covered:

* Urbanisation
* Concretization
* Littoralization
* Resiliency
* Integrated coastal zone management (ICZM)

Transversal competencies acquired:

* Communicating orally / writting in mother/foreign language
* Managing information
* Mobilizing reasoning
* Respecting a framework and instructions.
* Knowing how to adapt according to difficulties

Definition of key notions:

Urbanisation:
Phenomenon of mass population concentration in cities.

Artificialization:
Suppression of the natural state of a man-made surface. It results in the loss of natural resources and the waterproofing of soils.

Concretization:
Action to modify a soil to make it artificial. Construction of buildings and residences on the coasts.

Littoralization:
Population growth along coastal regions in fragile environment and limited space.

Resiliency:
Ability of a set to withstand forces that tend to decompose it. In this way, destabilizing, dangerous events can be overcome.

Integrated coastal zone management (ICZM):
A tool for governance of coastal territories for sustainable development.

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Introduction of the topic:

The distribution of the population between Mediterranean countries of the European Union (EU) and the countries of Southern and Eastern Mediterranean has changed considerably since the 1960s and has increased in recent years. Indeed, the overall population growth is associated with a significant increase in the urban population from 48% in 1960 to 67% in 2010. Most of this urbanisation occurred along the coasts (DSDS 2016-2025).

In order to meet economic and tourist demands, coastal cities face excessive land consumption with an irreversible impact on natural areas, groundwater, biodiversity and built cultural heritage. They are subject to artificialization, tourism as well as recreational activities (holiday homes, hotels and campsites multiply, often located near the seaside). Coastal municipalities tend to spread out. Some of the urban activities are dispersed in the neighbouring countryside thus forming artificial peri-urban spaces. Agricultural and natural environments are mostly replaced or fragmented by artificial and concrete surfaces (warehouses, businesses, shops, ports and marinas) leading to an increase in the waterproofing of the soils, faster than the residential use. The same applies to artificial surfaces dedicated to transport infrastructures.

Artificial soils cover all areas that support human activity (except agriculture and forestry): cities, housing, economic activities and transport networks. To this pressure on the natural environment are added the pollution generated by the population density (production of waste, energy dependencies) and new housing constructions. These pollutions cause negative impacts on the health and the environment in general. In addition, the participation of residents in urban planning decision-making remains low in many municipalities.

This increasing linear coastal urbanisation leads to an inadequate protection and management of land areas and urban sprawl (illegal constructions, gentrification of the coasts, unlimited tourist development). The ecological footprint of Mediterranean coastal cities is still too large. They are insufficiently resilient in their ability to deal with natural or human hazards and risks (DSDS 2016-2025).

Sustainable development issues identified in this topic:

What are the pressures caused by the artificialization of Mediterranean coastal municipalities? How do we plan and manage sustainable Mediterranean cities?

Sectorial approaches, conflicts of interest, economic development to the detriment of environmental protection, changing demands of societal demand (modes and quality of life, heliotropism), multiple regulations (business and environmental management).

As urbanisation progresses in Mediterranean and particularly on the South shore, this phenomenon continues the transformation of land with losses and irreversible damage, yet, the coastal municipalities are not managed in a sustainable way and are insufficiently resilient. "Population on Europe's coasts is constantly increasing, sometimes faster than in inland areas. Coasts are converted to manmade artificial surfaces at an even faster pace. There is a need to develop more information to better understand what is happening with built up areas and city planning in Europe and to establish some thresholds and other planning tools to avoid uncontrolled sprawl". (EEA, 2006). Nowadays, this pressure on Mediterranean coastlines continues with many impacts:

Excessive consumption of natural spaces:

There are many conflicts of use and competition for space between tourism and recreation, commercial and industrial activities, and agricultural activities.

Human transformation and development:

Loss of biodiversity and landscape transformation, irreversible development, loss of integrity and identity, fragility against natural hazards and climate change.

Intensive resource development:

In response to the influx of people, natural resources are over-exploited, including fish stocks and freshwater.

Anthropogenic waste release:

Increased contamination and poisoning to the detriment of terrestrial and marine biodiversity. Increased volume and lack of infrastructure to manage this waste.

Changes in equilibrium parameters:

Biological imbalances and ecological drift, impacts of climate change on a fragile interface. Ecosystem capacity to deliver goods and services declining (related to declining biodiversity). Remaining natural and semi-natural habitats are fragmented. Increased impacts of climate change on this interface.

Land use and fragmentation is a long-term change that is almost impossible to reverse. Urbanisation is the major cause of the decline of natural and semi-natural habitats in Europe (EEA, 2015). However, European society wants "blue growth", particularly for the maritime sector. The Marine Strategy Framework Directive is the basis for the EU policy for productive, clean and healthy oceans by 2020. This is accomplished by achieving or maintaining good environmental status by 2020 with a commitment to an ecosystem-based approach to managing human activities in the marine environment.

In the latest report of the Intergovernmental Panel on Climate Change (IPCC), mitigation measures are

recommended for the next two decades, including policies integrating the co-location of areas of high residential densities and areas of high employment densities. Proposed solutions include strengthening the development of small coastal cities as focal points, monitoring and controlling coastal urbanisation and sprawl.

They are among the solutions providing urban ecosystem services, contributing to greater resilience to climate change and sustainable development issues in coastal cities:

Increase and strengthen urban resilience:

Implementation of urban adaptation and sustainable management processes (geographic integration, thematic integration, application of institutional instruments, participatory, integrated and sustainable management).

Socio-economic cohesion:

Approximation and participation of all categories of actors for concerted and coordinated management at all levels and for all sectors. Political will and national strategies.

Large-scale modernization of the industrial sector:

Replacement of energy-intensive technologies with the best available, additional innovations. Collaborative activities between companies and between sectors that can reduce their consumption of raw materials and energy. Sharing of infrastructure, information, energy use.

Promote sustainable urbanization:

Construction of green buildings, landscaping of open and green public spaces, blue infrastructure.

Sustainable waste management:

Strengthen and develop waste treatment and recycling sectors. Reduce waste, increase reuse, recycling and energy recovery.

Regulations and planning:

Decision-making with evaluation of long-term developments. Implementation of Integrated Coastal Zone Management (ICZM).

Ecosystem-based management remains the key to secure ecosystem services and their benefits (EEA, 2015). This management method is supposed to combat the combined effects of the many existing pressures. ICZM is precisely one of the tools that decision-makers must seize and implement in their actions. The main challenge is to ensure the long-term resilience of coastal ecosystems and therefore the social resilience of Mediterranean communities.

Integrated Coastal Zone Management (ICZM), a tool for governance of coastal territories for sustainable development.

Integrated coastal zone management is a dynamic process that brings together government and society, science and decision-makers, public and private interests for the protection and development of coastal systems and resources. This process is intended to optimize long-term resource-based choices and their reasoned and reasonable use. It simultaneously takes into account the fragility of coastal ecosystems and landscapes, the diversity of activities and uses, their interactions, as well as their impacts on both the marine and the terrestrial.

Position of the topic in the school program:

	11	12	13	14	15	16	17
Mother / Foreign language / Litterature	X	X	X	X	X	X	X
History							
Geography	X	X	X	X	X	X	X
Mathematics							
Biology / Geology	X	X	X	X	X	X	X
Physic / Chemistry							
Social Science / Economy / Law							
Art / Musics	X	X	X	X	X	X	X
Technology / Computer science							

Ressources:

- EU-Soes, CORINE Land Cover 2006.
- FR Soes, Artificial spaces, 2009.
- EEA, 2010. Environment in Europe: Status and Outlook 2010 – Summary.European Environment Agency, Copenhagen.
- EEA Technical Report No 3/2010. Assessment of ecosystems and costs of biodiversity loss - The case of Mediterranean coastal wetlands, Copenhagen, 2011.
- EEA, 2010. 10 messages for 2010 – Cultural Landscapes and Biodiversity Heritage.
- EEA, 2011. Technical Report No 2/2011. Fragmentation of landscapes in Europe.
- EEA, 2016. Report No 7/2016. Soil Resource Efficiency in Urban Areas – Analytical Framework and Governance Implications.
- EEA, 2015. Environment in Europe: Status and Outlook 2015 – Summary. European Environment Agency, Copenhagen.
- UN, Millennium Development Goals 2015, New York.
- UNEP/MAP, 2016. Mediterranean Strategy for Sustainable Development 2016-2025. Valbonne. Plan Bleu, Regional Activity Centre.

Energy: Production and resources

Topic summary:

Located in the heart of three continents, fragile from an environmental point of view, the Mediterranean basin is also a source of energy, whether it is renewable energies (wind, sun) or fossil energies present in its basement. The recent discovery of gas deposits in the eastern Mediterranean also makes it a new energy region.

Main concepts covered:

* Renewable Energy
* Fossil Energy
* Greenhouse Gas
* Generator

Transversal competencies acquired:

* Communicating orally / writting in mother/foreign language
* Managing information
* Getting organized and planning
* Respecting a framework and instructions.

Definition of key notions:

Renewable Energy:

Any energy source that is regenerated at least at the same speed with which it is used. The following energies fall into this category: solar, wind, geothermal, marine, hydroelectric, biomass.

Fossil Energy:

The set of energy resources deriving from the transformation process of carbon-rich organic substances, especially plants, buried millions of years ago in an anaerobic environment. The following energies fall into this category: coal, oil, natural gas.

Greenhouse Gas:

The gases which are responsible for causing the greenhouse effect, that is the process by which radiation from a planet's atmosphere warms the planet's surface to a temperature above what it would be without this atmosphere. The main greenhouse gas is carbon dioxide.

Generator:

An electric generator is a device intended to produce electricity from a different form of energy. The different forms of energy, which are transformed into electricity, are normally mechanical energy, chemical energy, light energy or directly thermal energy.

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Introduction of the topic:

Energy production is causing considerable harm to the environment and human well-being, although it is useful to our modern way of life and standard of living in today's society. In Europe and as in some parts of the world, fossil fuels dominate the European energy system, representing more than three quarters of the energy consumption of the 33 member countries of the European Environment Agency (EEA) in 2011 and almost 80% of greenhouse gas emissions (EEA, 2013i).

IPCC has stated in these latest reports that the increase in the concentration of greenhouse gases (Ghgs) in the atmosphere is the result of human activity, in particular energy consumption and production, resulting in increased temperatures in the coming years. United Nations Framework Convention on Climate Change Countries agree to limit increase to below 2°C compared to the pre-industrial times (the global temperature has already increased by an average of 1°C worldwide and by 1.4°C in the Mediterranean region). If the temperature rises by more than 2°C, most of the Mediterranean Basin could quickly turn into desert. Mediterranean countries accounted for 6% of global carbon dioxide (CO2) emissions in 2015. Although this share is rather low compared to the other regions, it is particularly vulnerable to the consequences of climate change and is likely to be more exposed to extreme events.

In Mediterranean, the "hot spot" of climate change, the effects will take place in agriculture and fisheries (decline in stocks and yields), tourism (heat and drought waves, floods), coastal areas and infrastructure (sea-level rise, extreme weather events), human health (heat waves) and the energy sector (power plant water supply, hydro-electricity and increased consumption).

The scarcity of water resources is likely to affect all sectors. The most vulnerable areas will be those of Southern and Eastern Mediterranean countries (PSEM) where the impacts of climate change could overlap and amplify the pressures on the already existing natural environment and related human activities. In addition, the technical and financial adaptive capabilities of PSEM are more limited. Countries on the North shore of the Mediterranean Sea (NMS) will be more vulnerable in coastal areas as well as in areas with high population growth. Adjustments should be made to avoid or minimise the resulting economic damage and loss.

The energy sector, at the heart of climate change, is the main emitter of greenhouse gases. Climate change directly influences energy production and consumption (especially electricity). In addition, CO emissions are increasing on average faster in the Mediterranean than in the world (Mediterranean Energy Observatory). For example, the region will need to adapt the current energy system and opt for low-CO solutions in order to participate in climate change mitigation efforts.

Sustainable development issues identified in this topic:

How to reduce harmful emissions, dependence on fossil fuels and increase energy security?

1. Largely majority of non-renewable energy sources

Fossil fuels (coal, oil and natural gas) provide energy using mainly coal and oil. The oil obtained is the most widely used as petrol. Fossil fuels are problematic because they are responsible for most polluting emissions, such as sulphur oxides (SOX), nitrogen oxides (Nox) or particles, not to mention the impossibility of replacing and renewing this natural resource from a process that takes millions of years.

Consumption of non-renewable energy

Nearly 80% of the total energy consumed in the world has a non-renewable origin with a significant and growing consumption. While it remains a major topic of debate regarding its use and waste management, nuclear energy is one of the world's leading non-renewable energy sources.

The consumption of fossil fuels in the North shore of Mediterranean Sea is increasing. Europe is heavily dependent on imports and this makes European countries vulnerable to supply constraints and price instability. In 2011, 56% of all fossil fuels consumed in the EU were imported, compared to 45% in 1990.

To achieve its climate objectives by 2050, the EU must reduce its energy consumption and switch to alternative energy sources. This change would also bring economic, environmental and social benefits. Ensuring an economically efficient transformation of the European energy system requires a wide range of supply and demand actions.

Currently in the Mediterranean region, the primary energy demand of Northern countries exceeds South and East demand, representing 63% of the total energy demand in the Mediterranean. Energy consumption varies continuously and will certainly lead by 2040 to an increase of about 40% in the region's overall energy demand (most of the energy demand will come from the electricity and transport sectors). By 2040, the trend also shows that energy demand in the South and East will exceed the North one, reversing the current proportion. The economic growth of Eastern Mediterranean countries will continue their solid development.

Currently, demand for energy per capita in the South and East is less than half that of the North. As people in Southern and Eastern Mediterranean improve their access to modern energy services, this average will increase significantly in 2040 according to the Reference Case. This rapid increase in the energy demand of Southern and Eastern Mediterranean countries is linked to the trend in Turkey, the second largest consumer in the Mediterranean region. Algeria and Egypt are expected to be major consumers by 2025. The share of other countries is relatively smaller as they are smaller, but some of them may well have the fastest growth rate in energy consumption (Palestine, Tunisia and Syria in particular).

Energy mix

The energy mix will remain based on fossil fuels, but the share of fossil fuels could range from two-thirds today to almost half by 2040. At the same time, demand for oil will continue to rise, particularly for fuels in

the transportation sector. While fossil fuels remain the dominant energy source in the Mediterranean primary energy mix in 2040, whatever the scenario, oil will remain the dominant fuel until 2040. Renewable energy is expected to show strong growth trends until 2040, encouraged by incentives, forward-looking policies and technological advances. Energy efficiency is also expected to play a decisive role in end-use sectors and electricity generation: increased renewable energy in the mix will also be essential.

Faced with this increase in energy demand, the countries bordering the Mediterranean are facing several challenges: sustainably managing scarce resources, ensuring access to electricity for populations not yet served, and encouraging users to behave economically. In addition, these tensions may be exacerbated by the effects of climate change. The increase in temperature, the decrease in expected precipitation, would lead to a reduction in resources and an increase in water demand. At the same time, they would lead to a decline in electricity production (hydroelectricity, thermal power stations) and an increase in energy demand for water production and mobilization. It is therefore essential that the Mediterranean region change its energy trajectory and implement energy efficiency measures and renewable energy deployment targets.

2. Renewable energies as alternatives

Today, renewable energy is an effective solution. A "renewable, alternative or soft energy" is an energy obtained through an almost inexhaustible resource, either because of the immense amount of energy it contains, or because it is able to regenerate naturally.

These sources would therefore be an alternative to traditional processes and would reduce the environmental impact. The main known energy sources have not reached the stage of "sufficient supply" of energy. Of course, others are to be discovered.

Solar energy

It captures the energy of the sun through the use of sensor panels. Large fields of solar panels in deserts to collect enough energy to recharge power plants. More and more individuals are using small solar systems to supplement their electricity or to obtain hot water.

The major problem with this energy is the amount of sunlight required. Thus, it is effective only in certain geographical areas of the world. In addition, the lifespan of a module is about 30 years and the recycling channels are not sufficiently effective yet.

Wind energy

It has become one of the most common forms of energy. New innovations allow to install many wind farms. Using large turbine turbines, a generator activates and generates electricity.

While wind turbines seemed to be an ideal alternative, reality is beginning to reveal an unexpected ecological impact. They are a threat to wildlife causing nuisance for birds and bats.

Geothermal energy

It is created by the continuous high temperatures from the Earth's crust. The underground heat warms the water and produces steam. Then the steam is captured to operate turbines, which in turn feed generators. It is clean,

sustainable and environmentally friendly. It can be used on all scales for industrial utilization, for example.

The biggest drawback is that it can only be produced at specific sites.

The biomass

It is produced from the degradation of organic matter and is commonly used around the world. Electricity is made from the heat generated by the combustion of wood, plants, agricultural waste and household waste. Although this is an innovative solution, many environmental organizations are critical of the large European biomass power plants and their international wood supply chains.

Hydraulic energy

It is produced thanks to the power of the water that turns the turbines supplying generators. Most of the cities in the world are powered by water. The main problem right now is the aging of dams that require significant work to ensure their functionality and security.

According to the 450 scenario of the International Energy Agency, which would allow to maintain the increase of the temperature on the surface of the world below 2°C, renewable energies will have to cover, in 2040, 58% of the electricity needs, 22 % for the production of renewable heat and cold and 20 % for transport.

Renewable energy will account for nearly 60% of the new capacity installed until 2040. Several factors can encourage this evolution: lower costs, global diffusion of technologies, economic and geopolitical tensions linked to hydrocarbons (fossil fuels), the will to respect the commitments of the Paris Agreement. Regarding the decrease in costs, the International Agency for Renewable Energies (IRENA) estimates that the costs of electricity generated from wind and solar photovoltaic could decrease by 26% and 59% respectively by 2025.

3. Conclusion

For a sustainable future, significant investments in renewable energy and strong efficiency and policy measures will be essential. In addition to the obvious environmental benefits, these investments could improve Mediterranean energy infrastructure while reducing energy costs and enhancing security in the region. In addition, reducing geopolitical tensions and the resulting job creation would be a well-being for the whole region and beyond.

However, the simple shift from fossil-based energy production to renewable resources is not enough to «solve» the problem of the environmental impacts of energy production which requires more space and uses some non-renewal elements in batteries. In the Mediterranean, many countries are confronted with land predation (especially on common areas and some protected natural areas) linked to the industrial production of renewable energy. Reducing energy losses, increase energy savings and promoting the decentralization of energy supply networks are also part of solution.

Position of the topic in the school program:

	11	12	13	14	15	16	17
Mother / Foreign language / Litterature							
History		X					
Geography	X	X	X			X	X
Mathematics							
Biology / Geology		X	X	X	X	X	
Physic / Chemistry	X	X	X	X			
Social Science / Economy / Law							X
Art / Musics							
Technology / Computer science							

Ressources:

- Agence Européenne pour l'Environnement https://www.iea.org/
- Agence internationale de l'Energie https://www.eea.europa.eu/fr/themes/energy
- Mediteranean Energy Perspectives, Executive summary, 2018
- L'environnement en Europe, État et perspectives, 2015

Maritime economy

Topic summary:

In this document the essential concepts relating to the economy of the sea are outlined with particular reference to fishing and aquaculture, tourism and commercial navigation sectors, whose economic, environmental and social profiles are highlighted.

Main concepts covered:

* Blue economy
* Fisheries resources
* Traditional activity: fishing, aquaculture
* Maritime traffic
* Economic Sector

Transversal competencies acquired:

* Communicating orally / writting in mother/foreign language
* Managing information
* Getting organized and planning
* Respecting a framework and instructions.

Definition of key notions:

Blue economy:

Includes all activities related to oceans, seas and coasts.

Sustainable fishing:

Fishing using methods that do not degrade the reproductive capacity of fish while ensuring that the ecosystem is not damaged.

Aquaculture:

Animal or plant production activity in an aquatic environment (fresh water or marine environment).

Fishery resources:

Living resources (plant or animal) in aquatic environment.

Maritime Traffic & Commercial Navigation:

Maritime traffic related to the security of international shipments and the prevention of marine pollution caused by the ships.

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Introduction of the topic:

The Mediterranean Sea, due to its history, is an area marked by many maritime exchanges, both commercial and migratory. Since Roman times, it has played an important part in the economy because of its livelihood for part of the coastal population. However, this activity has lost its importance in the Mediterranean. Today, the maritime economy is based on offshore energy, maritime equipment and maritime and coastal tourism. This economic sector is currently booming and could be a source of income for all border countries. However, given the threats that these activities may pose to the Mediterranean and its biodiversity, inclusive sustainable economic development must be promoted in order to ensure the sustainability of the region. This is the concept of the blue economy. It includes all the economic activities of the maritime sector and seeks to ensure the economic sustainability combined with the sustainable development. It proposes a diversification of activities around fishing activities, but it is a sector in difficulty in the territory. For this topic, we will use the example of professional fishing (including fishing and aquaculture) to provide a non-exhaustive presentation of the issues facing the territory.

Concerning the maritime traffic, the ship is the mean of transport that reaches the most extreme dimensions. It is a complex system equipped with numerous high-tech facilities and it often carries very dangerous goods. So it is clear that safety management is a priority. However, only recently international shipping policies have been established, discouraging shippers from compromising safety, security and performance environmental issues, and encouraging innovation and efficiency.

We have structured our thinking around the three pillars of sustainable development: the economic, social and environmental pillars.

Sustainable development issues identified in this topic:

What are the challenges of sustainable development specific to the Mediterranean marine economy?

1. Environemental aspect

The Mediterranean Basin is a hotspot of biodiversity. That means that it is a territory that concentrates a great diversity of animal and plant species. It is the second largest hotspot in the world, as it concentrates 10% of the world's biodiversity. However, the Mediterranean is also the most polluted sea in the world. There is a strong presence of microplastics, which is a real scourge in the region. In addition, it is a territory that is particularly exposed to climate change. A report commissioned by the Union for the Mediterranean (UFM) and presented in December 2018 at the Climate Summit in Poland states that global warming will have a particularly severe impact on the Mediterranean region and will have serious economic and environmental consequences. Thus, «the effects of climate change on the Mediterranean region will be higher than the world average». Indeed, the high level of maritime traffic in the Mediterranean tends to threaten the well-being of endemic species. This, associated to the fishing activities, tends to weaken the fishing resources of the territory. For example, a study of the Food and Agriculture Organization of the United Nations (FAO) observed, in 2015, that the Mediterranean presents the highest exploited proportion of fish stocks at an unsustainable biological level (95% of stocks). However, these figures do not provide an accurate picture of the state of stocks, which are very difficult to assess, but international public actors agree on the need to intervene for the protection of this area.

In the Mediterranean, the fisheries resource is small in quantity but large in diversity: «While representing only 0.82% of the total surface area of the oceans, the Mediterranean Sea is home to 8 to 9% of marine biodiversity. It is the richest marine ecosystem in terms of species diversity. Between 10,000 and 12,000 Mediterranean species have currently been recorded, including just over 600 species of fish, 2,000 crustaceans, 1,400 molluscs, 150 echinoderms, 450 jellyfish, 600 sponges and 1,350 algae and marine plants. In addition, there are 5 species of reptiles and 21 species of mammals. In addition, fish consumption has concentrated on the noblest varieties, such as whiting and cod, which are used to make breaded fish sticks. In the past, fishermen sold fish on a seasonal basis (as is the case in local agriculture). However, the fishing effort no longer respects this seasonality and the fish are caught all year round and according to the quantities demanded by the market.

It is with this in mind that the EU, in cooperation with the countries on the Southern shore of the Mediterranean, have committed themselves to develop a blue economy that respects the environment and the principles of sustainable development. This includes all the economic activities of the maritime sector. These sectors represent a strong potential for the prosperity of the territory. It is therefore necessary to develop these activities while preserving the territories. Concerning the professional fishing industry, the principles of the blue economy can be translated into concrete measures to diversify activities. In order to have a more qualitative than quantitative management of the fish resource (fish, crustaceans...), professional fishermen can now take passengers aboard their boats to discover their profession and the beauty of the coast. This activity, practiced

only by professionals, is called “pescatourism”. In Italy, they can even offer meals, in suitable places, from their own fishing and to accommodate tourists in their own accommodation.

As for maritime traffic, Particularly Sensitive Sea Areas have been established over the years, to identify those ones that require special protection due to their fragility and importance on an ecological, socio-economic and scientific level (eg. Strait of Bonifacio, France and Italy). MARPOL (Marine Pollution) is the main instrument implemented by the International Maritime Organization for the prevention of pollution. Its objective is to preserve the marine environment through the complete elimination of pollution from hydrocarbons and other harmful substances and the minimization of the accidental spillage of these substances.

2. Economical aspect

The professional fishing sector in the Mediterranean is characterized by a more traditional fishing industry. For instance, 91% of the vessels are less than 12m long, which is characteristic of an artisanal fishing activity. Professionals tend to use nets, long lines and traps, avoiding the industrial fishing such as trawlers and large seiners. For example, in France, the Mediterranean area contributes only 3% of the fishing catch. Most of these catches are located in North Atlantic and North-East Atlantic. By way of comparison, the Sud Provence Alpes Côtes d’Azur region produces 4000 tons, compared to 208,000 for Brittany. However, this is an activity where it is difficult to obtain complete statistics because the sale of fish is made directly to customers from the port. However, we have some figures on global fishing catches at our disposal.

The total catches of the main producers in the world (2015) are displayed by the following table:

States	Tonnes	%
China	17 853 070	17.06 %
Indonesia	6 565 350	6.27 %
India	4 862 038	4.65 %
EU-28	5 160 318	4.93 %
Vietnam	2 757 314	2.63 %
United States	5 045 443	4.82 %
Peru	4 838 874	4.62 %
Japan	3 553 473	3.40 %
Russia	4 463 825	4.27 %
Philippines	2 154 943	2.06 %
Norway	2 441 089	2.33 %
Bangladesh	1 623 837	1.55 %
South Korea	1 656 819	1.58 %
Chile	2 132 337	2.04 %
Myanmar/Burma	1 953 510	1.87 %
Thailand	1 693 050	1.62 %
Malaysia	1 496 054	1.43 %
Others (*)	34 399 523	32.87 %
Total	104 650 868	100.00 %

If we compare these figures with the statistics of the Mediterranean coastal countries (see table below), we can see that their production is relatively low compared to the world production. Only Spain is characterized by a fairly high production (17.47% of European production).

MS	Tonnes	%
IT	191634	3.71 %
EE	70753	1.37 %
ES	901512	17.47 %
HR	72264	1.40 %
FR	497435	9.64 %
Totale	1733598	
Total EU-28	5160318	
Percentage	33,59	

Fishing industry in the Mediterranean is a fragile sector, which is struggling to recruit because working conditions are difficult. Diversification should enable professional fishermen to benefit from additional income, offering greater stability and thus contributing to better living conditions.

Pescatourism, which came from Italy, was developed in France in the 2010's. The countries of Southern Mediterranean Rim wish to develop this activity to strengthen the economic income of fishermen and reduce the fishing effort. Algeria adopted in 2016 national pescatourism regulations and Tunisia is currently experimenting with this activity in the Northern.

The container transport can represent the growth of maritime traffic in the Mediterranean: in the last 20 years, container handling in the Mediterranean ports has increased six-fold and the top thirty ports exceed 50 million TEU (from 9 million TEU in 1995 to 53 million today) with a percentage increase of 500% and as many as nineteen ports exceed one million TEUs a year. Data show that the Mediterranean has gained a central position in the global trade of goods, as «recovering water» against the Atlantic. The exponential development of the container market has opened up spaces for competitive positioning in many port systems and represents an opportunity to growth for the Mediterranean Basin.

3. Social aspect

Beyond the economic and environmental aspect, pescatourism contributes to the enhancement of the local heritage.

Indeed, the professional fishing in the Mediterranean has remained faithful to its foundations, keeping its artisanal aspect far from the industrial fishing. Fishing gear, nets, longlines and traps were invented by fishermen. Some practices may be more environmentally friendly than others. For example, longline fishing allows the selection of adult-sized fish. Most fishing techniques have been invented by fishermen themselves over time. In some territories, other ancient practices are still present even if they are hardly used any more: the madrague or tonara consisting in the installation of fixed fishing nets along the coast mainly for the capture of tuna was used by fishing communities in order to manage the fishing catch. Also, professional fishing has contributed to shaping coastal territories, and in particular large coastal cities such as Marseille or Sète. It has also been an important source of social cohesion on the coasts. Fostering exchanges and creating jobs, it has contributed to the emergence of communities with strong cohesion. Pescatourism contributes to the discovery of the port heritage and the local traditions by allowing individuals to meet fishing professionals. Thus, it raises awareness of the sector's challenges. Heritage walks are organised to allow visitors to discover artisanal fishing and its products. There are also citizen initiatives to promote human heritage. In addition, pescatourism helps to maintain activity in the area by allowing fishermen to benefit from a more stable income. It can also

promote the attractiveness of the profession for young workers. EU has drawn up the Blue Book (2007) in which is marked the need to propose an integrated maritime policy system, given from the awareness that much of our future depends on the still unused potential of the oceans, with the aim of offering growth, employment and sustainability. Therefore, we can conclude on the following points: the rejection of the sectorial approach until now followed by the Union and the Member States (ie: a policy for ship owners, one for ports, one for shipyards, one for the environment, one for fishing, one for pleasure craft, etc.); and the affirmation of the need for a «holistic» policy, which addresses in a global and inter-sector ways all aspects of maritime problems.

Position of the topic in the school program:

	11	12	13	14	15	16	17
Mother / Foreign language / Litterature							
History	X		X				
Geography	X		X	X	X	X	X
Mathematics							
Biology / Geology	X	X					
Physic / Chemistry							
Social Science / Economy / Law						X	X
Art / Musics							
Technology / Computer science							

Ressources:

- The two tables shown are taken from the document: Facts and figures on the common fisheries policy - Basic statistical data - 2018 EDITION, by Directorate-General for Maritime Affairs and Fisheries of the European Commission
- The state of fishing and aquaculture in the Italian seas (Ministero delle Politiche Agricole, Alimentari e Forestali - 2011)
- "Rapporto annuale sulla pesca e sull'acquacoltura in sicilia 2013" (assessorato regionale dell'agricoltura, dello sviluppo rurale e della pesca mediterranea) -rapporto ISPRA 2016 su Pesca ed Acquacultura
- SEA-Med Project Technical Series : The European Commission's new proposal for a Council Regulation on the conservation and sustainable use of fisheries resources in the northern and southern Mediterranean Sea ? An experience conducted in the Taza National Park, , Algérie. Bellia R. 2016. http://d2ouvy59p0dg6k.cloudfront.net/downloads/le_pescatourisme_algerie.pdf
- WWF Principles for sutainable fishing tourism, WWF Mediterranean Marine Initiative, Rome Italy, Gomei M., Bellia R (2019) http://awsassets.panda.org/downloads/wwf_fishingtourism_web_doublepage.pdf

Topic summary:

This theme should enable students to understand the challenges of migration and the international cooperation in the Mediterranean basin

Main concepts covered:

* Barcelona Process
* Union for the Mediterranean
* Migration
* International cooperation

Transversal competencies acquired:

* Communicating orally / writting in mother/foreign language
* Managing information
* Knowing how to work in a group.

Definition of key notions:

Migration:

Any movement of persons away from their place of usual residence, either within the same country or across an international border.

Migrant:

Any person who leaves.

Barcelona Process:

Initiated by the Euro-Mediterranean Ministerial Conference held from 27th to 29th November 1995 and gathering members of the EU and the twelve Mediterranean third countries. It is intended to establish a comprehensive Euro-Mediterranean partnership to make a Mediterranean common area of peace, stability and prosperity by strengthening political and security dialogue, an economic and financial partnership as well as a social, cultural and human partnership.

Multilateral international cooperation:

A system of international relations that focuses on negotiations, mutual commitments and cooperation with a view to establishing common rules.

Governance:

All the measures, rules, decision-making, information and supervisory bodies that ensure the proper functioning and control of a State, institution or organisation.

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Introduction of the topic:

The Mediterranean Basin has been characterized over the centuries as an area of encounters and sharing between populations. Far from being linear, these mobilities have been more or less important depending on the time. Traces of it can be found as early as the Phoenician civilization, in the last decades of the 9th century BC, when people from the Syrian-Palestinian coast left their villages to settle around the Mediterranean (from the Iberian Peninsula to Maghreb, giving them access to the Atlantic Ocean). This mobility has been perpetuated by the Greek civilization, which is widely present all along the coast. The Greeks around the Mediterranean were described by Plato as «ants or frogs around a pond» (Phedron, 109).

These population flows have enabled the diffusion of cultures, languages and technologies. They have therefore encouraged the emergence of new technologies and processes.

Mobility around the Mediterranean Basin, beyond being a historical feature, has made it possible to create important and lasting links between countries. These have led to the establishment of formal or informal supranational organizations and strategies to work on issues common to the territory. For example, there is the Union for the Mediterranean, which is an intergovernmental organisation bringing together 43 countries in the Mediterranean Basin, including 28 members of the EU. Its objective is to promote dialogue and cooperation at the Euro-Mediterranean level.

These organizations face many challenges due to the economic and social disparities that exist in the territory but also due to the variety of political systems. However, their intervention is necessary to provide global answers to the problems that are needed in the Mediterranean Basin. The vulnerability of this territory to climate change is one of the main issues.

Sustainable development issues identified in this topic:

What are the impacts of migration flows on the Mediterranean environment? How do countries cooperate with each other?

1. The Medierranean, an area of mobility

Migration flows have evolved over the centuries and are now taking many forms. It should be recalled that migration refers to «any movement of persons leaving their place of habitual residence, either within the same country or across an international border ». It can be caused for economic and social reasons (search for a better standard of living, flight from a high-risk area), or for climatic reasons (related to a sudden or gradual change in the environment due to climate change). These migrations can be internal or external to a State.

Within this area, we can distinguish several migratory zones:

- The Western Mediterranean - including the Maghreb and Europe
- The Balkans
- The Eastern Mediterranean - including the Mashreq and the Near

The region has experienced several successive waves of migration. In the 19th century, the migratory waves were in the North-South direction during the European colonization.

In the 20th century, South-North immigration appeared, mainly characterized by the flows of workers. Indeed, European countries that have suffered two World Wars are short of manpower and are seeking to attract workers.

Currently, Southern Mediterranean is characterized by high emigration. It concerns mostly young people heading mainly to Europe, but also to the Gulf countries, as well as to the United States and Canada.

In addition to these long-term migratory flows, the territory is also crossed by significant tourist flows. Indeed, the Mediterranean area is the world's leading tourist destination, which induces strong human pressure in summer. It welcomed 314 million visitors in 2014, representing 30% of the total number of international tourist arrivals worldwide. This number is expected to reach 500 million by 2030.

The mass tourism, which is concentrated on the coasts, leads to the environmental degradation, including marine pollution linked to waste water discharges and illegal landfills. In addition, there is an over-consumption of energy (electricity consumption is exploding because of the high use of air conditioning; the large abstraction of water tends to promote water stress on the territory, etc.). The multiplication of transport modes also contributes to the increase of greenhouse gas emissions in the region. In addition, the deployment of low-cost transport tends to attract more people at risk of damaging the Mediterranean ecosystem and to accentuate urbanisation in the region. The territory must therefore face major problems that require joint intervention.

2. The Euro-Mediterranean dialogue - an important development tool:

In 1995, the Euro-Mediterranean dialogue with the implementation of the Barcelona Process was formalised in order to efficiently manage the challenges of the territory. Established at the Barcelona Conference of 27

States, it should lead to the implementation of a Euro-Mediterranean partnership to establish the territory as a common area of peace, stability and prosperity. All of this is achieved by strengthening international political dialogue accompanied by an economic and financial partnership, as well as a social and cultural one.

Union for the Mediterranean
Union pour la Méditerranée
الإتحاد من أجل المتوسط

One of the main objectives of this partnership is to deal with the existing migration issues in the territory, but this cooperation also better enables the management of economic and environmental issues. This group of states works in particular with the Blue Plan, a Mediterranean regional activity centre that produces studies and scenarios on the future in order to raise awareness among Mediterranean actors and decision-makers on environmental and sustainable development issues.

These States have also developed a Mediterranean Strategy for Sustainable Development, first in 2005 and then over the period 2016-2025. Based on the results of the United Nations Conference on Sustainable Development (Rio +20), this strategy should lead to the implementation of actions to protect the environment while allowing a viable economic activity.

The Euro-Mediterranean cooperation is also apparent in other areas, such as the maritime sector, with the creation in 1949 of the General Fisheries Commission for the Mediterranean. It brings together 23 countries in the territory that work together to conserve fish stocks.

Another example is the Medfish project, which brings together WWF and the MSC Council to analyse the territory fisheries.

The Mediterranean States are also represented in bodies such as the Conference of Peripheral Maritime Regions, which helps to promote a more balanced development of the European territory. It seeks to impact on creating the necessary conditions for social, economic and territorial cohesion by acting, in particular, on policies with a strong territorial impact.

This cooperation aims to promote a homogeneous development of the territory on the long term. The Malta Declaration of 2017 (made during the crises of European migrants by the leaders of the European Union in Malta, which focuses on measures to stem the flow of immigration from Libya to Italy and the Eu) therefore seeks to strengthen this Euro-Mediterranean exchange through research and innovation, which should enable the regional development through the employability of young people, job creation and the education and empowerment of women.

Migrants, refugees and asylum seekers have rights protected under international law, regardless of how they arrive in a country and the purpose of their movement. They have the same rights as everyone else and, in addition, enjoy special protection under the following texts:

- the Universal Declaration of Human Rights, which states in Article 14: «Everyone has the right to seek and enjoy in other countries asylum from persecution»;
- the UN Convention relating to the Status of Refugees (1951, and its 1967 Protocol), which prohibits the return of refugees to countries where they are at risk of persecution;
- the International Convention on the Protection of the Rights of All Migrant Workers and Members of Their Families (1990);
- regional legal instruments relating to refugees, including the Organisation of African Unity Convention (1969), the Cartagena Declaration (1984), the Common European Asylum System and the Dublin Regulation.

3. Intervention through education:

The Euro-Mediterranean University of Fez was created with the aim of training young residents in regional issues (renewable energy, water conversation, big data).

In parallel to this university, the "Méditerranée Nouvelle Chance" (MedNC) project was created in 1988 to promote the establishment of a regional network of guidance, training and professional integration centres. It seeks to promote the employability of young people who have left school before graduating. MedNC has thus made it possible, creating local socio-professional integration schemes to lead to higher results than national averages.

The Euro-Mediterranean initiatives contribute to the promotion of the regional employability of young people while seeking to stimulate innovation in the area.

Position of the topic in the school program:

	11	12	13	14	15	16	17
Mother / Foreign language / Litterature							
History	X	X	X				
Geography		X	X		X	X	X
Mathematics							
Biology / Geology						X	
Physic / Chemistry							
Social Science / Economy / Law						X	X
Art / Musics							
Technology / Computer science							

Ressources:

- Barcelona Convention: https://web.unep.org/unepmap
- Union for the MEditerranean: https://ufmsecretariat.org
- Food and Agriculture Organization of the United Nations / Fao: http://www.fao.org/gfcm/en
- Conference of Peripheral Maritime Regions: https://cpmr.org/
- The new chance Mediterranean network: https://www.iecd.org/en/mednc/
- Amnesty : https://www.amnesty.org/fr/what-we-do/refugees-asylum-seekers-and-migrants/

Cultural heritage

Topic summary:

The Mediterranean Sea has been a natural and economic resource. Throughout its history, it has had a significant influence on the creation of a common cultural heritage. In terms of sustainability, the rapid and progressive transformation of the world into globalization has modified geographical spaces, ways of life, economy, environment, etc., which has irreversibly and substantially affected cultural heritage.

Main concepts covered:

* Mediterranean cultural circle
* Mass tourism vs. sustainable tourism
* Air pollution
* Sea level rise
* Degradation / destruction of cultural heritage
* Loss of ancestral trades related to the sea
* Food
* Art and Literature

Transversal competencies acquired:

* Communicating orally / writting in mother/foreign language
* Managing information
* Mobilizing reasoning
* Mobilizing computer / digital skills
* Respecting a framework and instructions.
* Knowing how to work in a group.
* Knowing how to adopt according to the difficulties

Definition of key notions:

Mediterranean Cultural Circle:

A Mediterranean cultural identity emerged in the territory of the geographical region of the Mediterranean, recognizable in its material and spiritual contents.

Mediterranean acculturation:

Changes in values, behaviors and consumption patterns in order to imitate residents of the hosting society: Mercantilization of traditions, cultural clashes, loss of ancestral trades, food, etc.

Degradation / destruction of heritage:

The increase in pollution levels in recent years (due to human activities) is one of the main causes of the deterioration of historical monuments and buildings in the world.

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Introduction of the topic:

The Mediterranean environment, which includes a balance between natural features and human intervention in space, has been rapidly changed and dissolved in recent times. This is due to a changed lifestyle and the development of technology. Changes occur in natural habitats and ecosystems, but also in lifestyles, culture, economy, diet, language, etc.

Accelerated technological advancements have changed people's habits and mindsets. Until recently, people were relying on their strengths and resources. They used resources from their immediate surroundings to survive and acquire goods. The environment was carefully guarded and maintained knowing that a preserved environment is a condition of their survival.

On the one hand, modern technical and technological capabilities have made products from the farthest corners of the globe available to people at reasonable prices. On the other hand, the obligation to preserve an environment was abandoned. The environment ceased to be a condition of survival. The modern society is based on a model of "everything is available", so they have lost their sense of obligation to the nature and the environment.

Throughout history, our ancestors have been forced to conserve and exploit ecosystems with modest technical means. They have created products and developed specific skills, bringing to traditions by which particular areas are recognized.

Sustainable development issues identified in this topic:

Is the cultural heritage a material and immaterial reflection of cultures in the context of the Mediterranean, in a continuous flow of economic, social, cultural relations, etc.

Technological advances, rapid population growth, globalization and in general, the rapid and progressive transformation of the world has modified borders, ways of life, economy, natural environments, language, food, culture... directly affecting sustainability and by extension the cultural heritage of the Mediterranean.

1. Mass tourism vs sustainable tourism

In the last 50 years, we have seen how the tourism phenomenon has grown worldwide. The Mediterranean is one of the regions subject to this so-called mass tourism. This is a phenomenon of such magnitude and with such rapid expansion that it could not but generate an impact. This impact can be classified as economic, environmental and socio-cultural.

At a socio-cultural level, the following can be emphasized: the deterioration of historical sites and archaeological monuments; the acculturation: changes in values, behaviours and consumption patterns with the aim of imitating the residents of the host society; the commodification of traditions; the cultural shock.

2. Air pollution

The air pollution can be translated as high levels of pollution, or acid rain (for example city traffic degrading the facades of stone and marble buildings, sculptures...)

The increase in pollution levels in recent years is one of the main causes of the deterioration affecting historical monuments and buildings around the world. The cost of removing the filth is raised to the point of endangering cultural heritage. Air pollutants emitted mainly by industry and transport impact greatly on the deterioration of many materials used in cultural monuments. Polluted air in cities is filled with particles and gasses, gradually destroying the materials historical monuments are made of, acid rain and soot being the main destructive elements. This damage does not only affect their appearance but also their structure, causing swelling and contributing to the breakdown of the stone (for example the Acropolis in Athens, Greece, is made of marble, which is very susceptible to surface degradation even at very low levels of acid rain; the marble frieze panels of the Parthenon have been chemically transformed and numerous pieces have begun to crack and fall).

3. Rising sea levels

Dozens of Mediterranean coastal towns declared as world culture heritages are in danger. A study in Nature Communications[1] shows that these sites, for the most part, are threatened by the sea level rise, one of the consequences of global warming. The investigation evaluates how this factor combined with extreme weather events can lead to increased erosion and flooding along the coastlines. According to the study, the countries with the highest percentage of the world heritage sites threatened by the rising sea levels are Italy, Croatia, Greece and Tunisia. In Spain they have looked at Tarragona and also the Tramuntana mountain range in

1 Lena Reimann, Nature Communications volume 9, Article number: 4161 (2018). Department of Geography, Kiel University, Kiel, Germany.

Mallorca. In the case of the Tramuntana, research indicates an especially high rate of exposure to erosion.

4. Degradation/destruction of cultural heritage environments

The rapid and progressive transformation of rural, cultural and urban landscapes, ways of life, economic factors and the natural environment can substantially and irreversibly affect the heritage or an area of heritage value (for example construction work or communication routes near sites, monuments and heritage areas).

Managing change in heritage environments, sites and areas does not necessarily mean avoiding or impeding change. Such management must define how such changes should be implemented and actions necessary to assess, measure, avoid or remedy degradation or loss of significance, and propose improvements related to conservation, management and interpretation resources.

5. Loss of ancestral skills related to the sea

Many of the ancestral skills directly related to the sea or the maritime environment are in decline and are destined to disappear. Some of them due to technological progress and others due to the economic crisis, others due to the change in non-sustainable economic models increasingly aimed at the tertiary sector. Undoubtedly, this also plays a fundamental role in the pollution of the seas (mainly caused by plastics and spills, and how this affects marine species).

Among the ancestral skills, some stand out, such as artisanal fishing, net weaving, trades related to the fish processing industry (salted fish, pickled fish) and trades related to the boat building, such as traditional shipbuilders and caulkers.

6. Food

This point deals with the overexploitation of fishery resources, food waste due to discarding of fish and quotas imposed by the EU and climate change that affects traditional Mediterranean crops through droughts, the advance of desertification, the wearing away of soil, etc.

7. Art and literature

It is apparent that the Mediterranean has undergone significant changes throughout history. Examples of these changes are found in various literary works and through their authors, who were inspired by the Mediterranean.

Different intellectuals, who either lived in the Mediterranean, or settled in the region, have provided important sources of information, in the form of travel guides and nature guides, novels, poetry, paintings, engravings and so on. Thanks to this information, we can see the transformation of the Mediterranean: demographic pressure, degradation of landscapes (construction along the coastal regions, urban disorder...), sea pollution, overexploitation of marine resources, a loss of ancestral trades and crafts...

Position of the topic in the school program:

	11	12	13	14	15	16	17
Mother / Foreign language / Litterature	X	X	X	X	X	X	X
History	X	X	X	X	X	X	X
Geography	X	X	X	X	X	X	X
Mathematics							
Biology / Geology	X	X	X	X	X	X	X
Physic / Chemistry							
Social Science / Economy / Law							
Art / Musics	X	X	X	X	X	X	X
Technology / Computer science							

Ressources:

- Reimann, L., Vafeidis, A.T., Brown, S. et al. Mediterranean UNESCO World Heritage at risk from coastal flooding and erosion due to sea-level rise. Nat Commun 9, 4161 (2018).

https://doi.org/10.1038/s41467-018-06645-9

- https://www.nature.com/articles/s41467-018-06645-9

Topic summary:

In this topic students are introduced to Mediterranean's basin geological structure and its dynamic system of natural forces. The students can experience the different natural hazards (e.g. earthquakes, volcanoes, landslides, tsunamis, floods, tornadoes, avalanches, fires, hurricanes, thunderstorms etc.) and their impact to human life as well as to animals and plants behavior.

Main concepts covered:

* Natural disasters
* Earthquake / Lithospheric-Tectonic plate
* Mantle / Magma
* Hotspot
* Hydrological stress
* Greenhouse gases (GHGs)
* Mediterranean climate

Transversal competencies acquired:

* Communicating orally / writting in mother/foreign language
* Mobilizing reasoning
* Mobilizing computer / digital skills

Definition of key notions:

Natural hazards:

Natural process or phenomenon that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

Tsunami:

Long, high sea waves caused by an earthquake or landslide or other disturbance.

Earthquake:

Sudden violent shaking of the ground, typically causing great destruction, as a result of movements within the earth's crust.

Rock-falls/landslides:

Collapse of material from a cliff or steep slope.

Flood:

Temporary cover of a land by fresh or salt water which under normal conditions is not covered by water. This submersion can be done slowly or suddenly and be repeated regularly or randomly.

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Introduction of the topic:

The Mediterranean region is a territory marked by the presence of many natural hazards, which become risks given the population density all around the basin.

The region is characterized by a temperate climate with a strong sunshine and strong winds. It alternates between hot summers, with temperatures between 25 and 40° - which can cause drought episodes - and mild, wet winters, with variable precipitations. Significant rainfall events occur during the spring and fall, which can lead to violent incidents due to climate change causing flooding and landslides.

Summer drought episodes are the cause of frequent and devastating fires during the aestival period. These are destroying hectares of land, sometimes causing many victims, such as the fire at a seaside resort in Greece in 2018, which killed 102 people.

The geological structure of the Mediterranean basin is also the source of seismic and volcanic hazards: the Mediterranean Sea is a highly fragmented area from a geological point of view. Several tectonic plates exist in the Mediterranean Basin. For example, seismic episodes that occur in the area of Southern Aegean (from West to East) are due to the convergence of African with Eurasian Plates.

All these climatic and geological characteristics tend to make the Mediterranean Basin vulnerable to four main categories of natural hazards, which consequences are accentuated by the density of the population, in particular on the coastline:

- The omnipresent seismic risk from East to West of the Basin which is accompanied in some regions by a volcanic risk

- Torrential floods

- Droughts affecting the Maghreb region in Mashreq and marking an increased extension in Southern Europe

However, these violent events tend to become more severe with global warming, which will be greater in the Mediterranean than in the rest of the world. Indeed, its position between two air masses (arid in North Africa and temperate in Europe) as well as its geographical specificities make the territory particularly vulnerable. Climate change tends to increase the intensity of already dangerous Mediterranean meteorological phenomena. It is therefore important that the regional stakeholders adopt resilience strategies.

Sustainable development issues identified in this topic:

What are the main natural risks in the Mediterranean region?

1. Floods risks

Floods are the most common natural disaster in the Mediterranean. In the period 1990-2010, floods accounted for 35% of all natural disasters that hit the Mediterranean region[1]. They are mainly caused by phenomena called "Mediterranean episodes". The Mediterranean episode results in short thunderstorms, with heavy and localized rainfall. It takes place over a relatively short period of time where the equivalent of precipitation of several months can fall in a few hours or a few days. This leads to a swelling of rivers that can lead to torrential floods with significant overflows.

These Mediterranean episodes are frequent and widespread throughout the region. They occur three to six times a year, usually in the fall, when the sea is warmest. They are caused by hot, humid and unstable air coming from the Mediterranean. The higher the sea temperature is, the greater the risk of violent episodes is.

Some 210 destructive flood events struck 22 countries during the past 20 years affecting 3,220,000 people, causing 4,250 dead, and economic losses. The Southern and Eastern Mediterranean countries recorded the highest number of deaths with 3,820 victims mostly due to sudden flash floods striking intensely populated urban areas built in flood prone zones. On the contrary, the Northern Mediterranean countries[2] registered the highest economic impacts with 21,400 billion euro lost mostly striking touristic coastal towns built without an adequate protection.

2. Coastal flooding risks

Coastal areas are often at risk due to rising of sea levels which could be due to wind waves, freshwater inflows and meteorological tide or stormsurge. The elevation of sea level due to stormsurge is a complex phenomenon, which depends on a number of factors, such as the changes in atmospheric pressure, the intensity, the speed and the orientation of the wind towards the coast, the shape and depth of the coastline, the altitude and the morphological slopes of the area, etc.

The most significant damage often results from the direct impact of the waves on fixed structures. Indirect impacts include flooding and undermining of major infrastructures, such as highways and railroads. Hooding of deltas and other low-lying coastal areas are exacerbated by the influence of tidal action, storm waves, and frequent channel shifts.

3. Drought risks

The Mediterranean climate causes severe droughts that can lead to major fires. The most destructive fires recorded since the 1980s in Europe are mainly located in Portugal, Greece and Spain.

The risk of drought is almost uniform throughout the country, causing fire risks. Their frequency is increased by human activity. Note that Forest fires often come from crimes or accidents, even if droughts are factors facilitating the outbreaks of fires or accentuating their consequences. Their impact on the forest cycle and

1 (Albania, Algeria, Bosnia-Herzegovina, Croatia, Cyprus, Egypt, France, Greece, Israel, Italy, Jordan, Lebanon, Libya, Malta, Montenegro, Morocco, occupied Palestinian territory, Slovenia, Spain, Syria, Tunisia and Turkey)

2 Italy, France, Spain, Greece, Slovenia and Albania

biodiversity is a subject of debate, some scientists judging the fire necessary for the regeneration cycle of vegetation.

In addition, the high coastal concentration, combined with tourist populations, accentuates the water demand in the territory, which favours the drying up of the groundwater and leads to a hydrological stress in the territory.

The primary effects of a drought are loss of crops, livestock, and water used for consumption. If resulting food shortages become chronic and famine can occur. Secondary effects of drought may include fires, flash flooding, and desertification, the last one results from increased wind erosion of soils. Wind-blown ash and dust can also compromise the air quality of far-distant areas. In these ways, even localized droughts can have global consequences.

4. Seismic risks, volcanoes and tsunami

Seismic episodes are often deadly in the Mediterranean region. The tectonic plates of the Mediterranean area are convergence zones. This means that a plate is pushed under another one. This convergence movement began in the Mediterranean 70 million years ago and is still ongoing.

The Mediterranean region is seismically active, due to the convergence to the north (4-10 mm / year) of the African plate relative to the Eurasian plate along a complex boundary of tectonic plates. Several openings and closures of ocean basins over geological time have made an area extremely rich in seismic hazards with all types of mechanisms. This allows us to divide the territory into two distinct parts: the Eastern Mediterranean (from Italy to Turkey), which is characterized by intense seismicity with earthquakes whose magnitude can rise to 7.5 Richter with more than 350 recorded tsunamis and the Western Mediterranean.

Thus, during the 20th century, 198,548 earthquake victims were recorded. However, the seismic risk is not homogeneous throughout the Mediterranean territory. The Northern shoreline is the most affected, particularly the Italian Peninsula, Greece and Turkey. The Southern shore is much less prone to these risks, despite some violent events (for example, in 1960, the El Asnam earthquake in Algeria killed 2633 people or the Al Hoceima earthquake killed more than 1000 people in Morocco in February 2004).

Volcanism in the Mediterranean is also the result of this intense tectonic activity.

Volcanoes are vents that allow lava, rock fragments and gases to escape from layers beneath the earth's surface. There are several volcanoes in the Mediterranean region including Vesuvius, Etna, and Stromboli. The catastrophic earthquake of Thira is comparable in destruction to the one resulting from the 1883 eruption of Krakatoa, and it is believed to have wiped out the Minoan civilization in 1470 B. C. The Italian Peninsula is especially known for its intense seismic activity as well as its volcanism. Moreover, the presence of magma near the surface has driven some Italian regions to satisfy part of their energy needs by drawing on geothermal sources.

Tsunamis are ripples formed on the ocean surface where the seafloor is abruptly disturbed, displacing the water above it. Sometimes they consist of single waves, but very often a sequence of waves is created due to a seismic event or a landslide. Anything that causes a seafloor disturbance can produce a tsunami[3].

Several devastating tsunami events have been documented for the Mediterranean in the last 2,500 years. Both

3 Earthquakes, volcanic explosions, undersea landslides, and meteor impacts are common causes

earthquakes and volcano eruptions have triggered tsunami in this region in the past.

5. Erosion and sedimentation

Soil erosion and the resulting sedimentation constitute major natural hazards causing social and economic losses. Erosion occurs in all climatic conditions. However, it is discussed as an arid zone hazard because it is a major proximate cause of desertification associated with salinization. Erosion by water or wind occurs on any sloping land regardless of its use.

Soil erosion has three major effects: loss of support and nutrients necessary for plant growth; downstream damage from sediments generated by erosion; and depletion of the water storage capacity, because of soil loss and sedimentation of streams and reservoirs, which results in reduced natural stream flow regulation.

Stream and reservoir sedimentation is often the root of many water management problems. Sediment movement and subsequent deposition in reservoirs and river beds reduce the useful lives of water storage reservoirs, aggravate the flood water damage, impede the navigation, degrade the water quality, damage crops and infrastructures, and result in excessive wear of turbines and pumps.

6. Salinization

Saline water is common in dry regions, and soils derived from chemically weathered marine deposits (such as shale) are often saline. However, saline soils have usually received salts transported by water from other locations. Salinization most often occurs on irrigated land as the result of poor water control. The primary source of salts impacting soils is the surface and/or the ground water. Salts accumulate because of the flooding of low-lying lands, the evaporation from depressions having no outlets, and the rise of ground water close to the soil surfaces. Salinization results in a decline in soil fertility or even a total loss of land for agricultural purposes. In certain instances, farmland abandoned because of salinity problems may be subjected to the water and wind erosion.

Inexpensive water usually results in over-watering. In dry regions, salt-bearing ground water is frequently the major water resource. The failure to properly price water from irrigation projects can create a great demand for such projects and result in misuse of available water, causing waterlogging and salinization.

7. A territory vulnerable to climate change

In 2014, IPCC, which assesses the state of knowledge on climate change, identified the Mediterranean as one of the 25 hotspots of climate change. It is a particularly vulnerable territory due to the fact that:

- Its position between two climatic regimes (arid in North Africa - temperate in Europe);
- Its geographical specificities (semi-enclosed sea surrounded by mountains);
- Its extensive coastline with high concrete content and population concentration.

An increase of 2 to 3°C is expected in the territory by 2050. Temperatures could reach 5°C more by 2100. Currently, the increase is already higher in the Mediterranean Basin than in the rest of the world. There was an increase of 1.4°C over the pre-industrial era compared to 1°C for the whole world.

In addition, the Mediterranean Basin, whose climate is already rather arid, will see its summer rainfall fall by 25% on the Northern shore and 35% on the Southern one. The most pessimistic scenarios predict a decrease of 40% in precipitation by 2100 depending on the country and season. The precipitation reduction is mainly due to the increase of greenhouse gases emissions causing a greater change to climate.

Storm events will intensify, increasing the risk of high floods, which can be destructive to the territory and its biodiversity, and leading to human and economic losses. Similarly, droughts and heat waves will become more frequent, leading to significant water stress in the territory.

Climate change could also lead to the development of new risks, such as sea level rise, ranging from 40cm to 1m by the end of the century, but also, the acidification of water, caused by an excessive absorption of carbon dioxide.

It is therefore important for the whole Mediterranean Basin to act for sustainable development and to establish strategies for resilience and adaptation to climate change.

Position of the topic in the school program:

	11	12	13	14	15	16	17
Mother / Foreign language / Litterature							
History	X	X	X	X	X	X	X
Geography	X	X	X	X	X	X	X
Mathematics							
Biology / Geology	X	X	X	X	X	X	X
Physic / Chemistry							
Social Science / Economy / Law						X	X
Art / Musics							
Technology / Computer science							

Ressources:

- All information about the european agreement (Council of Europe) about natural hazards : https://www.coe.int/en/web/europarisks/about-us
- Resources for young people (in french) about prevention of natural hazards : http://www.jeunes.gouv.fr/spip.php?article7110
- Risks of Tsunami : https://www.eskp.de/en/natural-hazards/tsunami-risk-in-the-mediterranean-sea-935107/
- Coastal risks : https://www.coe.int/t/dg4/majorhazards/activites/2009/Murcia_26-27oct2009/Murcia_26-27oct09_Micallef.pdf
- Tsunamis and coastal risks : https://www.nationalgeographic.com/environment/natural-disasters/tsunamis/
- About earthquakes : https://www.who.int/hac/techguidance/ems/earthquakes/en/ ; https://www.n-d-a.org/earthquake.php
- About floods : https://www.nationalgeographic.com/environment/natural-disasters/floods/
- A geopark is a protected area with geological attractions generally corresponding to geosites Some geoparks in the Mediterranean region are involved in projects to raise awareness of geological phenomena and in particular geological risks. Accéder à la liste des géoparks de l'UNESCO : http://www.unesco.org/new/fr/natural-sciences/environment/earth-sciences/unesco-global-geoparks/list-of-unesco-global-geoparks/
- An overview of natural hazards in european Region : https://www.espon.eu/sites/default/files/attachments/20130704_ESPON_TERRITORAL_07_CS6_CM_Final.pdf

Biodiversity

Topic summary:

The Mediterranean Basin welcomes a tremendous diversity of habitats and species. Habitat loss, invasive species, overexploitation, pollution, tourism and other kind of anthropogenic activities –impacts are the primary causes of biodiversity degradation in the Mediterranean Basin. In this topic, some essential environmental issues related to the reduction of biodiversity in the Mediterranean are presented.

Main concepts covered:

* Endemic species
* Alien species

Transversal competencies acquired:

* Communicating orally / writting in mother/foreign language
* Managing information
* Getting organized and planning
* Mobilizing reasoning
* Mobilizing computer/digital skills

Definition of key notions:

Ecosystem:

A community of living organisms in conjunction with the non-living components of their environment, interacting as a system.

Biodiversity:

A contraction of biological diversity. It reflects the number, variety and variability of living organisms. It includes diversity within species (genetic diversity), between species (species diversity), and between ecosystems (ecosystem diversity).

Endemic species:

Any species whose range is restricted to a limited geographical area.

Alien species:

Any live specimen of a species, subspecies or lower taxon of animals, plants, fungi or micro-organisms introduced outside its natural range; it includes any part, gametes, seeds, eggs or propagules of such species, as well as any hybrids, varieties or breeds that might survive and subsequently reproduce (EU 1143/2014).

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This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

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Introduction of the topic:

The Mediterranean is a semi-enclosed sea at the crossroads between Europe, Africa and Asia, representing just 0.82% of the surface area of the world's oceans. Its geological and human history has given the Mediterranean region its richness in terms of biodiversity, but also in terms of social, cultural and political diversity.

The Mediterranean region is considered to be one of the world's hotspots where biodiversity is exceptional.

The Mediterranean Basin is the third richest hotspot in the world in terms of its plant biodiversity (25,000 species), and one of the most important areas on Earth for endemic plants. The Mediterranean Sea, even though representing a small part of the world's oceans, is inhabited by an unusually rich and diverse biota. It is one of the major reservoirs of marine and coastal biodiversity, with 28% of endemic species and 7.5% of the world's marine fauna and 18% of its marine flora. About one-third of the Mediterranean fauna is endemic.

It hosts approximately 17,000 species, representing 4–18% of the world's marine biodiversity, and includes temperate, cosmopolitan, subtropical, Atlantic and indo-pacific taxa. Many of these species are rare and/or threatened and are globally or regionally classified by the International Union for Conservation of Nature (IUCN) as threatened or endangered.

Unfortunately, the Mediterranean is amongst the most impacted regional sea areas, as a consequence of different anthropogenic pressures on several coastal and marine ecosystems. Human activities such as overpopulation, coastal urbanization, littoralization, trade, pollution, uncontrolled expanding tourism, and unsustainable modes of consumption, are fundamentally and irreversibly responsible for biodiversity loss and ecosystem services degradation in the Mediterranean region. Furthermore the habitat modification and loss, the climate change (e.g. warming, acidification and sea level rise), the pollution, the overexploitation (e.g. overfishing) , the scarcity of fresh water, and the intentional or indirect introduction of invasive species (also called alien species), largely contribute to the biodiversity reduction, degradation and loss.

To enable students to understand the value of biodiversity and the importance of its conservation in the Mediterranean Basin, a series of themes will be presented below. These themes address both important Mediterranean endemic species and the threats they face, as well as other issues affecting the conservation of biodiversity.

The student will be able to communicate more effectively about biodiversity issues

Such us:

- What is the status of biodiversity in the Mediterranean Basin?

(Students will be able to explore the status of the biodiversity in the Mediterranean and why biodiversity is declining in the basin. By learning about the causes and consequences of biodiversity loss, the students will be able to participate in maintaining biodiversity in the future)

- How can we protect biodiversity in the Mediterranean region?

Students will be able to identify ways to ensure that biodiversity will be adequately maintained for the future generations. Students should also be able to understand that the ecological integrity, the social equity, and the economic prosperity are connected and are important components of a sustainable society.

Sustainable development issues identified in this topic:

According to the sustainable development goal (SDG) 15: "Life on Land "and to the SDG 14: "Life below water", the preservation of biodiversity and the sustainable use of ecosystem services are required in order to ensure the survival of our planet, the well-being of all living creatures, including our own species. Concepts in this section help students to investigate on how the biodiversity affects their lives and supports life on Earth. Understanding the importance of biodiversity increases students' awareness of why and how people's actions affect biodiversity and why is it important to protect, maintain and (if possible) to restore biodiversity.

The issues raised by the proposed theme are given below:

• Endemic and/or keystone marine species and the threats they face (sea grass meadows, hard corals, white sharks ,blue fin tuna, sea turtles, the Mediterranean Monk seal, cetaceans etc.);

• Alien species (Green alga species *Caulerpa taxifolia,* fish species, *Siganus rivulatus* and *Siganus luridus*, small mussel, *Brachidontes pharaonic*, *Pterois miles*, *Lagocephalus sceleratus* and *Plotosus lineatus* (the latter being the only marine alien species of Union Concern) etc.)

• Mediterranean Wetlands

• Marine Protected Areas (MPAs)

• Pollution

1. Endemic and/or charismatic species in Mediterranean

Among animals, freshwater fishes (about 400 species) and amphibians (108 species) have the highest rate of endemism with 253 species (63%) and 76 species (70%) respectively. Reptiles (349 species), including two resident marine turtles, have a 48% (168 species) rate of endemism with a high proportion of lizards (65%) and snakes (30%). Mammals include 297 species, 30% of which are terrestrial endemic species, including a great number of rodents, shrews, moles and hedgehogs. Considering the marine environment, it has a high rate of endemism as well as many emblematic or charismatic species of conservation concern, such as turtles, cetaceans and the endangered Mediterranean monk seal (*Monachus monachus*). There are several unique and endangered habitats, including the seagrass meadows of the endemic *Posidonia oceanica*, vermetid terraces built by the endemic gastropod *Dendropoma petraeum*, coralligenous assemblages, and deep-sea and pelagic habitats that support unique species and ecosystems. The avifauna includes about 600 species with around 500 bird species known as being permanent and breeding within the Mediterranean neighboring countries. Many sensitive habitats exist within the coastal ecosystems.

Further reference will be made to some important species such as:

• Sea turtles *Caretta caretta* and *Chelonia mydas*;

• The great white shark;

• Cetaceans fauna;

• Seagrass medows (*Posidonia oceanica*);

• The monk seal (*Monachus monachus*).

2. Alien species

The introduction of non-native species into an ecosystem can threaten endemic wildlife (either as predators or competing for resources) and affect human health and ecosystem services (with quite important effects on the local/Mediterranean economies).

As alien species are considered plants, animals, fungi and micro-organisms that have been transported inadvertently or intentionally across ecological barriers and have established themselves in areas outside their natural range. They can create serious problems for the native species. Alien species spreading rapidly across the natural environment, interacting with native species and posing threats to native biota and/or ecosystems. More than 985 alien species are found in the Mediterranean Sea. There are various introduction pathways. The most important one is the Suez Canal, which is responsible for the introduction of more than 420 Lessepsian species. Most of these species are currently present in the Eastern part of the Mediterranean Sea and some gradually expanding their range of distribution westwards. The second most important pathway is shipping, responsible for the introduction of 300 alien species that are scattered all over the Mediterranean, especially close to the harbors. Aquaculture is responsible for the introduction of 64 alien species, which are mainly found in two areas with aquaculture facilities: the Thau Lagoon (Gulf of Lion, France); and the Venice Lagoon (Northern Adriatic, Italy). Last but not least, as the number of species is drastically increasing, is aquaria releases, including species that are deliberately released in the natural environment by aquarists.

Some indicative alien species are the following:

• Killer Algae (*Caulerpa taxifolia*)

• Blue-spotted Cornefish (*Fistularia commersonii*)

• Silver-cheeked Toadfish (*Lagocephalus sceleratus*)

• Devilfire fish or Lionfish (*Pterois miles*)

• Redcoat (*Sargocentron rubrum*)

• Nomad Jellyfish (*Rhopilema nomadica*)

• Indo-Pacific Mussel (*Brachidontes pharaonis*)

• Striped eel catfish (*Plotosus lineatus*), this being the only marine alien species of EU Concern.

3. Mediterranean wetlands

Mediterranean wetlands include a wide variety of natural habitats such as river deltas, freshwater, brackish, and salt lakes and marshes, permanent and intermittent rivers, floodable forests along rivers, as well as salt pans and dammed reservoirs.

Natural and human-made wetlands in the Mediterranean countries are estimated to cover ca. 0.15-0.22 million km2, about 1.1-1.5% of wetland area globally. Almost one-quarter (ca. 23%) of Mediterranean wetlands are now human-made (such as rice fields, reservoirs, saltpans and oases) – a much higher percentage than the global average of ca. 12% 2.The largest wetland areas are in Egypt, France, Turkey and Algeria, together making up

about two-thirds of the Mediterranean wetland area. Given the arid or semi-arid nature of the Mediterranean Basin, the percentages of national surface areas covered by wetlands are generally small, ranging from over 8% in Tunisia to less than 1% in eight countries, mostly in the Middle East and North Africa. But all these wetlands are of great importance to people's livelihoods and for maintaining biological diversity.

Mediterranean wetlands are in degraded condition and they are under threat. The last century has seen the loss of more than half of the wetlands, which has resulted in a dramatic degradation of their functions and in a loss of their values. The loss of wetlands in the Mediterranean region will affect endemic freshwater fish, amphibians, mammals and reptiles. Even if many attempts have been made to counteract this trend, the degradation and loss haven't been stopped or reversed yet.

Wetlands in the Mediterranean Basin provide many and varied benefits in terms of well-being to the Mediterranean population.

People directly harvest wetland-dependent plants and animals through fishing and hunting for food, and they use wetlands for grazing animals. Wetlands in increasingly dry regions, such as the Mediterranean, are particularly crucial for the sustainable management of water resources, in terms of both quality and quantity. They help to provide and purify water upon which people depend on for drinking, industry, energy production and irrigated agriculture. Mediterranean wetlands, particularly coastal wetlands, are important for helping to mitigate climate change as they help to manage extreme weather events through buffering floods and coastal storm-surges and providing water in droughts. Conversely, wetlands draining or the water resources reduction can result in the release of large amounts of stored carbon. Wetlands are also increasingly important for their aesthetics and beauty, and more and more people are visiting wetlands for education and tourism.

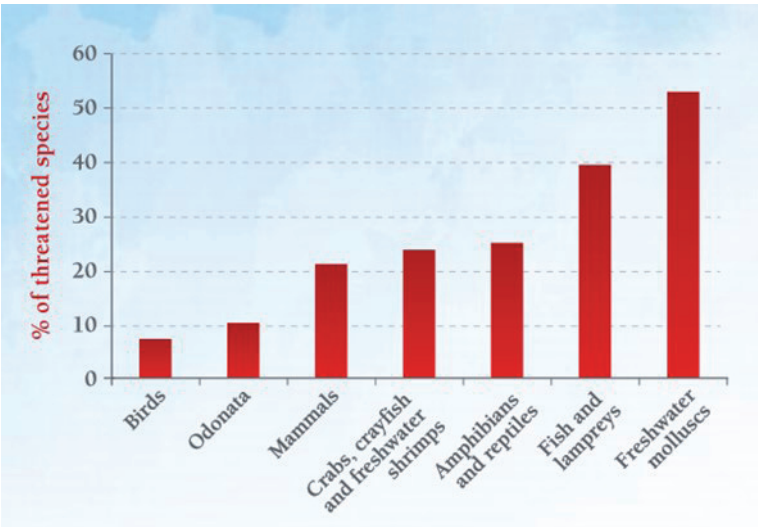

Figure 1: Proportion of species threatened (grouping together categories CR, EN. And VU) by taxonomic group –Source MWO, IUCN

4. Marine Protected Areas (MPAs)

Marine protected areas (MPAs) are geographically distinct zones for which protection objectives are set. They constitute a globally connected system for safeguarding biodiversity and maintaining marine ecosystem health and the supply of ecosystem services. Almost 86 000 km² of the Mediterranean is classified as MPAs or are

considered as Natura 2000 sites. Since 2016, only 3 % of the Mediterranean Sea have been protected.

5. Pollution

Pollution is the release of harmful substances, such as pesticides and sewage, into the environment. Biodiversity is threatened by many types of pollution, including the build-up of carbon dioxide and other greenhouse gases in the atmosphere, acid rain and toxic chemicals (released into the air, soil, or water during manufacturing, farming, building, mining, transportation, and many other activities). All forms of pollution (air, water, soil, noise) pose a serious threat to the biodiversity.

Position of the topic in the school program:

	11	12	13	14	15	16	17
Mother / Foreign language / Litterature	X	X	X	X	X	X	X
History	X	X	X	X	X	X	X
Geography	X	X	X	X	X	X	X
Mathematics							
Biology / Geology	X	X	X	X	X	X	X
Physic / Chemistry	X						
Social Science / Economy / Law						X	X
Art / Musics	X	X	X	X	X	X	X
Technology / Computer science							

Ressources:

- https://mio-ecsde.org/project/vlachogianni-t-vogrin-m-scoullos-m-aliens-in-the-mediterranean-mio-ecsde-athens-2013/
- https://www.researchgate.net/publication/236231013_Ecosystem_and_Biodiversity_Hotspots_in_the_Mediterranean_Basin_Threats_and_Conservation_Efforts
- www.medqsr.org/biodiversity-and-ecosystems
- https://cmsdata.iucn.org/downloads/the_mediterranean_a_biodiversity_hotspot_under_threat_factsheet_en.pdf

Climate Change

Topic summary:

Although it is an ancient phenomenon, climate change is increasingly the subject of current affairs. As a result of the increase in greenhouse gases, the average temperature is warming causing meteorological changes, changes in biodiversity, but also has socio-economic impacts.

Main concepts covered:

* Temperature
* Biodiversity
* Climate
* Economy

Transversal competencies acquired:

* Communicating orally / writting in mother/foreign language
* Managing information
* Mobilizing reasoning
* Knowing how to adopt according the difficulties

Definition of key notions:

Greenhouse effect:

Gases form a protective layer around the earth retaining the heat of the sun, much like the gardener's greenhouse

Carbonic dioxide:

Naturally present in the environment, it is stored in plants and oceans. Humans release billions of tonnes of CO2 from the burning of fossil fuels, deforestation and agricultural practices

Ocean acidification:

The ocean pH by absorbing part of the additional CO2 decreases and has negative effects on the growth and the reproduction of certain marine organisms.

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Introduction of the topic:

Climate change is defined as the variation of the climate due to natural or human factors. It is characterized by a global increase in average temperatures (= global warming) which causes regional, seasonal and extreme meteorological disturbances (= climate change) such as droughts, storms, cyclones, typhoons ...

This phenomenon is being monitored by IPCC (Intergovernmental Panel on Climate Change). Created in 1988, it regularly assesses scientific, technical and socio-economic information related to climate change.

Be careful to not confuse meteorology and climate. The weather is the weather at a given time and place, while the climate is observed over a period greater than 30 years.

Although this problem has received media attention in recent years, this phenomenon is not new: it started with the industrial area. Indeed, each of the past three decades has been successively warmer on the surface of the Earth than all previous decades since 1850. And there has been an increase of 1°C between 1850 and today (climate variability can only explain a difference of 0.2°C). However, it is now urgent to act: if we continue on the current trends, we will reach in 20 years the 1.5°C that we should reach in 2100.

The first description of the greenhouse effect was made in 1827 by Joseph Fourier. Present in the atmosphere, certain gases retain a part of the solar energy allowing an average temperature of 15°C (which would otherwise be -18°C). Currently, the earth is warming due to an increase in greenhouse gases.

Sustainable development issues identified in this topic:

What are its causes, consequences and solutions in the Mediterranean territory? What are the effects already visible and its prospects?

1. What is link between climate change and human activities?

Present in the atmosphere, gases such as CO2 trap a part of the solar energy allowing an average temperature of 15°C (which would otherwise be -18°C).

Since the beginning of the industrial era, humans have been using fossil fuels and releasing more CO2 into the atmosphere than the Earth could absorb. This higher greenhouse gases concentration leads to a reduction in the radiation reflected back into space and an increase in the radiation reflected back to the ground. This phenomenon is the cause of global warming and therefore of climate change.

2. What is the impact on the climate and the sea?

Climate change is characterized by an overall increase in average temperatures. It results in an increase in temperatures and a decrease in precipitations. In the Mediterranean:

Presently, we are observing:	The projections are:
- An increase in hot days, hot nights; - An increase in heat waves and heat peaks; - No clear trend in the evolution of annual precipitation; - Increasing droughts.	- Substantial increase in temperatures; - The waves of heat and heat peaks are more frequent , more long and / or intense; - Significant increase in droughts.

The hot seasons will therefore be warmer and drier. On land, it is expected that soil degradation combined with periods of drought and fires will contribute to the desertification. We are also talking about a potential runaway effect, which could occur beyond a tipping point, leading to an acceleration of the phenomenon and an amplification of the harmful effects.

At the level of the Mediterranean Sea:

Presently, we are observing:	The projections are:
- Average surface water temperature rises; - Deep waters have already warmed by almost 1 ° C since 1980; - The thermocline goes down.	- Surface waters are expected to warm by 2.5 ° C by 20100; - Freshwater deficit will lead to increased salinity; - An increase in sea level from 0.3 to 0.5m by 20100 following the melting of glaciers and ice caps. (The increase in temperature causes a decrease in the density and thus the volume of water. In contrast, an increase in salinity causes a decrease in density. This is compensated).

In addition, the increase in extreme phenomena and the rising waters contribute to increasing coastal erosion.

3. What impact does this warming have on flora and fauna?

Due to the high temperatures , the life cycles of the species are disturbed (early flowering, late leaf fall, etc.). The ranges are moving north.

In the Mediterranean:

Presently, we are observing:	The projections are:
- The rise in temperature impacts marine habitats and causes mortalities in deep seagrass meadows, gorgonians and sponges; - The prosperity growth of exotic species and modification of migration habits of certain fish species; - The early return of some birds, wintering further north of large waders (former flamingos) and reduction in the number of wintering waterbirds.	- An increase mass mortality phenomena; - The simplification of ecosystems and modifications of food chains which could have an impact in particular on the distribution of certain cetacean species; - The extension of the area of distribution and abundance of exotic species; - The reduction of marine fish affected by exploitation - Strengthening of threats to birds and favoring the breeding of some species.

4. What socio-economic consequences?

Climate change has also an impact on human activities and populations.

Presently, we are observing:	The projections are:
- Change in the behavior of certain commercial species, but allow the exploitation of new resources; - Increase in fires since 1970.	- Future of uncertain fisheries; - Water scarcity and increased research for water; - Decrease in summer tourism and tourist sites; - Deterioration of tourism reception conditions in summer due to the heat and increase in spring and autumn; - Agriculture impacted by changing precipitation patterns; - Flooding in coastal areas and threat to coastal development due to erosion and rising sea levels, resulting in forced migration of populations.

5. A little history

The first description of the greenhouse effect dates from 1927 by Jospeh Fourier.

In 1988, Intergovernmental Panel on Climate Change (IPCC) was created, which regularly assesses scientific, technical and socio-economic information related to climate change. This group presented its first report in 1990.

At the Earth Summit in Rio de Janeiro in 1992, the Conference of the Parties (COP) has been established with the adoption of the UN Framework Convention on Climate Change. Each year, it brings together the

signatory countries, non-governmental organizations (NGOs), local authorities, trade unions, companies, etc. The objective of COP is to develop the United Nations Framework Convention on Climate Change by taking stock of the implementation of the commitments made in favour of the climate, by specifying them, and bynegotiating new commitments.

In 1997, the Kyoto Portocole came into force, which requires 38 industrialized countries to reduce their emissions by 5% (compared to 1990 levels) between 2008 and 2012.

In 2012, new emission reduction targets were set under the Kioto Protocol for the period 2013-2020 (unfortunately in a reduced number of countries).

In 2015, COP 21 took place in Paris. For the first time, upstream of this meeting, MedCOP was set up (a kind of COP centred on the Mediterranean).

The objective is to limit the increase in the average temperature of the earth to 2°C, by reducing greenhouse gas emissions and promoting sobriety and energy efficiency as well as renewable energies. Furthermore, we have to adapt to this change while respecting the needs of the ecosystems and populations.

Position of the topic in the school program:

	11	12	13	14	15	16	17
Mother / Foreign language / Litterature							
History							
Geography	X	X	X	X	X	X	X
Mathematics							
Biology / Geology			X	X	X	X	X
Physic / Chemistry	X	X	X	X			
Social Science / Economy / Law						X	X
Art / Musics							
Technology / Computer science							

Ressources:

- ADEME: le changement climatique en 10 questions – Mai 2018
- Plan Bleu: Les enjeux du développement durable en Méditerranée dans un context de changements climatiques – Septembre 2013
- Réseau Action Climat France: kit pédagogique sur les changements climatiques – 2015
- IUCN: Changement climatique et milieu marine n Corse – 2018
- MedPAN: La méditerranée : un environnement marin côtier en mutation selon les scenarios sur l'évolution du climat – 2012

Part 2 – Education and Mediterranean Sea

Place of the Mediterranean sea in educationals programs

Despite the enormous importance that the Mediterranean Sea plays in all inhabitants' lives of the Mediterranean region, and in Europe as a whole, it does not have the place it deserves in school curricula. It is not a central subject in any school discipline, even if it can be mentioned discussing about other topics. A little more directly the sea is approached in geography, by studying the countries of the Mediterranean Basin and the Mediterranean climate. It is the same in the contents of the natural science programs, the Mediterranean Sea is only mentioned when we talk about the particularities of the Mediterranean flora and fauna. With such an educational approach, students in the Mediterranean have few opportunities to familiarize themselves with their sea, to know its values, to learn to value and preserve it, and to manage it sustainably in the future.

We believe that the school curricula in each partner country should not be an obstacle to the change of the approach. Innovative and attractive teaching can be integrated into most school subjects and into curricula and even outside teaching activities.

This will be the content of our Activity Guide.

	Mother and Foreign language / Litterature	History	Geography	Mathematics	Biology / Geology	Chemistry / Physics	Social Science / Economy / law	Art /Musics	Technology / Computer science
Waste and Pollution			X		X	X	X		
Seawater quality			X		X		X		
Artificialization of the coastline	X		X		X			X	
Energy: Production and resources		X	X		X	X	X		
Maritime economy		X	X		X		X		
Politics and governance		X	X		X		X		
Cultural heritage	X	X	X		X		X	X	
Natural hazards in the Mediterranean Basin		X	X		X				
Biodiversity	X	X	X		X	X	X	X	
Climate Change		X	X		X	X	X		
Based on the 5 countries of the project									

	11	12	13	14	15	16	17
Waste and Pollution		X	X	X	X	X	X
Seawater quality	X	X	X	X	X	X	X
Artificialization of the coastline	X	X	X	X	X	X	X
Energy: Production and resources	X	X	X	X	X	X	X
Maritime economy	X	X	X	X	X	X	X
Politics and governance	X	X	X	X	X	X	X
Cultural heritage	X	X	X	X	X	X	X
Natural hazards in the Mediterranean Basin	X	X	X	X	X	X	X
Biodiversity	X	X	X	X	X	X	X
Climate Change	X	X	X	X	X	X	X
Based on the 5 countries of project							

Glossary

WASTE AND POLLUTION

Environmental issues due to the impacts of pollution and waste in terrestrial and marine ecosystems.

SEAWATER QUALITY

Water condition monitoring by key parameters and associated impacts such as water quality issues (from coastal and marine recreational and economic activities) and their impacts on human and marine life.

COASTLINE ARTIFICIALIZATION

Alteration of the physical condition of a coast and its replacement by an artificial surface, resulting in the loss of natural resources and the waterproofing of the soils.

ENERGY: PRODUCTION AND RESOURCES

Processes to provide energy and resources (renewable energies or fossil energies).

MARITIME ECONOMY

All activities related to oceans, seas and coasts (fishing, aquaculture, tourism and commercial navigation sectors). The maritime economy is now often referred to as the 'blue economy'. Blue economy is all about economic activities dependent on marine resources. It comprises of various verticals like aquaculture, maritime tourism, blue-biotechnology, ocean energy, marine mining, offshore oil and gas, etc.

POLITICS AND GOVERNANCE

All political systems and governance in the Mediterranean Basin including migration politics and international cooperation.

CULTURAL HERITAGE

The legacy of physical artifacts and intangible attributes of a group or society that is inherited from the past generations. It includes tangible culture (monuments, landscapes, old city centers) and intangible culture (folklore, language, traditions, spiritual contents).

NATURAL HAZARDS

Natural process or phenomenon that may cause loss of life (earthquakes, volcanoes, landslides, tsunamis, floods, fires..), injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

BIODIVERSITY

The distribution and variety of species found within a specified geographic region. Among other factors, the biological diversity depends on temperature, precipitation, altitude, soils, geography and other species. Biodiversity is typically a measure of variation at the genetic, species, and ecosystem level.

CLIMAT CHANGE

Climate change is a long term shift in global or regional climate patterns. As a result of increased greenhouse gas emissions, the average temperature is warming resulting in weather changes, changes in biodiversity and socio-economic impacts.

Erasmus+

MED Educ 2018-1-FR01-KA201-048146

BASTIA GOLO MEDITERRANEE

PETRA patrimonia

hcmr ΕΛΚΕΘΕ

Departament de Sostenibilitat i Medi Ambient Consell de Mallorca

ISTITUTO TECNICO NAUTICO DOMENICO MILLELIRE

ISTITUTO ISTRUZIONE SUPERIORE GIUSEPPE GARIBALDI LA MADDALENA

Liceo GIUSEPPE GARIBALDI

MedORO

OSNOVNA ŠKOLA PUČIŠĆA