

Sea Change Teaching Module 4 & 5: The Ocean – a Treasure Trove for Human Medicine, Health and Wellbeing

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1. Background Information to FEE Modules

The ocean makes planet Earth a habitable place to live and the marine environment is a source of vital human health benefits. Some of the invaluable benefits and services the ocean provides include:

Food: Seafood is a major food staple and protein source.

Transportation: 90% of all EU external trade is transported by sea and European ship owners control almost 40% of the world fleet (1).

Recreation: The benefits that can be derived from spending time around the ocean are intangible. Marine tourism is the second most valuable world marine industry after shipping and transport (2). **Inspiration:** The ocean has provided the inspiration for many great works of art.

Medicine: Biomedical products derived from marine plants and animals provide important medicinal products and health benefits.

Climate Regulation: The ocean plays a key role in climate regulation especially in buffering the effects of increasing levels of greenhouse gases in the atmosphere and rising global temperatures. **Economy:** Ocean-related industries provide revenue through fishing, seafood distribution, tourism, recreation and transportation. According to the EU Blue Growth programme, the 'blue' economy in Europe represents 5.4 million jobs and generates a gross added value of almost €500 billion a year, with further growth possible (3).

The ocean is vitally important to Europe. The EU Member States have between them the largest maritime territory in the world and all of us depend on the ocean and its resources. Despite the importance of Europe's sea areas, their sustainable development and protection faces threats from natural and human pressures. By better understanding the relationships between ourselves and the sea, we will be better able to protect these precious resources.

Ocean Literacy

Ocean literacy is an understanding of the ocean's influence on you—and your influence on the ocean (4)

An ocean-literate person:

- Understands the importance of the ocean to humankind
- Can communicate about the ocean in a meaningful way
- Is able to make informed and responsible decisions regarding the ocean and its resources

The Seven Principles of Ocean Literacy

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

2. The Ocean – a Treasure Trove for Human Medicine, Health and Wellbeing

The ocean covers some 70% of our planet's surface. It is a living system containing a wide range of habitats – from sunlit coral reefs and shallow coastal waters, to the vast, empty expanses of the open ocean and the eternal darkness of the ocean abyss.

But did you know that the ocean is also a treasure trove of existing and potential medicines that we are only now beginning to fully explore? After all, 80 percent of all living things exist in the ocean and it has been said that we are 300 to 400 times more likely to find new human medicines in the ocean than on land. (5)

Eating fish was always known to be healthy, because it is high in protein and minerals, low in fat and contains omega-3 fatty acids that reduce cholesterol and protect us from heart disease. Cod liver oil is known to be rich in essential vitamins including vitamin A and vitamin D as well as omega-3 fatty acids, which have anti-inflammatory properties. Oily fish, such as salmon, mackerel and sardines are also rich in omega-3 fatty acids as well as vitamin D, both of which prevent depression, lower inflammation, prevent blood clotting and preserve the health of the human brain. They are also capable of reducing pain levels and reducing swelling in inflammatory conditions such as arthritis. (6).

As well as providing a wide variety of natural medicines, the ocean is also a natural gymnasium and relaxation area. The seaside is one of the most popular holiday destinations. It also provides an extensive range of activities – from active water sports such as ocean yachting, water-skiing and scuba diving to more relaxing pursuits such as sea angling, birdwatching and simply relaxing on a beach, which are all good for our mental health and wellbeing (7).

Importantly, the sheer vastness of the ocean and its every-changing nature have given inspiration to numerous artists of all kinds, including writers, painters, sculptors and filmmakers.

The Human Health and the Ocean fact sheet

http://seachangeproject.eu/images/SEACHANGE/Media_Centre/HumanHealthOcean_Factsheet_set .pdf

2.1 The Ocean as a Treasure Trove for Human Medicine

Marine animals have no way of knowing that the chemicals in their bodies can have positive applications for human health. So why do they produce these very useful chemicals in the first place?

When animals cannot either fight or physically run away, as is the case with many 'sessile' (or rooted) marine animals such as barnacles and sea anemones, it helps to be able to exude chemicals which keep predators and competitors for space at a distance. Some of these chemicals have applications in human medicine.

Competition for space may also explain why some of these invertebrates produce anti-cancer agents. If two species are competing for the same piece of bottom space, it would be helpful to produce a substance that would attack rapidly dividing cells of the competing animal to stop it growing any bigger or reproducing more of its own kind.

For example, the shallow-water Caribbean sponge *Tectitethya crypta* contains two chemicals – spongothymidine and spongouridine – to keep competitors for space away. These chemicals have been used as models for the development of anti-cancer and anti-viral drugs such as AZT (a drug used to treat HIV), anti-viral drugs to treat herpes, and an anti-leukaemia drug (8)

Bryozoans or 'Sea Mats' are a common fouling organism in both temperate and tropical waters. They contain a compound which is the source of the anti-cancer compound bryostatin 1.

Secosteroids, a group of chemicals used by corals to protect themselves from disease, have been discovered to have healing properties against asthma, arthritis and other inflammatory diseases in human.

Coral reefs are home to a dazzling array of animal life, each of which may contain compounds with applications to human medicine. The corals themselves contain enzymes called secosteroids which can be used to treat asthma, arthritis and other inflammatory diseases in human beings.

The barnacle family, which has been considered a pest in the past because of the way their colonies build up on ships and piers, have now been discovered to be an important source of human medicine. The bryozoan 'Sea Mat' *Bugula neritina*, for example, produces an anti-cancer compound named 'bryostatin 1' and grows in such dense numbers that the U.S. National Cancer Institute

recently collected over 26,000 pounds of it from docks and pilings with little impact on the barnacle population (9).

Blue-green algae, which is commonly found in Caribbean mangrove swamps, can be used to treat small-cell lung cancer and has been endorsed by the National Cancer Institute for the treatment of melanoma and some tumours, while Yondelis[®] - the first new treatment in 30 years for soft-tissue sarcoma, can be extracted from sea squirts (10).

Other marine animals currently being investigated as sources of human medicine include:

- A soft coral called the Caribbean Sea Whip, which acts as a powerful anti-inflammatory drug on human skin (11)
- Sea sponges, sea squirts and sea slugs all contain bioactive molecules which can protect us from viruses, bacteria and even cancer tumours (12)
- Bivalve shellfish, which are being investigated for clues about the human ageing process, including metabolic activity and stresses brought about by our environment (13).

2.2 The Ocean Gym

The fact that so many people take their holidays by the ocean reveals its importance as a source of physical and mental wellbeing. People find the seashore a great source of calmness and peace, which provides the chance to observe a vast natural resource which stretches out beyond the horizon. "Being near, in, on or under the water can make you happier, healthier, more connected and better at what you do", says scientist Wallace J. Nichols in his book 'The Blue Mind' (14).

Participation in marine sports and leisure activities – from yachting to SCUBA diving or from sunbathing to surfing – increase both our physical and mental wellbeing, through exercise and relaxation.

How many marine sports and leisure activities have you tried? Here are a few examples:

Swimming	Surfing	Photography
Paddling	Water Skiing	Painting
Sunbathing	Kite surfing	Beachcombing
Yachting	Snorkelling	Cliff walking
Canoeing	SCUBA diving	Making sandcastles
Angling	Bird watching	Wildlife spotting

As well as the health benefits that time by the ocean can bring to the individual, marine leisure and tourism is a major contributor to the economies of many seaside communities. In 2011, it was estimated that maritime and coastal tourism in Europe employed 3.2 million people and was worth some €138 billion to the European economy. Coastal areas attract more than one third of all tourism business in Europe. Which is no wonder, the extraordinary beauty, cultural wealth and great diversity of Europe's coasts make them the preferred destination for many holidaymakers from Europe and abroad.

(source: https://ec.europa.eu/maritimeaffairs/sites/maritimeaffairs/files/docs/body/coastal-and-maritime-tourism_en.pdf)

2.3 The Ocean and Creativity

Another way the ocean contributes to the health and wellbeing of humankind is through its positive influence on creativity (15). This may be because of the relaxing effect of being next to the ocean, the sense of wonder it inspires, or the excitement of witnessing a storm at sea. Whatever the cause, the ocean has been the source of inspiration for many scientists, philosophers, artists and writers over the centuries. Great works of art inspired by the ocean include:

<i>The Old Man and the Sea</i> – Novel by Earnest Hemingway	<i>Four Sea Interludes</i> – Music by Benjamin Britten	
20,000 Leagues Under the Sea – Novel by	Hebrides Overture – Music by Mendelssohn	
Jules Verne	Octopus's Garden – Music by the Beatles	
Moby Dick – Novel by Herman Melville	<i>The Fighting Temeraire</i> – Painting by J.M.W. Turner	
The Tempest – Play by William Shakespeare		
<i>La Mer</i> – Music by Debussy	The Gulf Stream – Painting by Winslow Homer	

3. Help the Ocean to Help You

- Despite its seemingly limitless size the ocean is a delicate living system, inhabited by animals and plants which can be affected by even minute changes in their environment.
- Our own activities on land and at sea from the burning of fossil fuels such as petrol, diesel and coal, which produce carbon dioxide gas and increase ocean acidity, to plastic litter and the overexploitation of fish stocks – can all affect the ocean and the delicate balance of life it contains.
- Damaging the health of the ocean and its ability to create the oxygen we rely on to breathe or the food we need to eat is really putting our own health at risk. View video 'Our Ocean Our Oxygen' <u>https://vimeo.com/173739456</u>

Your role: Using marine resources sustainably

When choosing medicines produced from marine animals and plants, it is essential to choose only those created by sustainable means. Using marine animals and plants as a source of human medicine can be of great benefit, but its collection and harvesting can present dangers to the living things that produce it (16).

The harvesting of seahorses for use in traditional medicine increased ten-fold during the 1980's to the point where annual consumption reached 50 tons a year in Asia alone – representing about 20

million animals supplied by 30 different countries. This virtually halved the worldwide population of seahorses between 1990 and 1995 (17).

To protect such species, and to provide a guaranteed supply of the sought-after compounds, the alternative to harvesting large numbers of marine animals and plants is to analyse the active compounds they contain and then try to reproduce them artificially. Alternatively, valuable species can be 'farmed' in large numbers and the active compounds harvested, which is what has been done with one species of sea squirts that produces anticancer chemicals (18).

4. Teacher's Notes and Activities

Marine animals and plants have long been recognised for their health-giving and curative properties. Today however, we are facing the challenge of exploration and discovery of new compounds from marine organisms while striving to preserve the environment in which they live against global warming, pollution and overfishing.

Large scale harvesting of marine organisms – even to save human life or promote human health – must be sustainable. This not only preserves the habitats in which these organisms live, but also ensures that enough of them remain in place to breed and sustain their population.

Humankind has long recognised the benefits to health and wellbeing that come from the ocean – as a source of nutritious food, as a place to relax and as a source of inspiration. However, as the technological and industrial ability of humankind grows, along with its demand for food and other resources, so do the effects we are having on the health of the ocean.

These effects include marine pollution, habitat destruction and overfishing, along with global warming, which has reduced the size of the polar icecaps and led to an increase in sea level across the world.

The ocean has also been a great inspiration to artists of all kinds. We suggest four creative activities that might be fun to do.

The aim is to help students understand the links between a healthy ocean and human health and creativity. The activities can be adapted to teaching pupils between ages 6 and 14.

The activities proposed in this pack focus on:

- Outlining the ways in which the ocean supports all life (including our own) on planet Earth
- Illustrating the ways in which the ocean contributes to our health and wellbeing
- Addresses Ocean Literacy Principle # 6 'The ocean and humans are inextricably interconnected'
- Demonstrating that human actions can damage the health of the ocean and even put our own health at risk

<u>Keywords:</u> ocean literacy, global warming, marine pollution, overfishing, sustainable fisheries, biodiversity

Learning Outcomes

- Recognise that the ocean is important to humankind and a source of vital health benefits
- Explain that the ocean provides food, medicines, oxygen and is a source of health and wellbeing
- Recognise that humans have altered (and continue to alter) the marine environment, sometimes harmfully
- Identify ways in which marine pollution and habitat destruction takes place
- Explain ways in which the marine environment can be protected
- Identify everyday actions anyone can take to protect the marine environment
- Identify and use key vocabulary associated with the marine environment, health and wellbeing
- Understand that much of the oxygen we breathe is generated in the sea by seaweeds and microscopic plants called 'phytoplankton'

To initiate this topic, it is suggested that a discussion around the question "What would our life be like if the ocean did not exist?" take place and the points identified recorded and displayed.

These points can be added to as the lesson progresses and reviewed at the end of the period.

The objective of the exercise is to allow students to explore and appreciate the myriad ways in which the ocean contributes to human health, wellbeing and creativity on planet Earth.

Activity 1 – Old Wives' Tales

The ocean covers two thirds of our planet's surface. Humans have no control over its storms and currents. There are reefs to navigate and giant waves to contend with. In the centuries gone past, seafarers had great respect for the uncontrollable forces of the ocean. But they also thought up clever imaginary 'rules' or 'Old Wives Tales' about the sea to give them a feeling that somehow, they understood and might even be able to control the mysterious forces of Nature around them and come back to their loved ones alive and well (19).

• "Never go to sea on a Friday"

This superstition is linked to the idea that Jesus Christ was crucified on a Friday and Adam and Eve were expelled from the Garden of Eden on that day.

• Never whistle at sea

This comes from the belief that to whistle at sea will cause the wind to rise. This is where the expression 'whistling up a storm' comes from.

• Never kill a swallow, an albatross or a seagull while at Sea

This is because these birds were thought to carry the souls of lost sailors.

• Dolphins and Sharks

Having a dolphin swimming alongside a ship was a sign of good luck. But having a shark following a ship was thought to be a sign of bad luck to come.

• Red Hair and Flat Feet.

Meeting a red-headed person or one with flat feet on the way to your ship before she sailed. was thought to be bad luck. However, if you spoke to them before they spoke to you, this bad luck could be avoided.

• Don't mention the 'D' word!

The words 'drowning' or 'drown' were never to be spoken while at sea in case this summoned the actual event!

• Bringing good luck

Pouring a glass of wine onto the deck of a ship, or throwing a coin into the sea as a tribute to the sea god Neptune, was thought to bring good luck on a voyage.

Likewise, having a woman with her eyes open as the figurehead of a ship would bring good luck as she would be able to see trouble ahead and guide the ship around it.

• Cats are 'good luck' at Sea

Having a cat on board a ship is said to bring good luck. Sailors even used the cat as a kind of barometer, in that if the cat sneezed, rain was said to be on its way. If the cat was playful, then the wind would soon start to blow.

• "Eating fish is good for your brain"

This 'Old Wives' Tale' is actually true - because fish contain omega-3 fats. Omega-3 fats make up a large part of the human brain. Since we are born with only 75% of our brain cells already in place, we need to eat plenty of omega-3 fats to make up the rest. This is why omega-3 rich foods such as cod liver oil are fed to young babies, since the remaining 25% of our brain cells are made up over the first year after birth. It is also recommended that mothers who are expecting a baby should eat two servings of fish a week – including at least one oil-rich fish, such as mackerel or herring.

Activity 2 - Write a 'Sea Story'

Get creative and write your own short story about the sea. Here are some ideas to get you started:

- My best ever holiday by the seaside
- The day in the life of a pirate
- What would it be like to be a mermaid / merman?
- What would happen if the ocean dried up?
- You can be any marine animal you want to be. What would you be and why?

Activity 3 - Drawing Cartoon Marine Animals

Copy and/or colour these two marine beasties

a) A Funny Fish





Activity 4 - Sea Shopping Quest

There are many products in the supermarket that have ingredients from the ocean. Can you match the cartoon and the description?

And can you find any of these products in your family's shopping cart?

Description		
1. Fresh seafood:		
Fish, mussels, oysters, shrimps, crabs, seaweed, as a whole or cut in pieces.		
2. Processed seafood:		
Seafood that is preserved through cooking, drying, freezing, a vacuum pack,		
3. Canned seafood:		
Seafood that is preserved through canning.		
4. Salt:		
A mineral that is used as a food flavor		
5. Fish oil pills:		
A dietary supplement rich in omega-3 fatty acids that is derived from oily fish such as salmon, cod and krill.		
6. Fortified foods:		
Fish oil (omega-3) is added to increase the nutrient content of foods such as butter, eggs, dog food, milk,		
7. Salt preservative:		
Salt is added to food to prevent decomposition. Salt absorbs water from foods, making the environment too dry to for bacteria.		
8. Marine derived E-numbers:		
Additives such as E401 that are used to thicken custard mix, cordial, flavoured milk, ice blocks, thickened cream, voghurt		
Also in ice cream, yoghurt, pudding, salad dressing, ham, chocolate milk, toothpaste, shampoo, shoe		
E401 is derived from kelp. It is also sold as kelp pills (20).		
9. Silica:		
A mineral that is found in sand and the cell wands of diatoms, used as an abrasive in toothpaste, in paint and in beer		
10. Algae cosmetics:		
Seaweed and algae are used for their moisturising and healing properties		













Here you can find the solution.

Description	Cartoon
1. Fresh seafood: Fish, mussels, oysters, shrimps, crabs, seaweed, as a whole or cut in pieces.	
2. Processed seafood: Seafood that is preserved through cooking, drying, freezing, a vacuum pack,	
3. Canned seafood: Seafood that is preserved through canning.	









Activity 5 Make a Sea Change

Even by making a small change in your everyday life, you can achieve big results in helping to protect the ocean. Make a sea change today and pledge to protect the ocean by checking the boxes below:

Stop Plastic Marine Debris



Pledge 1: Refuse plastic drinking straws

Pledge 2: Avoid cosmetics that contain microbeads (hidden plastic). Check for polyethylene and polypropylene

- Pledge 3: Carry a reusable water bottle
- Pledge 4: Choose biodegradable or reusable cutlery and plates over plastic

Pledge 5: Dispose of plastics properly; don't flush (e.g. Q-tips, sanitary products or sticking plasters)

- Pledge 6: Use reusable shopping bags over disposable plastic bags
- Pledge 7: Compost your organic waste to use fewer rubbish bags
- Pledge 8: Reuse, recycle and opt for no packaging when possible

Stop Ocean Acidification by Reducing Carbon Emissions



- Pledge 1: Think before driving. Explore transportation alternatives to reduce fuel consumption.
- Pledge 2: Choose an energy efficient vehicle
- Pledge 3: Keep your tyres properly inflated (will boost your miles per litre of fuel consumption)

Pledge 4: Reduce your energy use at home (think insulation, turning off lights, shorter cycles on washing machines)

Pledge 5: Conserve water (shorter showers, turn off tap when brushing teeth etc). It takes a lot of energy to pump, treat and heat water

Pledge 6: Waste less food. Agriculture and food production uses vast amounts of carbon dioxide

Pledge 7: Buy locally produced and seasonal food to minimise carbon emissions of transportation.

Stop Pollution of the Ocean by Contaminants



- Pledge 1: Use eco-friendly cleaning products
- Pledge 2: Dispose of chemicals properly
- Pledge 3: Avoid foods treated with synthetically manufactured pesticides
- Pledge 4: Do not discharge sewage from boats into coastal waters

Pledge 5: Dispose of unused medicines responsibly; don't flush them. Return them to your local pharmacy.

Stop Depletion of Fish Stocks



- Pledge 1: Choose sustainable seafood
- Pledge 2: Buy ocean-friendly certified seafood
- Pledge 3: Ask about the sustainability of seafood before you order in restaurants

Pledge 4: Learn more about the fishing and aquaculture sectors so you can make informed choices.

Submit your pledge online: http://seachangeproject.eu/ouroceanourhealth/take-action-checklist



The following cartoons explain why we should make a seachange.







Further reading and resources

Sea Change Web Site

http://www.seachangeproject.eu/

The *Sea Change* project aims to establish a fundamental "Sea Change" in the way European citizens view their relationship with the sea, by empowering them, as ocean literate citizens, to take direct and sustainable action towards a healthy ocean, healthy communities and ultimately a healthy planet.

Sea Change will create a deeper understanding of how the health of European citizens depends on the health of our ocean, and how the health of our ocean depends on the actions of our citizens.

For more information on the project, useful 'Ocean Literacy' resources and ways in which you can get involved, please visit <u>http://www.seachangeproject.eu/</u>.

This includes the Human Health and the Ocean fact sheet at:

http://seachangeproject.eu/images/SEACHANGE/Media_Centre/HumanHealthOcean_Factsheet_set .pdf

A short cartoon movie explaining the principles of Ocean Literacy at:

http://www.seachangeproject.eu/seachange-about-2/ocean-literacy

Short videos showing how the marine environment is a source of vital human health benefits at: <u>http://www.seachangeproject.eu/campaign/our-ocean-our-health</u>

European Marine Science Educators Association (EMSEA)

http://www.emsea.eu

EMSEA is dedicated to facilitating the exchange of success stories and good practices in marine education and to providing a networking directory of marine educators and to co-organising annual conferences for educators throughout Europe.

European Report on Coastal and Maritime Tourism

Interesting and comprehensive report showing just how important coastal and maritime tourism is to Europe.

https://ec.europa.eu/maritimeaffairs/sites/maritimeaffairs/files/docs/body/coastal-and-maritimetourism_en.pdf

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