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.

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/