EDUCATIONAL PACK

Sea Turtles

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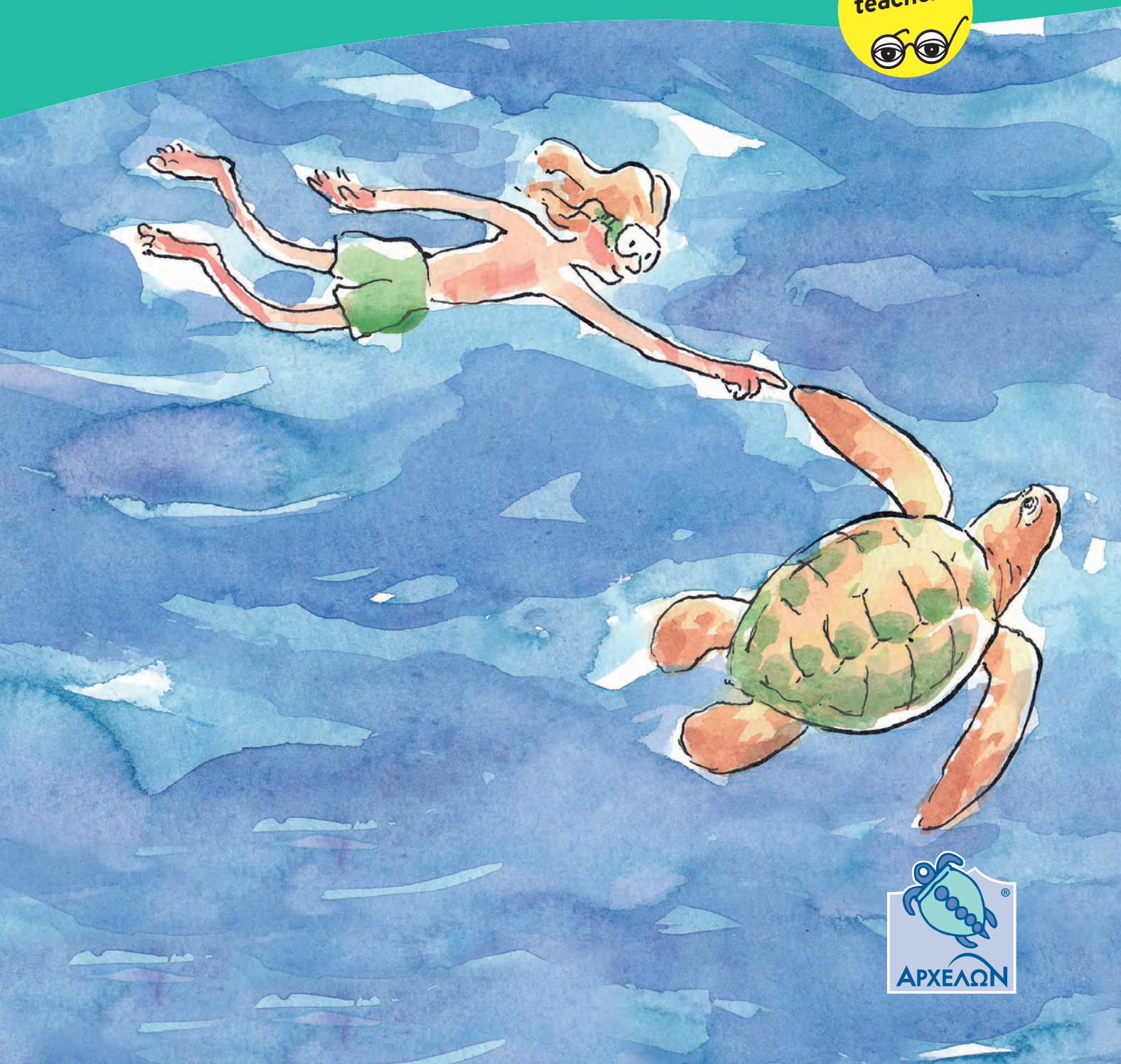
For teachers



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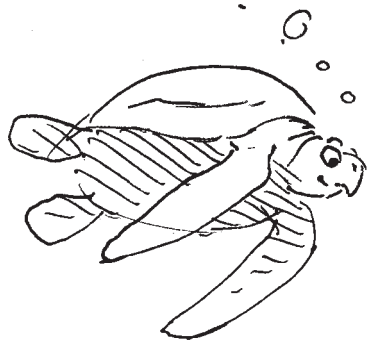

ΑΡΧΕΛΩΝ

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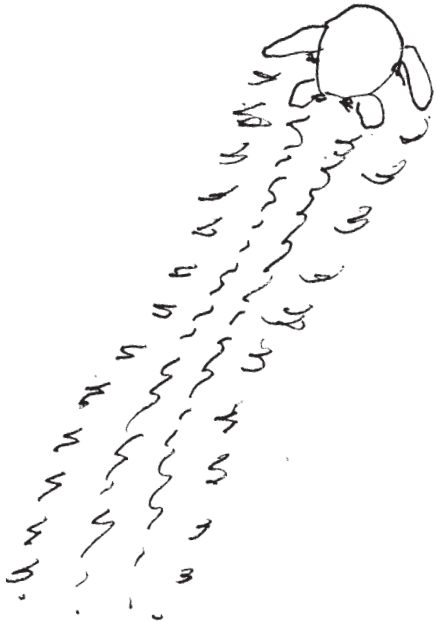


How the educational material was designed

This pack of materials includes educational activities for students in primary school and the gymnasium.

The activities are thematically adapted to the Mediterranean conditions and the goals of the LIFE15 NAT / HR / 000997 – EUROTURTLES project, of which they form part. They aim to explain the relationships between marine animals and their environment, the impact of human activities on both, and the need to maintain the functionality of natural ecosystems.

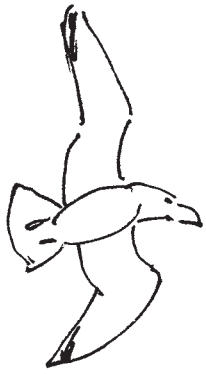
Towards this goal, the material includes:

- simple activities suitable for young students
- activities that promote collaboration and teamwork
- indoor activities such as coloring, wordsearches, etc.
- outdoor activities which offer experience in Nature
- activities which introduce students to scientific methodology (i.e., observation, hypothesis formulation, outdoor sampling, inference)
- activities which stimulate students' imagination (e.g., artistic expression, creative writing, etc.).

Recommendations for using the material

Since each activity is autonomous (although some may form groups), the educational material can be used in many ways and regardless of the order in which it is presented. Instead of recommending one, single method, we suggest the following:

- Study the material and choose that which suits your needs.
- Choose an activity that you enjoy doing or has an interesting theme.
- Choose one that fits the skills and knowledge of your students, as well as their preferences (e.g. a game, role-playing, stories)
- Write down your comments on how effective an activity was – feel free to improve it.
- Discuss with the students whether or not they liked an activity, and how it could be improved.
- Adapt an activity to your own needs, i.e., combine two activities into one, divide one activity into two, and create your own variations.
- Put together your own pack of the materials and activities you use so that it will be ready for future use.
- Need more information? Visit the websites of ARCHELON (http: //www.archelon.gr/) and the LIFEEUROTURTLES Program (http: // www.euroturtles.eu/ and https://www.facebook.com/ LifeEuroturtles).
- Did you encounter any problems using the material and/or activities, or do you have any suggestions for improvement? Please complete and send us the form on the last page of this booklet.



Brief overview of The Mediterranean Sea and sea turtles

The Mediterranean Sea is ancient

The Mediterranean is the only large sea in the world surrounded by three continents. However, this was not always the case: The shape of the continents and seas is constantly changing, even though the process is very slow: The solid crust of the Earth floats on the viscous magma which dominates the Earth's interior; the slow-moving currents of the magma push the crust in different directions.

- About 250 million years ago, the entire land surface of the planet consisted of one continent, Pangea.
- 200 million years ago, Pangea split into northern and southern continents, separated by a long, narrow, and shallow ocean that was the ancestor of the Mediterranean.
- 100 million years ago, these two continents began to approach each other, continually narrowing the ocean that separated them until they split into a series of closed seas and lakes: Aral, the Caspian, the Black Sea and the Mediterranean.
- Six million years ago (in the Messinian), Gibraltar's straits closed and the Mediterranean gradually dried up ('Messinian Salinity Crisis'), with the exception of a few salty lakes at its deepest spots. After 630,000 years, the Atlantic again flooded the Mediterranean and gave it its present form.

The Mediterranean is rich

The Mediterranean is one of the richest seas in the world.

- It is rich in habitats: Its 46,500 km of coastline (12,000 km in Greece, while the whole of Africa has only 30,500 km of coastline) form thousands of bays, its bottom being divided into 9 underwater basins, each with its own species of animals, the water is saltier in some places, (Eastern Mediterranean) and sweeter in others (western Mediterranean and near estuaries).

- It is rich in islands: The Mediterranean archipelagos contains 11,879 islands (9,835 in Greece). After thousands or even millions of years of isolation, many islands have endemic species – species that do not exist elsewhere (e.g. dittany in Crete, lizards and snakes in the Aegean islands, centipedes in Crete and the Dodecanese, and snails in the Aegean islands).
- It is rich in biodiversity (species diversity): Although it constitutes only 0.82% of the world's seas, it hosts 5.6% of marine animal species and 16.9% of marine plant species. These include almost 750 species of fish (nearly 500 species in Greece).
- It is rich in its ability to attract and sustain 'invasive' life: It has become home to species from three continents (Europe, Asia and Africa) and two oceans (the Atlantic and the Indian). Most of the saltwater fish came from the Atlantic, most fresh water fish from Eurasia, and the human species from Africa.
- It is rich in history: Geological history (the process of orogenesis in the area from the Pyrenees to the Himalayas, the convergence of continents accompanied by volcanic eruptions such as in Thira, the Messinian Salinity Crisis that drained the Mediterranean six million years ago and created thick deposits of salt in the soil), in Evolutionary history (new species are constantly coming to the Mediterranean, endemic species evolve in isolated corners of the Mediterranean), but also Cultural history (from prehistoric times to the present).

However, the Mediterranean Sea is poor as regards animal populations: Its clear waters indicate that there is relatively little plankton, so it can only sustain small fish populations (compared, for example, to the North Sea, whose cloudy appearance is due to an abundance of plankton). In addition, the Mediterranean is very susceptible to pollution because it is so landlocked that it takes 50 years to renew its waters.

The Mediterranean varies from place to place

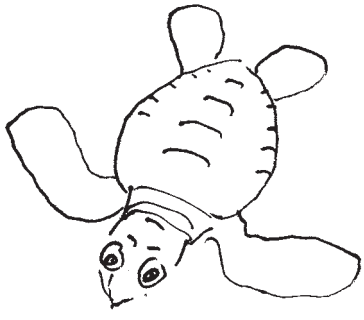
The Mediterranean Sea differs from place to place, which is why in every corner there are different species of animals and plants that characterize each region.

- It has a varied geomorphology: Near the coast lies the shallow shelf (often with deep, underwater canyons carved into it). Below the open seas, there is the abyss (i.e., shallower areas divide the sea floor into underwater basins).
- Its waters are not the same: Colder water is found in the west (where it receives water from the Atlantic and many rivers), and warmer and saltier water to the east (where a great deal of water is evaporated without being replenished).
- It has varied degrees of isolation from other areas: Its colder western basin is next to the Atlantic Ocean, which has been supplying it with fish and other marine species for millions of years. Its warmer eastern basin has always resisted the invasion of species from the Atlantic. The most isolated corners of the Mediterranean are its deep basins, most notably the Hellenic Trench, an area off the Kythera coast which is the deepest point in the Mediterranean, i.e. -5.267 m). It is the place where no living creature in one abyss can cross the shallow divide separating them from the neighboring abyss.
- It has a varied history: During the Messinian Salinity Crisis, the deeper basins became salty lakes, while the Aegean was transformed into a series of freshwater lakes. Since the beginning of the 20th century, the new Suez Canal has allowed marine species to come to the Mediterranean from the Red Sea and the Indian Ocean.

Marine life

Marine life relies on nutrients that come mainly from the land and reach the sea by river water and wind. The abundance of nutrients and sunlight in the sea determine how many fish and other marine organisms it contains. Phytoplankton, the tiny plants floating in the water (such as algae and diatoms) and the few marine plants (i.e., seaweed, *Posidonia*) use solar energy to photosynthesize, which is the process by which they make their own food using nutrients from water and energy from the sun).

The microscopic animals floating in the water (such as



invertebrates, newborn fish, jellyfish and mollusks) are called zooplankton. They feed on planktonic organisms of appropriate size, and are eaten by larger marine animals in turn. Most marine fish are carnivorous, with tiny fish eating plankton and huge sharks hunting for large fish.

The sea is comprised of a series of distinct zones based on depth, each with its own characteristic environment and species:

- The **pelagic zone** is the top layer of the sea where sunlight reaches, and is divided into two zones according to depth: the **epipelagic zone** (0-200m from the surface) and the **mesopelagic** (200-1000m). The pelagic zone is where the plankton gather – they rise close to the surface every day to photosynthesize (in the case of phytoplankton) or to hunt (in the case of zooplankton), and descend deeper into the zone at night to avoid fish. The zone is also the home of all the plankton-eating pelagic fish species (i.e., the tiny atherines, anchovies, sardines, etc.) which make up 40% of the Mediterranean fish, as well as the medium-sized (i.e., mackerel, barracuda, and garfish) or larger species (tuna, swordfish, sharks, dolphins) which feed on them. White sharks came to the Mediterranean about 700,000 years ago from the Australian seas and because of their isolation, they became a distinct Mediterranean population.
  - All marine mammals in the Mediterranean live in this zone except the seal, which lives near the coast. Even the huge cetaceans (18 species of whales and dolphins, of the 80 species in the world) reside here. Their dark-coloured backs and white undersides serve to camouflage pelagic fish and cetaceans in the open sea.
- The **benthic zone** extends from the end of the pelagic zone down to the sea floor, and is subdivided into two main zones: the **bathypelagic** and the **abyssopelagic**. Because the environment is very bio-diverse, it can host most marine species, although small numbers of each.
  - In coastal waters, there are many fish and other animals that find refuge in the rocks and underwater meadows of the endemic sea plant *Posidonia*. Some fish species (e.g., morays, groupers, blennies, anglerfish, octopuses, etc.) stay near the rock which shelters them, while others hide in the sand (e.g., soles,

weevers, rays, worms, mussels, etc.) or hunt near the bottom (wrasses, flathead mullets, blue damsel fish, goatfish, cuttlefish, etc.). Almost 1 out of 4 benthic species are endemic, thanks to the isolation of the Mediterranean basins from other seas.

- If we compared the sea to a fishing business, it would be characterized by having numerous shoals of silver-coloured fish, while the benthic zone would represent the small aquarium down the street, with its countless number of colourful species, but few individuals of each type.
- The **bathypelagic** (or 'deep sea' zone) is located about 1,000-4,000 m below the sea surface, and the **abyssopelagic** ('abyssal sea zone') starts at 4,000 m from the surface.) Sunlight does not reach either of these two zones. Abyssopelagic species, such as fish, lobsters, crabs, squid, cuttlefish, corals, etc.) feed on dead organisms which 'fall from the sky'. However, only 10% of the total mass of marine organisms end up in waters deeper than 100 meters, i.e. 95% of the Mediterranean waters. Because food is scarce and water is cold, the animals of the abyss move slowly, eat little, grow slowly and live for many years.

The brackish waters of estuaries and lagoons are shallow, become warm in early spring, and are extremely rich in plankton (8-10 times more than the sea). Many sea fish (flathead, grey mullets, soles, European bullheads, etc.) give birth there because newborn fish will grow fast and will be protected from large predatory fish.

The beaches with dunes were formed by sand created through thousands of years of erosion and transported by rivers, waves and the wind. Grasses and bushes resistant to salt and the shifting sands grow here, while only animals (mainly invertebrates) resistant to heat and drought are able to survive. Marine animals such as juvenile fish (e.g., soles) congregate at the edges of the waves to protect themselves from large predatory fish and feed on abundant invertebrates found there), except for the female sea turtles that come onto the beach to spawn. The largest variety of species is found close to the coast, thanks to the nutrients from the land and the regenerative action of the waves.

The rocky shores are characterized by biologically diverse zones, each of them with its own plants and animals. The uppermost zone (above sea surface) is sprinkled with droplets of sea water and is home to salt-resistant plants belonging to the genus *Limonium*, such as *Limonium* sp. The second, slightly lower zone is only reached by the strong winter waves, and below that lies the zone constantly hit by the waves, hosting animals which shelter in the rocks (e.g., limpets, crabs, young blennies, etc.). On the rocks below the surface of the water, photosynthetic organisms (such as seaweed and algae) coexist along with herbivores (sea urchins, etc.), small fish swimming near the seabed (wrasses, blue damsels), predators hiding in holes waiting for their prey (morays, octopuses, groupers) and scavengers (fireworms). In the small pools between the rocks, the waves are constantly refreshing the water, and one can easily see small sea animals such as crabs, shrimp, anemones, young fish, etc.

Compared to other seas, the Mediterranean Sea has deep coastal waters and steep shores that sink abruptly into the sea. Especially on its European coasts, the Mediterranean Sea has few sandy beaches that sea turtles so desperately need.

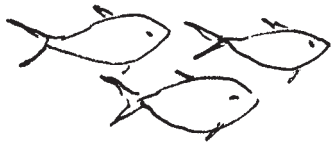
The turtles, unique marine reptiles

Sea turtles, the only Mediterranean marine reptiles, appeared in the oceans along with dinosaurs: The oldest known sea turtle lived 180 million years ago. At that time, a global ocean circled a continent divided into two parts. The climate was warm and ideal for cold- blooded reptiles, which get heat from the environment to warm their bodies and become active. Thus, the ancestral turtles were much larger than today (*Archelon ischyros* was 4.5 meters long).

The movements of the continents and the emergence of the Central American land mass prior to 3 million years ago divided the oceans. As a result, *Caretta caretta* sea turtles were separated into two isolated populations: One in the Pacific-Indian Oceans, and the other in the Atlantic Ocean-Mediterranean Sea. At the same time, the movement of the continents changed the routes of the warm sea currents, making the climate cooler, with successive

glacial periods and cold seas (i.e., the passages beneath Africa and America) that were inaccessible to sea turtles. However, sea turtles adapted to these changes and continued to swim in almost all the seas (except for the very cold ones, such as the Arctic).

Caretta caretta, the Loggerhead Sea Turtle, is one of the three sea turtle species currently living in the Mediterranean, and one of the seven sea turtle species which live all over the world. The sea turtles share many biological and physical characteristics:

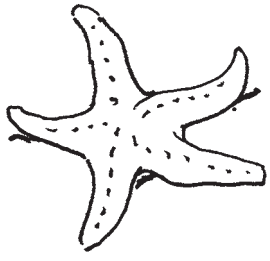


- They are cold-blooded (poikilotherm) like all reptiles, and warm their bodies with the aid of the sun (like all reptiles).
- They breathe with lungs on the surface of the sea, although they can remain underwater for many hours.
- They are protected by a hard shell (carapace) attached to their skeleton, but unlike land turtles, they cannot retract their heads and flippers into it.
- They are slow-moving, and therefore feed on slow-moving prey (mainly plants and various invertebrates, such as jellyfish, sponges, anemones, corals, worms, crustaceans, mollusks, sea urchins, starfish, fish eggs, etc.), which they capture and crush with their powerful keratin beaks.
- They have fin-shaped limbs (flippers) perfectly suited for swimming and, in the case of female turtles, used to excavate and camouflage their nests on sandy beaches.
- All female sea turtles leave the sea to spawn on the beach: Each lays her eggs into a pit she has excavated on the beach, covers and camouflages it, and returns to the sea. The eggs are left to incubate with the sun's heat.
- All sea turtles have glands in their eyes that secrete tears and salt. These glands function to remove any excess salt which may have accumulated during feeding, and in the case of females, clear any sand which may have entered the eyes during the nest-building process.

The Loggerhead is the third largest sea turtle today (after the Leatherback Sea Turtle and the Green Turtle), weighing 80-200 kg and having a carapace length of 70-95 cm. It can live in any sea with a water temperature of at least 13ºC, which encompasses all areas except the two poles, the South Pacific and the Indian Ocean. Loggerheads live in the open sea or coastal waters, spend-

ing many hours resting on the seabed (when the water is shallow) and hunting mainly during the day. When migrating, they swim at a speed of 1.6 k/h (0.4 m/s).

Female turtles usually begin spawning between the ages of 17-33 years. After mating with one or more males, the female turtle travels to the sandy beach where it was born, reaching the land at night and laying 80-120 eggs into a pit excavated by using its rear flippers. Then, it covers the nest with sand and camouflages it by tossing and moving the sand around with its front flippers, and finally returns back to the sea. During the May-June reproduction period, a female turtle will excavate and lay eggs in 2-4 nests, and will not lay eggs again for about 2-4 years.



It is estimated that a *Caretta caretta* turtle can live 47-67 years in nature.

Sea turtle eggs are soft, and their shell resembles thin skin. The eggs incubate in the nest for about 42-70 days. The temperature of the nest determines a hatchling's sex: Female turtles are produced when the nest temperature is 32ºC, while males are produced when the temperature is 28ºC, and an equal number of both sexes is produced when the nest temperature is 30ºC. (It is worth noting that the higher temperatures caused by global warming has resulted in a decrease in the number of male turtles born).

The hatchlings in each nest emerge all together (or in 3-4 groups), They leave the nest at night, and run to the brightest point of the horizon – the sea, which is illuminated by the light of the moon and the stars. They swim near the seabed, where they rely on the receding wave to pull them off the beach and into the sea. They orient themselves with the help of the Earth's magnetic field (a ferrous chemical compound in their brains functions as a compass). Males will spend all their life in the sea, and females will only return to the beach about 20 years later to give birth.

Caretta caretta turtles swim in all the Greek seas, but mainly nest on particular beaches:

- In Zakynthos (Laganas, Sekania), where the density of nests (about 1,500 nests / km) is one of the largest in the world.
- In Kyparissia Bay.
- In Lakonikos Bay.
- In Crete (Rethymnon, Chania and Messara Bay).

Eggs and hatchling turtles are at risk from natural predators (dog, fox, ferret, rats, seagulls, cormorants, crows and big fish), but adult turtles have practically no predators. In the past, people sometimes ate turtles and eggs. Nowadays, all sea turtles are protected by law.

Today, human activities pose the biggest threat for turtles:

- Nesting beaches are 'disappearing' because of building projects connected the with tourism development.
- Hatchlings become disoriented by improper or excessive lighting near the beaches, making it difficult for them to find the sea.
- Nesting beaches are not accessible to the turtles and/or nests are destroyed due to sun-beds, beach umbrellas, etc. left on the beaches at night.
- Vehicles driving on the beach compact the sand, making both nest-building and hatching difficult.
- Violation of boating laws (speeding, etc.) are responsible for turtle injuries or deaths
- Unsafe fishing practices (i.e., use of nets and longlines, as well as abandoned fishing nets or lines) that cause trapped turtles to drown or to lose or injure their flippers.
- Marine pollution, including plastics and toxic substances. Plastic bags are particularly dangerous to turtles, who confuse the floating bags with jellyfish and swallow them. This can lead to suffocation or, if swallowed, inability to digest food.
- Some turtles bear deliberate injuries by humans

Old and new inhabitants of the Mediterranean

Initially, the Mediterranean waters were rich in tropical fish, the heritage of Tethys, an ancient tropical ocean from which it was separated 10-15 million years ago. When the Mediterranean dried up 6 million years ago during the Messianic Salinity Crisis, it lost its tropical fish and was later colonized by temperate-zone species from the Atlantic Ocean. In the deep and warm Mediterranean, isolated by the shallow Strait of Gibraltar, marine species evolved separately from their relatives in the cold Atlantic.

In 1869, human activity was inadvertently responsible for causing a new Mediterranean colonization by tropical fish, an event referred to as 'lessepsian migra-

tion'. With the construction of the Suez Canal, a passage was opened to the Mediterranean, allowing species from the Red Sea and the Indian Ocean (seas which had also originated from Tethys), to spread into the Mediterranean. Mediterranean waters are cold for tropical species but climate change, a consequence of human activity, is gradually warming them, with recorded temperature increases of 1-3ºC over the last 30 years. Perhaps today we are witnessing the Mediterranean return to what it once was: a tropical sea.

Now, in the 21st century, about 12,000 species live in Mediterranean waters. Of these, 500-1,000 species are non-endemic (40% molluscs, 20% fish). Most invasive species live in the SE Mediterranean, near their point of entry, while only a few have reached the western Mediterranean, where the waters are cold. People have started to fish for the larger-sized fish, but need to learn which of those are safe to eat. For example, *Lagocephalus sceleratus* are toxic and deadly when eaten by humans.

Some additional species have arrived in the Mediterranean via the sea water used as ballast to stabilize a ship not carrying cargo. In fact, more than 190 species of small marine animals (molluscs, arthropods, worms) and plants (algae) from the Indian and Pacific oceans have been brought into the Mediterranean in this way.

More than 447 species of fish live in Greek waters, compared to 470 species in the eastern Mediterranean and 664 species which live throughout the Sea, plus invaders, to which nearly 40 new invasive species have been added. In total, 90 invasive species were recorded in 2003, and 126 species in 2005 (mainly bottom-dwelling invertebrates and a few fish).

Humans migrated to the Mediterranean area a long time ago

The human species may have originated and evolved in Africa, but groups inhabited the Mediterranean area early on:

- 5.7 million years ago, ancestors of modern humans left their footprints in the mud of Crete.
- 700-790,000 years ago, *Homo erectus* left his tools and bones in Algeria and the Levant.

- 400,000-40,000 years ago, *Homo neanderthalensis* inhabited areas on the north and east sides of the Mediterranean Sea.
- 38,000-3,000 years ago, based on remains found in the Frachthi Cave in the Peloponnese, *Homo sapiens* (modern man) lived by eating fish and molluscs, while 10,000 years ago, they used boats to reach the island of Cyprus.
- For many thousands of years, only a few people lived in the Mediterranean area, which mainly become populated after the 18th century (i.e. in 600 AD, the population was about 20 million, in 1000 AD approximately 40 million, in 1500 AD about 70 million, in 1700 about 100 million, in 1850 there were 117 million inhabitants, in 1950 225 million, in 2000 437 million, and the estimated population for 2050 is 594 million).
- Today, the Mediterranean area has 460 million inhabitants and is visited every year by about 265 million tourists.

What people in the Mediterranean do

Up until the early 20th century, people had little impact on the sea: Population was low, simple fishing gear was used, travel was by sail boats, no industrial complexes existed, and no plastic was dumped into the sea.

On the contrary, people have long had a strong effect on the land. Intensive farming practices and destruction due to forest fires have made the soil vulnerable to thunderstorms, which are very common in the Mediterranean. The soil lost by erosion (up to 1.4 meters per millennium) ended up in the sea enriching it with nutrients. Erosion was more pronounced in times of peace and prosperity of the great ancient civilizations (e.g., Egyptian, Persian, Greek, Roman), but much less so when crops were abandoned due to war or epidemic.

The impact of human activity on the Mediterranean Sea became much more pronounced in the 20th -21st centuries, mainly because of marine pollution and overfishing.

Much of the oil supporting human activities is transported through the Mediterranean: In 2006, it was crossed by 6,700 tankers with 500 million tons of oil. Of the oil being transported, nearly 1 million tons (20% of global oil spills) are dumped into the Mediterranean each year (400,000 tons are deliberately dumped, as part of

ship maintenance). In total, about 220,000 ships in excess of 100 tons, representing about 30% of the world's commercial tankers and 20% of its oil tankers, pass through the Mediterranean.

In addition to petroleum, which is both toxic to humans and is carcinogen), special paints for the hulls of ships (antifouling paint) which prevent the adhesion of marine organisms are extremely toxic to marine life, gradually eroding and ending up on the seabed.

Plastics are the most common type of modern era rubbish, indicating that in the future, they may serve as the geological marker of our time, the Anthropocene: Annual global production of plastic has increased from 2 million tons in 1950 to 380 million tons in 2015, i.e., 7,800 million tons, with 50% of that total having been produced during the 13-year period 2002-2015. About 42% of plastics are used in product packaging.

It is estimated that about 30% of all plastics produced are still used today. Of the plastics that are no longer in use, only 9% have been recycled in Greece, compared to 30% in Europe, while 79% have ended up in landfills or in the bottom of the sea. It has been recorded that there is about one piece of plastic per square meter across the Mediterranean sea.

These articles of plastic (nylon fishing nets and ropes, plastic bags, bottles, lids, etc.) often prove deadly for any wildlife (such as turtles, seals, seagulls, whales, dolphins, sharks and other big fish) which become trapped in them Over the years, plastic trash is broken down into 'microplastics', tiny pieces of plastic that are invisible to the human eye and at the same time so numerous (i.e., up to 100,000 pieces per cubic meter) that the zooplankton confuse them with their food and consume them. Microplastics are found today on every beach and, by being passed on from zooplankton to fish, they enter the food chain, even reaching our own dishes.

Noise pollution caused by ship engines and sonar devices is a lesser-known type of marine pollution. These sounds, which can exceed 200 dB (decibels) locally, affect fish behaviour and can be dangerous to the survival of marine mammals (cetaceans), which use very low frequency sounds to explore the marine environment and

communicate with each other. There are indications that some cetaceans become grounded in shallow waters because they are disoriented in an environment with intense underwater noise pollution.

Light pollution mainly threatens sea turtles reproducing on the beaches. The amount of light on a beach lit by a full moon is only 0.1-0.3 lux, but the artificial light in a parking lot is 10 lux, and that of a residence is 100-300 lux. A female turtle may be oriented by the currents and the seabed shape so as to approach the beach where she was born at night, but she will avoid going to beach with bright lights. When leaving the nest, the hatching turtles head for the brightest part of the horizon, which is normally the sea reflecting the light of the moon and stars, but on beaches with bright lights, they become disoriented and exhausted, sometimes not ever reaching the sea.

Due to the development of fishing equipment and technology, such as larger fishing boats, nets, and lines made of synthetic fibres, and sonar fish tracking, more fish are caught, even in the deepest basins of the Mediterranean sea. The result of overfishing is the depletion of fish populations, since the number of fish being caught each year is bigger than the number of new fish born. Unfortunately, even species which are not the target of fishermen are constantly facing a population loss because of the decline in fish they feed on or because they become trapped in fishing gear and drown.

During the last 50 years, the Mediterranean Sea has lost 41% of its marine mammal population, 34% of its fish population, and 34% of the *Posidonia* grasslands, the latter being destroyed during the process of trawling. In addition, 53% of the approximately 70 species of sharks and rays in the Mediterranean Sea are in danger of extinction, mainly because they are caught in trawling nets and longlines which aim to catch other fish species. Pelagic species (e.g. sea turtles, blue sharks) are often trapped in driftnets, which are prohibited in the Mediterranean, and modern trawlers threaten the rays that live at great depths.

Overall, the Mediterranean countries have a Gross Maritime Income equal to the 20% which corresponds to the global average, even though the Mediterranean constitutes only 1% of the worldwide seas. 93% of this

income comes from tourism, and only 2% from aquaculture. This means that a healthy marine environment has an economically greater value than aquaculture, so maintaining the sea in a healthy condition must be a priority in the Mediterranean management plan.

What can people do for the Mediterranean?

It is not possible for people to return to past lifestyles so as not to adversely affect the sea. They can, however, slightly change their activities to limit their damage to the Mediterranean:

- By recycling waste (especially plastics), they can reduce the volume of trash and the resultant marine pollution.
- With proper fisheries management (e.g. effectively limiting the fishing of endangered species, stopping the use of prohibited driftnets, establishing permanent or temporary marine life sanctuaries), they can preserve species currently endangered in the Mediterranean.
- With a network of marine parks, the preservation of many vulnerable species will be ensured, and the population increase of other species would also be supported.
- With proper control of the maritime industry and boat use (e.g., proper maintenance of engines and propellers to reduce marine noise, building quieter-running boats, limiting the speed of ships in the most ecologically sensitive marine areas, protecting *Posidonia* meadows by constructing permanent docking or mooring facilities for recreational boats) their impact on marine life will be reduced.

The Mediterranean Sea and the environment in general can also be helped by the practice of energy-saving measures (e.g., using power-saving bulbs, changing the temperature in the heating/cooling thermostat by 1-2 degrees, installing double-glazed glass windows and doors, properly insulating homes and buildings, placing special shades on office windows) the effects of climate change will be lessened.

The photographs

There are two versions of the same presentation: the full version (51 slides) and the short version (20 slides). You can use whichever best suits your needs. (Note: slide numbers for the short presentation are given in parentheses next to the full-version numbers.)

Slide 1 (1)
(cover page)
Slide 2
250 million years ago, all the continents were united into one (*Pangea*), and there was only one, single sea: A small edge of the sea was *Tethys*, the ancestor of the Mediterranean.
Slide 3
Pangea was divided into the present continents, which changed position by floating over the fluid interior of the Earth. New land masses (i.e., Central America and Arabia) emerged near the Equator and separated the warm seas, along with the sea turtles that were living in them.
Slide 4 (2)
Today, the Mediterranean Sea is the only sea surrounded by three different continents.
Slide 5
Because it has been affected by and received species from 3 continents and 2 oceans, the Mediterranean is one of the world's centres of biodiversity; in fact, it has many species which live exclusively in it. Although its size comprises only 1% of the world's seas, it hosts almost 6% of marine species and nearly 17% of marine plant species.
Slide 6
Most marine species in the Mediterranean Sea came from the Atlantic Ocean, passing through the Strait of Gibraltar.
Slide 7
The Mediterranean Sea has a wide variety of species because it varies widely from place to place: For example, it is much colder where water from rivers or the Atlantic ocean flow into it.

Slide 8

The Mediterranean Sea is geologically diverse, with the rise of new mountain ranges which changed the flow of rivers and streams. Six million years ago, it was separated from the Atlantic Ocean and dried out during the Messinian Salinity Crisis, to later be flooded again after many centuries

Slide 9

The Mediterranean Sea is morphologically diverse, with many small bays, 12,000 islands and deep submarine basins separated by a shallower sea.

Slide 10 (3)

The sea forms zones, each with its own unique species. The pelagic zone has lots of light and plankton, and large schools of fish, but a small number of species.

Slide 11

Large predators live in the pelagic zone: Tuna, sharks, whales, dolphins and others.

Slide 12

To protect themselves from predators, small fish (such as sardines) live in large schools.

Slide 13

The pelagic zone has many fish because it has a lot of food: Microscopic animals (e.g. newborn shrimp, crabs, jellyfish and fish) that make up the zooplankton.

Slide 14

The zooplankton feed on phytoplankton, tiny plants (such as diatoms) that are carried by the currents.

Slide 15

In some seas, there is so much plankton that the water looks cloudy.

Slide 16

Seas with much plankton (such as the North Sea) are famous for their large fish populations. But the Mediterranean has little plankton.

Slide 17

The Mediterranean has clear waters due to the small amount of plankton it contains. Unfortunately, it also has small fish populations (although it has 750 species).

Slide 18 (4)

Its rocky shores have numerous crevices which shelter many species of land and sea animals.

Slide 19

Its rocky shores are home to many invertebrates (e.g. limpets, crabs) that cling to the rocks or others than hunt freely (e.g. sea scallop, octopus).

Slide 20 (5)

Many small-sized fish species such as blennies and wrasses live near the rocky shores, each in its own hideaway.

Slide 21

Predators such as dusky groupers, octopus and cuttlefish also hide among the rocks and go out at night to hunt.

Slide 22

In larger caves, the Mediterranean seal *Monachus monachus*, a marine mammal threatened by extinction, finds refuge, gives birth and raises its young.

Slide 23 (6)

On the sandy beaches, there are no hiding places, only sand that is shifted by the waves and the wind.

Slide 24 (7)

A few species of plants, such as the Sea Lilly, grow on the beach. Their roots protect the beach by preventing the wind from blowing the sand away.

Slide 25 (8)

On the sandy sea floor, the animals (fish, mussels, oysters, etc.) hide in the sand. Sole fish mimic the colours of the sand where they lie down on one side, and with their eyes on the other side, observe the small animals that pass by.

Slide 26

Underwater meadows of the plant *Posidonia*, which only grows in the Mediterranean, extend out from the sandy beaches. Many young fish and other tiny creatures hide among the leaves of this plant.

Slide 27

Both above and below the surface, the sandy beach environment provides a home for specialized species of animals: Small fish (such as sole and weeverfish) live on the sandy sea bottom, and desert insects live in the grasses on the beaches. Sea turtles use the beaches for nesting.

Slide 28 (9)

Although they live in the sea, sea turtles lay their eggs on the sandy beaches, where the eggs are warmed by the sun and grow into hatchlings.

Slide 29

Each turtle digs a deep pit, into which it lays about 100 eggs. Once the hatchlings are out of the eggs, the turtles run toward the brightest place they can see: the sea.

Slide 30 (10)

Because sea turtles are in danger of extinction, ARCHELON volunteers protect the nests from foxes with wire mesh, and marks them with warning signs so that bathers do not stick umbrellas into them.

Slide 31 (11)

To protect the nests, ARCHELON volunteers find them by following the tracks left by the mother turtles in the sand. Every morning, the team walk all over the beach, or take photos from above with a drone.

Slide 32

Every hatchling that reaches the sea will travel around, swimming for 15-30 years before (in the case of females), approaching land again to nest.

Slide 33

To track a turtle, scientists attach a special transmitter that sends signals from the turtle's location to a satellite.

Slide 34

With these signals, the route of each turtle can be mapped.

Slide 35

The routes of the Mediterranean turtles intersect with the busiest shipping routes in the world. Encounters with boats are frequent and dangerous.

Slide 36 (13)

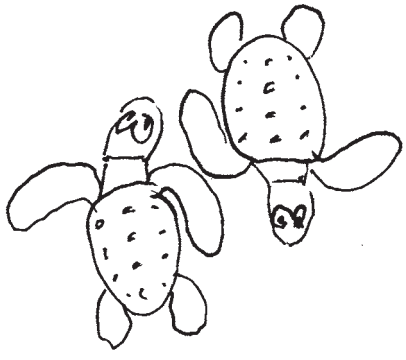
All large-bodied marine animals are endangered by the propellers of both small and large vessels. Animals which must come to the surface to breathe run a greater risk of being injured.

Slide 37 (14)

Marine animals are also at risk from sea pollution, since nearly one million tons of oil are spilled annually in the Mediterranean.

Slide 38 (15)

Many marine species (particularly fish) are endangered because of overfishing. As the numbers of fish in the sea is reduced, more and more young fish are being caught, damaging the future fish population.



Slide 39

Large marine animals are endangered by nets. They often get entangled in abandoned nets and drown.

Slide 40 (16)

All marine animals are endangered by plastics that end up in the sea. Large animals are trapped in pieces of plastic, while small ones swallow tiny pieces of plastic that resemble their food.

Slide 41

Some large animals get trapped inside discarded open cans and die of starvation.

Slide 42

Beaches are often organized to attract tourists by the addition of umbrellas and sunbeds, which can obstruct or injure female turtles trying to nest, and by artificial lighting, which can disorient the hatchlings trying to reach the sea.

Slide 43 (17)

To every problem, there is a solution: Lights on the beach? Yes, as long as they are special lights that only illuminate the ground and do not disorient the hatchlings.

Slide 44

Protected marine areas? Yes, as much as possible, because they keep areas of the beach and ocean that are irreplaceable for marine life in good condition.

Slide 45

Each protected area allows marine animals to grow and multiply, supporting the growth of life in the sea.

Slide 46

Fishing? Yes, but under controlled conditions regulating what kinds of fish can be caught, the minimum size of fish allowed, etc. This will ensure that enough fish will be left in the sea, and also prevent other species (such as jellyfish) to multiply in their place.

Slide 47 (18)

Trawling? Yes, but with a special escape 'door' in the net which allows turtles to get out while keeping the fish in.

Slide 48 (19)

Rubbish? Yes, but with proper recycling, so less plastic ends up in the sea.

Slide 49

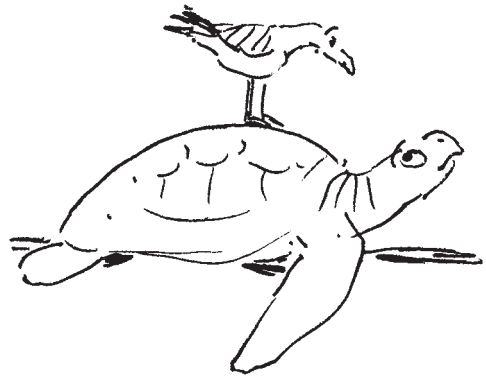
Tourism on the beaches? Yes, but with respect for the areas with remarkable marine life, and in a way that doesn't provide obstacles to the turtles who enter the beach to nest.

Slide 50 (20)

People and turtles live symbiotically in the Mediterranean. If the sea becomes unsuitable for turtles, it will soon become the same for humans, too.

Slide 51

(photo presentation for the LIFE EUROTURTLES programme, with online images)



Proper methodology for outdoor activities

What does applying the right methodology to outdoor activities offer students?

- develops their practical skills (calculations and measurements, comparisons, use of tools etc)
- increases their knowledge and understanding of the environment, and appreciation for it.
- familiarizes them with the scientific way of thinking and methodology
- encourages them to think and act independently
- methods can be applied to other geographical areas or curriculum modules
- helps them to understand the environmental management procedures which have already been implemented
- causes only a minor disturbance to habitats, plants, and animals
- provides an engaging, enjoyable learning experience
- helps develop their collaborative skills
- offers them a unique experience
- allows for foreign language speakers or those with linguistic or motor disabilities to join in
- requires a minimal amount of equipment.

What should you do when implementing outdoor activities?

- choose suitable clothing for the weather, and wear a hat
- have all the supplies needed to provide first aid
- check your equipment both before and after the activity

What should NOT be done during an outdoor activity?

- participants should not place their hands in areas which are not completely visible
- do not leave trash behind
- do not collect more than is absolutely necessary
- do not forget to replace stones and fallen logs which you may have picked up or temporarily moved – put them back into their original locations
- do not put permanent marks on trees and rocks

Brief instructions for the activities

Activity A1: How big is a turtle?
Cut out a paper image of a hatchling. On the ground, make an outline of an adult sea turtle in its actual size.

Activity A2: Finger-puppet stories
Make simple paper finger puppets of sea creatures, and together act out a story with the animals depicted.

Activity A3: Make a mobile
In groups, participants make a mobile featuring sea animals. Use blue twine of different lengths to suspend the animals according to the number of years each animal lives.

Activity A4: How many hatchlings are in the nest?
Cut hatchlings out of paper. You will need as many hatchlings as the number that grow in a nest.

Activity A5: Beach observation
Participants closely examine the beach, observing small animals, plants and everything else which catches their attention.

Activity A6: Which beach do I want?
Participants draw pictures of two beaches: One as they would like it to be, and the other one containing something which doesn't belong there.

Activity A7: Looking for tomorrow's trash
Everyone looks in their homes or school for items that one day will become rubbish.

Activity B1: How big is a turtle?
Cut out a paper image of a hatchling. On the ground, make an outline of an adult sea turtle in its actual size.

Activity B2: Make a mobile
In groups, participants make a mobile featuring sea animals.

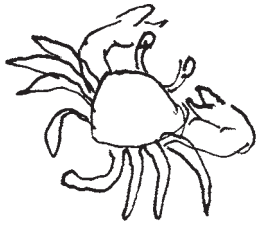
Use blue twine of different lengths to suspend the animals according to various criteria, such as their place in the food chain, the type of food they eat, etc.

Activity B3: Beach observation
They look for and note down in an improvised diary the animals they encounter on the beach.

Activity B4: Which beach do I want?
Participants draw pictures of two beaches: One as they would like it to be, and the other one containing something which doesn't belong there

Activity B5: Travelling trash
With a simple experiment, participants determine which types of trash can most easily reach the sea.

Activity B6: The life cycle of trash
Participants bury different types of rubbish and observe the decomposition rate of each material.



Activity B7: The right tool
Participants examine the adaptations of various animals to their lives in the sea.

Activity B8: Trapped in Trash
Using images and their prior knowledge or experience, participants examine ways in which marine animals become trapped or entangled in the trash that ends up in the sea.

Activity B9: Animal Wordsearch
Game with hidden words associated with marine animals and their food.

Activity B10: Biodiversity diorama
In groups, participants use collage techniques to make a two-dimensional representation of the sea bottom, onto which they attach pictures or models of various kinds of animals, each in the area of the seabed where it lives.

Activity B11: Everything is connected
Participants play the roles of animals or plants. They should

all be linked together with yarn so that they realize that in any one place, no one or nothing is independent.

Activity B12: Card Stories
Participants make cards of different species, objects, activities, dangers, etc. found in a marine environment. In groups, they use the cards to create the episodes of a story.

Activity C1: Everything is connected
In the area where the activity takes place, participants search for the relationships between biotic and abiotic elements there, and then make a mosaic, using as tiles the facts and relationships between them.

Activity C2: One for all and all for one
Everyone decides how they would utilize a piece of land next to a wetland. Then, they all try to reconcile their different ideas and needs.

Activity C3: Looking for trash
They explore the beach and record the trash they find, organizing it into categories.

Activity C4: Identifying the beach zones
Participants choose a representative sample of the beach zones, then record the flora they find along the length of the chosen area.

Activity C5: How would I manage a beach? (role-playing game)
Participants assume the roles of different groups who have interest in the area, and they try to reach a compromise on a local problem.

Activity C6: Tracking a sea turtle
Participants map the coordinates from the sea turtle's satellite tracking transmitter to depict their routes.

Choose activities

To choose the activities that suit you best, we suggest four guidelines:

1. Browse both the teacher's guide and the student's version.
2. Look at the brief descriptions of the activities (in the section 'Brief description of activities').
3. Look at the characteristics of each activity (Table 1).
4. Look at the basic principles and objectives associated with each activity (Table 2), and follow the standards of the Hellenic Pedagogical Institute.

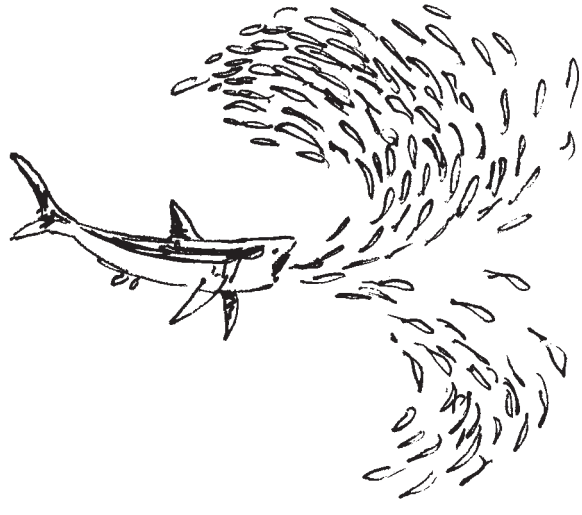


Table 1.

The activities organized by topic and age

ACTIVITIES	6-10 years (Primary 1-3)	10-12 years (Primary 4-6)	12-15 years old (Gymnasium)	Paper-based	Indoors	Outdoors	Game	Imagination exercise	Observation exercise	Scientific methodology	Artistic expression	Animals	Landscapes	Ecology	Human activities	Protection and management
A1	+			+	+	+					+	+				
A2	+			+	+			+			+	+				
A3	+			+	+						+	+				
A4	+			+	+							+				
A5	+					+			+			+	+			
A6	+			+	+						+		+			+
A7	+				+				+						+	+
B1		+		+	+	+					+	+				
B2		+		+	+					+	+	+		+		
B3		+				+			+	+	+	+	+			
B4		+		+	+						+		+			+
B5		+			+				+	+					+	+
B6		+			+	+			+	+					+	+
B7		+		+	+				+			+		+		
B8		+		+	+			+	+			+				+
B9		+		+	+				+			+		+		
B10		+		+	+			+			+	+	+			
B11		+			+		+	+				+		+		
B12		+		+	+			+				+		+	+	
C1			+	+	+			+	+			+	+	+		
C2			+		+		+	+					+	+	+	+
C3			+	+		+			+	+			+		+	+
C4			+	+		+			+	+			+	+		
C5			+		+		+	+					+		+	+
C6			+	+	+					+		+		+		

The Hellenic Pedagogical Institute has outlined (http://www.pi-schools.gr/perivalontiki/) some basic principles, goals, and themes that should be incorporated into every Environmental Education program.

Basic principles:

- Opening schools to society.
- Orienting students to think about environmental issues or problems, particularly their prevention or resolution.
- Using an interdisciplinary approach to the topic/problem.
- Engaging students in direct action at a local level with an aim to achieve long-term results at a national and global level.
- Promoting cooperation, cultivating values, and creating new models, attitudes and behaviours of individuals, groups, and society towards the environment.
- Provide students with equal opportunities to build knowledge, skills, values , and attitudes needed to protect the environment.
- Placing emphasis on the active involvement of students with discussion, debate, exchange of views, research, criticism, and creative work and action.
- Focus students' attention on the sustainable development of the environment.

Objectives:

- Cognitive (concept building, understanding of relationships/interactions/ consequences of humans and the environment, environmental problems, protective measures, etc.).
- Scientific (familiarise students with scientific methodology/research, critical and creative approach to topics, development of a scientific mentality, etc.).
- Teamwork (working in groups, developing collaborative relationships, respecting different views, lifestyles, creative action, etc.).
- Social (linking school with daily life, cultivating responsibility, decision making, and creative actions, etc.).
- Aesthetical (creating a close relationship with nature through the mediation of all the senses, etc.).
- Self-education (use of the library, press, new technologies, internet, etc.).

Thematic Axes:

- Climate change – Protecting the atmosphere.
- Air (air pollution in cities, etc.).
- Water (pollution and depletion of surface and groundwater, etc.).
- Soil (desertification, erosion, etc.).
- Energy (depletion of non-renewable energy sources, over-exploitation of natural resources, etc.).
- Forests (protection and sustainable management of forests etc.).
- Biodiversity / Species extinction.
- Waste management (human and industrial)
- Human activities (i.e., structures and the operations/activities which take place within them, both in urban and green suburban areas, etc.).
- Human relationships (i.e., the social and economic dimensions of development and the environmental problem, gender equality, human values, problems of minority groups, etc.).

Table 2:
The activities categorized according to the principles and goals of the Hellenic Pedagogical Institute

ACTIVITIES	Opening schools to society	Orienting students to think about prevention or resolution of problems	Interdisciplinary approach	Taking action locally	Promoting collaboration	Equal opportunities	Active participation	Focus on sustainable development	Cognitive goals	Scientific objectives	Participation goals	Social goals	Aesthetic goals	Self-education goals	Thematic focus: Biodiversity	Thematic focus: Waste management	Thematic focus: Human activities
A1									+		+				+		
A2							+				+				+		+
A3									+		+				+		
A4									+						+		
A5						+			+				+		+		+
A6	+	+			+			+				+			+		+
A7	+	+			+	+	+	+	+		+	+				+	+
B1									+		+				+		
B2									+		+				+		
B3						+			+	+			+		+		+
B4	+	+			+			+				+			+		+
B5	+	+			+	+	+	+	+	+	+	+				+	
B6	+	+			+	+		+	+	+	+	+				+	
B7									+						+		
B8	+	+			+				+			+			+	+	+
B9									+						+		
B10						+			+		+			+	+		
B11					+	+		+	+		+				+		
B12	+					+	+				+			+	+		+
C1					+	+	+		+	+	+			+	+		
C2	+	+	+		+	+	+	+	+		+	+				+	+
C3	+	+			+	+		+	+			+				+	+
C4			+						+	+	+		+	+	+		
C5	+	+	+		+	+	+	+			+	+		+	+	+	+
C6									+	+				+	+		

For each activity...

For each activity, the following information is provided:

Age: Age range in years
Time: How much time will be needed
Materials: Necessary materials
Number: The optimum number of students recommended for best results
Place: Indoors or outdoors
Season: The best time period for each activity
Objective: What students will achieve
Glossary: Definitions of the terms in the text
Introduction: Basic information on the subject of the activity
Instructions: Step-by-step description of the activity
For discussion: Questions that require critical thinking
Expansion: Ideas for complementary activities on the same topic
Sources: Books or websites where the idea for the activity came from

ACTIVITIES
Primary Grades 1-3

ACTIVITY A1:

How big is a turtle?

Age: 6+
Time: 1 hour

Materials:
- Worksheet (1 per student)
- Scissors (1 for each group)
- Paper glue (1 for each group)
- Coloured pencils or crayons (1 set for each group)
- Chalk (1-2 for each group)
- Measuring tape (e.g. the type used for sewing) (1 for each group)

Number: Small group

Place: Indoors and outdoors

Season: All year round

Goals:
- Students will approach nature with imagination.
- Students will learn the actual size of a sea turtle.

Glossary: None required

Introduction:

Sea turtles are the only Mediterranean reptiles which live in the sea. Of the three species which swim in the Mediterranean, only the *Caretta caretta* nests there.

They are very similar to their closest relatives, tortoises (land turtles), and terrapins: All turtles have a hard carapace, scaly skin, and a mouth with a keratin beak.

However, sea turtles have certain characteristics that indicate their adaptation to marine life: they have fin-like flippers to facilitate swimming, large eyes for better vision in the dark depths of the sea, hydrodynamic-shaped bodies for less water resistance, but have lost the ability to retract their heads and limbs into their carapaces.

Sea turtles have much larger bodies than land turtles (a sea turtle's carapace measures up to 110 cm long, a tortoise's up to 25 cm long, and a terrapin up to 20 cm), probably because movement in the sea is easier and food is more abundant.

Instructions:

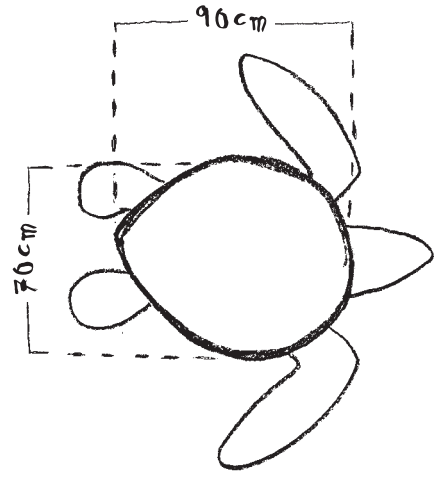
- Each student colours the turtle provided on the worksheet, then cuts and folds it, fixing it with a little glue at the points marked with small circles, squares or triangles.
- In groups of 2-4, students draw an actual-sized sea turtle on the ground in chalk, using a measuring tape and the dimensions given. Afterwards, the students can draw a picture of a student next to a turtle, on the ground.

For discussion:

- Do you see something on the turtle's body that helps

it move in the water?' 'What is it?' 'Does it help it move on land?'

- 'Is a sea turtle as big as you had imagined it to be?' 'Would you be afraid of it swimming next to you?' 'Do you think you would be in danger?' 'Or do you think that maybe it would be in danger from you?' 'Why?

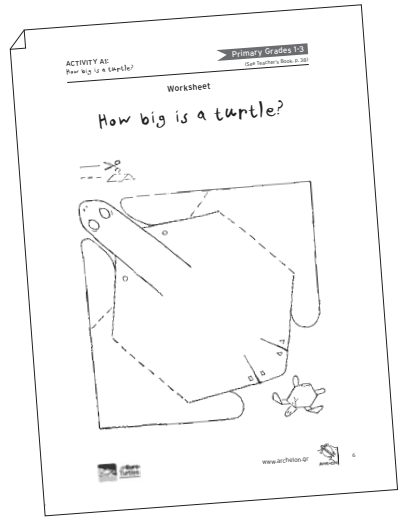


Sources:

ARCHELON, 'The Sea, Turtles and Me', educational material on marine biodiversity and the role of humans, p.14

'Dinosaurs, giants of Patagonia', Educator's Guide, p.11

https://www.si.edu/Content/SE/Educator%20Guides/Dinosaurs%203D%20-%20Giants%20of%20the%20Patagonia.pdf



ACTIVITY A2:

Finger-puppet stories

Age: 6+
Time: 1 hour

Materials:
- Worksheet (1 for every 1-2 students)
- Scissors (1 for each group)
- Adhesive tape (1 for each group)
- Coloured pencils or crayons (1 set for each group)

Number: Small group

Place: Indoors

Season: All year round

Goals:
- Students will approach Nature with imagination.
- Students will work collaboratively to create a story.

Glossary: None required

Introduction:

Storytelling helps students to approach a topic in many ways (i.e., verbally and emotionally, consciously and subconsciously). A fairy tale can be a cause for discussion about animals, humans, and students' relationships with the world.

A landscape is not the same for all its inhabitants. Every animal has a preference for where to find food, some quiet corners to sleep in, and some familiar routes from its table to its bed. If we look at a landscape with the eyes of a gull and a turtle, we will see two different landscapes.

Instructions:

- Distribute photocopies of the Worksheet and ask students to choose 1-2 finger puppets each (e.g., one for each hand). Let them colour and cut the puppets they chose, and help them to glue them so that they fit properly on their fingers.
- **Idea 1:** Make a story together, with the heroes being the animals pictured on the puppets. You can create the beginning of the story, and each student in turn can add an episode to the story (e.g., describe what he or she does at this point in the story).
- **Idea 2:** Alternatively, sit somewhere overlooking a landscape. Each student plays the role of the animal they chose for their puppet, and imagines what their life would be like in that landscape. As the students begin to imagine, ask some questions that stimulate their imagination (e.g., Where do you live in the landscape? Do you always live in the same place, or do you move around? What will you eat here? Where will you sleep? Do you live alone? Who lives next to you?)

- In turn, everyone describes the life they have imagined. The others listen and comment.

For discussion:

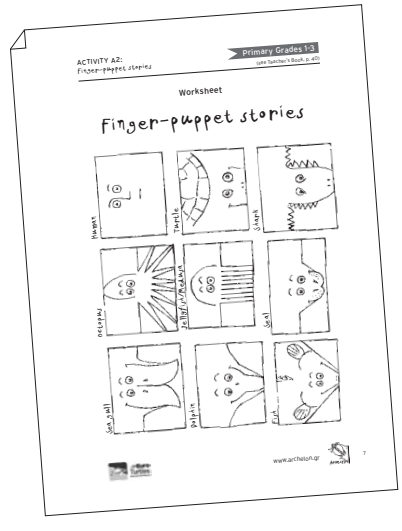
- 'Is this landscape a good place for an animal or plant to live?' 'Why?'
- 'Where would most animals sleep?' 'Where would they eat?'

Sources:

Kidspot> Discovery Center> 4-6 years> Craft> All finger puppet templates, http://www.kidspot.com.au/discoverycentre/Four-to-six-Craft-Finger-puppets+5385+534+article.htm

Kidspot> Discovery Centre > 4-6 years >Craft > All finger puppet templates, http://www.kidspot.com.au/parenting/occasions/happy-toddler-zone

Rodari T. (1985), Grammar of the imagination, Prescription editions.


ACTIVITY A2:
Finger-puppet stories

Primary Grades 1-3

Worksheet

Finger-puppet stories

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ACTIVITY A3:

Make a mobile

Age: 6+
Time: 1-2 hours

Materials:
- Worksheet (1 for each group of 3 students)
- Scissors (1 for each group)
- Thin twine (1.5-2 m for each group)
- Thick needle or thin pin (1 for each group)
- Thin pieces of wood or twigs (2-3 for each group)
- Coloured pencils or crayons (1 set for each group)

Number: 3+

Place: Indoors

Season: All year round

Goals:
- Students will approach Nature with imagination.
- Students will collaborate on a project.

Glossary: None required

Introduction:

Many different species of animals live in the sea: Animals that swim or walk, animals with flippers or with legs, animals that breathe underwater or on the surface, animals that live for a few years or for many years.

Sea Turtles:
Have four flippers for swimming, rise to the surface to breathe, live 80-100 years.

Dolphins:
Swim with their tail, rise to the surface to breathe, and live 20-50 years.

Tuna:
Swim with their tail, breathe in the water, live up to 25 years.

Crabs:
Walk on the seabed with 10 legs (2 are claws), breathe underwater, live 1-3 years.

Starfish:
Walk on the seabed with hundreds of tiny feet, breathe in the water, live up to 35 years.

Conch:
Crawl on the seabed with one foot, breathe underwater, live up to 5 years.

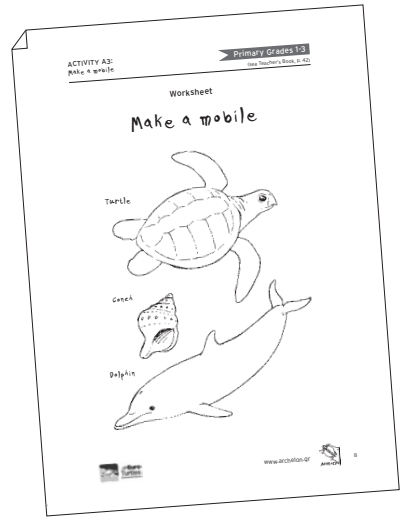
	WHAT IT DOES	WHAT IT HAS	WHERE IT BREATHS	HOW MANY YEARS IT LIVES
Sea Turtle	Swims	Flippers (4)	On the surface	80-100
Dolphin	Swims	Flippers (2+1)	On the surface	20-50
Tuna	Swims	Flippers (6)	In the water	Up to 25
Crab	Walks	Legs (8+2)	In the water	1-3
Starfish	Walks	Feet (hundreds)	In the water	Up to 35
Conch	Crawls	Leg (1)	In the water	Up to 5

Instructions:

- Each group of students makes a mobile. They place the front side of the Worksheet on a glass window and trace the animal pictures onto the back of the Worksheet. Then they colour both sides of the animal picture and cut them out.
- With a pin, they pierce the top of each animal, tie a piece of string to it, and hang it on one of the twigs. Each animal hangs on a string, the length of which corresponds to its life span (e.g. 50 cm long for 50 years). Make sure that the animals do not touch one another. Hang the mobile in a door frame to swing in the wind.

For discussion:

- 'Do the sea turtle, dolphin and tuna all have something that is similar?' 'What about the crab and starfish?'



Sources:

ARCHELON, 'The Sea, Turtles and Me', educational material on marine biodiversity and the role of humans, p.16.

ACTIVITY A4:

How many hatchlings are in the nest?

Age: 8+
Time: 1 hour

Materials:
- Old newspapers or A4 paper (10 sheets for each 2-3 students)
- Pencil (1 for 2-3 students)
- Scissors (1 for 2-3 students)

Number: Small group

Place: Indoors

Season: All year round

Goals:
- Students will work together to create a project.
- Students will learn the actual size of a sea turtle.

Glossary: None required

Introduction:

Sea turtles live their entire lives in the sea, but females lay their eggs in the warm sand of a beach.

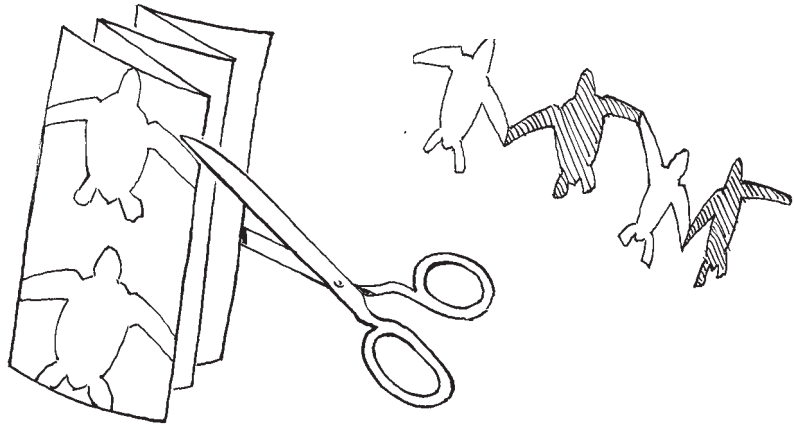
Adult female turtles return to the beach where they were born, crawl out onto the land at night, and lay about 120 eggs (small as ping pong balls and soft as leather) into a deep pit they have dug away from the waves, and then returns to the sea.

Turtles do not incubate their eggs as birds do; instead, the eggs will be warmed by the sun for two months. When the hatchlings have developed, one night they will dig themselves out of the nest, run to the sea, and swim away. Every female turtle that survives will return after 20-30 years to give birth on the same beach.

If we walk along the beach in the morning, we may find many small hatchling tracks from the nest to the sea.

Instructions:

- The students fold each of the 10 sheets into 5 equal strips, like an accordion (each strip is almost 6 cm wide).



- They draw two turtles on the front, one below the other.
- They cut the turtles, leaving the front flippers still attached together.
- All together, the number of hatchlings made from the 10 sheets of paper are about as many as are born in one nest. Each paper turtle is the same size as a real newborn turtle.

For discussion:

- 'What would happen if we stuck our beach umbrella into the sand above a turtle's nest?' 'And if we drove our car over the sand?'

Sources:

ARCHELON, 'The Sea, Turtles and Me', educational material on marine biodiversity and the role of humans, p.16.

ACTIVITY A5:

Beach Observation

Age: 6+
Time: 1-2 hours

Materials:
- Cardboard rolls from toilet paper (2 per student)
- Adhesive tape or rubber bands

Number: 4+

Place: Outdoors (beach)

Season: Spring or summer

Goals:
- To develop students' observation skills
- To introduce students to the diversity of organisms in the natural world.

Glossary: None required

Introduction:

From a distance, a natural landscape looks empty of life. This impression is misleading, since the Mediterranean landscapes are among the richest in the world in endemic species (i.e., species that do not exist anywhere else).

A beach brings together animals from the land and sea. Land animals move around close to the plants where they find their food, while marine animals prefer the shallow waters and wet sand.

To find the land-dwelling animals on the beach, one has to look carefully at the plants (e.g., the flowers and the underside of the leaves), beneath stones (replace the stones exactly as you found them) and piles of leaves. In the sand and the mud, you will find footprints of small and large animals which moved around during the night.

For marine animals, one has to search in the shallow water in the ponds between the rocks. Digging into the sand with your hands, you will find mussels and tiny water fleas (called isopods, which are related to shrimp).

Instructions:

- Make 'binoculars' by attaching two cardboard rolls together with adhesive tape or rubber bands. With these 'binoculars', students can more easily focus their attention on small animals, plants and objects.
- Walk slowly along the beach, observing instead of talking, and looking through the 'binoculars' instead of picking things up. Every now and then, take small breaks to discuss what you observe. (Before going to the beach, you can take a practice walk close to the school to familiarize students with observing).
- Students use the 'binoculars' to look into anything that

catches their attention. They can look at things from various perspectives: from above, from the side, even from below.

- Students look for traces of animals and humans on the path, in the sand, and at the water's edge. Traces can be footprints, feathers or hairs, leaves or fruit with signs they have been eaten, evidence of digging in the ground, etc. Can they find traces of three different species of animals?

For discussion:

- 'What animals or plants did you see?' 'Where were they?'
- 'Do these animals and plants also exist in school?' 'Why?'

Sources:

USDA Forest Service, Wet and Wild World, http: //www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5073119.pdf

Oltman M. (2002). Natural Wonders, A Guide to Early Childhood for Environmental Educators, Created by the Minnesota Early Childhood Environmental Education Consortium, p.54 (available at https://www.seek.state.mn.us/sites/default/files/naturalwonders. pdf)

ACTIVITY A6:

Which beach do I want?

Age: 6+
Time: 1 hour

Materials:
- Worksheet (2 per student)
- Coloured pencils or crayons (1 set for each student)

Number: Small group

Place: Indoors

Season: All year round

Goals:
- Students will approach Nature with imagination.
- Students will develop their critical thinking skills.

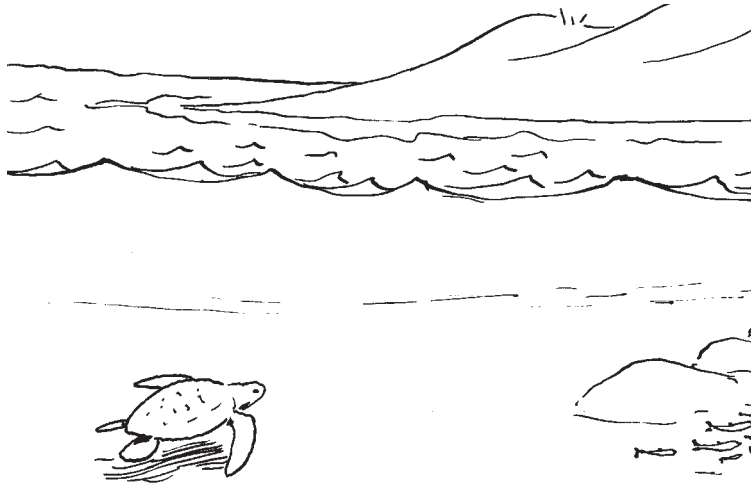
Glossary: None required

Introduction:

People have been living on the beaches of the Mediterranean since prehistoric times. Until recently, their impact on the beaches was slight: There were few houses, boats and harbours were small, and fishing nets were small and all made with natural materials (stones, wood, iron, leather, fibres, and wool).

Since the 18th century, the coastal population has been increasing, and ships and ports have become larger.

From the 20th century onward, people have been building thousands of holiday homes on the beaches, using



many plastics that – when thrown away – end up in the sea, using harmful pesticides in agriculture which are washed into the rivers and the sea by the rains, and fishing with huge nets, moving further and further from the shore and reaching deeper and deeper into the sea.

Today, it is more difficult to find the large schools of fish that had previously existed, but it is even harder to find a beach or a sea bottom without trash.

Instructions:

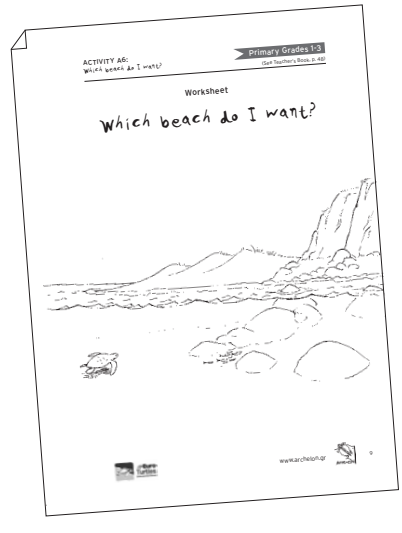
Each student uses two Worksheets to colour two versions of the same beach: One as they would like it to be, while the other containing something which would trouble them if it were on the beach.

For discussion:

Which of these two beaches do we most often find? Why?
What can we do to make beaches the way we wish they could be?

Sources:

ARCHELON, 'The Sea, Turtles and Me', educational material on marine biodiversity and the role of humans.



ACTIVITY A7:

Looking for tomorrow's trash

Age: 6+
Time: 1-2 hours (over 2 days)

Materials:
- Worksheet (1 per student)

Number: Small group

Place: Indoors

Season: All year round

Goals:
- Students will understand that their lifestyle affects marine pollution.
- Students will realize that they can reduce marine pollution through proper recycling.

Glossary:
Recycling: The selection of trash made from certain materials (i.e., paper, glass, metal, plastics, etc.) for their use as raw material for the production of new materials.
Decomposition: The breaking down of dead organic material into its inorganic components by microorganisms.
Pollution: The introduction of

Introduction:

All solid waste that ends up in the sea comes from inhabited areas on land. It consists of items used in homes, industries, and farming. In addition to causing the aesthetic pollution of the landscape, solid waste is often dangerous to wildlife: Batteries and rusting machines release toxic substances and oils, while glass bottles and cans frequently become animal traps.

Plastics comprise the bulk of solid waste, and take decades or even centuries to decompose. Pieces of nylon nets and ropes can become wrapped around the beaks and limbs of seabirds, cetaceans, and turtles, who often die of hunger as a result. Plastic bags cause suffocation or starvation to sea turtles which mistake them for jellyfish and swallow them. All plastics (even 'eco-friendly' biodegradable bags) dissolve into tiny pieces of plastic ('microplastics'), which for decades are carried by the waves and cause the deaths of birds and fish that swallow them in large quantities, along with the plankton and juvenile fish that comprise their food.

For the proper management of trash, well-organised landfill sites are needed. These special designed and constructed sites allow for the safe and sanitary disposal of trash: They are constructed with a waterproof floor that prevents toxic liquids from leaking out into the earth beneath it and polluting the surface and underground waters of an area.

However, the trash problem can only be addressed if the volume of refuse is limited by the selection and recycling of any materials that can be reused, such as paper, glass, metals, minerals, watch batteries. While a recycling program has high financial costs, part of which is covered

substances or energy into the environment by humans, with harmful effects on living organisms.

Pollutants: Substances which are harmful to the environment.

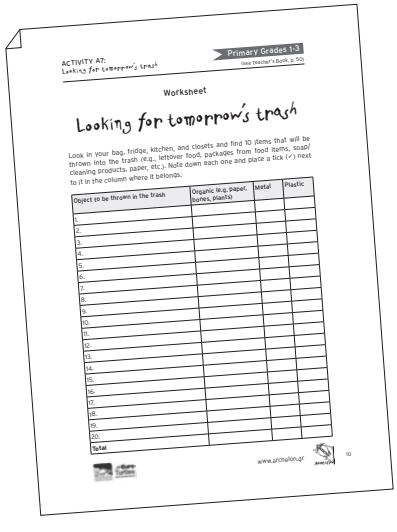
Landfill (Rubbish Landfill): Specially constructed site for the sanitary disposal of rubbish on soil that has been made waterproof with a special membrane to prevent contamination of the soil and aquifers. When a landfill cannot hold any more rubbish, it is usually covered with soil.

Dump: Illegal rubbish disposal site that allows liquids to drain from the trash into the groundwater, and solid trash to be swept away by the wind.

by the reusable materials, it yields a high environmental profit, since the volume of trash and landfills is reduced. To function effectively, recycling requires the goodwill and cooperation of the local residents of the area.

Instructions:

- Discuss the issue of trash in the sea. Have students ever found trash on the beach? Were they upset or indifferent about it? How do they think rubbish looks to marine animals? Could they be in danger from some of it? Why?
- Explain to students that the trash ending up into the sea came from the areas where people live, and that they will do a small research project to find some of this trash. Discuss what kind of garbage they would probably find, and how that could get into the sea. Then, distribute the Worksheet to them.
- Each student searches at home or school and, on the Worksheet, takes notes of 20 items that one day would be useless and thrown into the trash.
- Compare the Worksheets all together. Are there objects that appear in many worksheets? If all the recorded items together were the amount of rubbish that was thrown away (for example) in a week, how much would be thrown away in a whole year?


ACTIVITY A7.
Looking for tomorrow's trash

Primary Grades 1-3

Worksheet

Looking for tomorrow's trash

Look in your bag, fridge, kitchen, and closets and find 10 items that will be thrown into the trash (e.g., leftover food, packages from food items, soap/cleaning products, paper, etc.). Note down each one and place a tick (✓) next to it in the column where it belongs.

Object to be thrown in the trash	Organic (e.g. paper, bones, plants)	Metal	Plastic
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			
16.			
17.			
18.			
19.			
20.			
Total			

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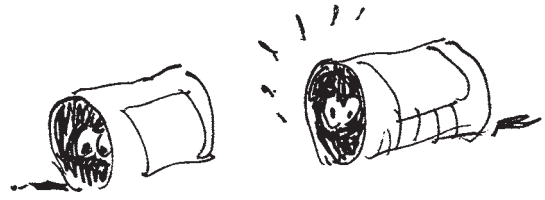
For discussion:

- 'Is all rubbish equally harmful?' 'Or is there some that is more dangerous to marine animals?' 'Or is there some that lasts for more time in the sea?' 'Is there any that bothers us the most?'
- 'Is there a way to throw out less trash?'
- 'Is there a way to prevent trash from reaching the sea?'

Sources:

National Oceanic and Atmospheric Administration's (NOAA) Marine Debris Program (2012), Turning the Tide on Trash: A Learning Guide on Marine Debris, p.34-37, https://marinedebris.noaa.gov/sites/default/files/TurningTideonTrash_GL%20edition.pdf



ACTIVITIES
Primary Grades 4-6

ACTIVITY B1:

How big is a turtle?

Age: 6+
Time: 1 hour

Materials:
- Worksheet (1 per student)
- Scissors (1 for each group)
- Paper glue (1 for each group)
- Coloured pencils or crayons (1 set for each group)
- Chalk (1-2 pieces for each group)
- Measuring tape (e.g. the type used for sewing) (1 for each group)

Number: Small group

Place: Indoors and outdoors

Season: All year round

Goals:
- Students will approach Nature with imagination.
- Students will collaborate to complete a project.

Glossary: None required

Introduction:

Sea turtles are the only Mediterranean reptiles living in the sea. Of the three species swimming in the Mediterranean, only *Caretta caretta* reproduces in Greece.

They are very similar to their closest relatives, tortoises (land turtles), and terrapins: All turtles have a hard carapace, scaly skin, and their mouths have hard beaks made of keratin.

However, sea turtles have certain characteristics that indicate their adaptation to marine life: They have fin-like flippers to facilitate swimming, large eyes for to see better in the dark depths of the sea, hydrodynamic-shaped bodies for less water resistance, but have lost the ability to retract their heads and limbs into their carapaces.

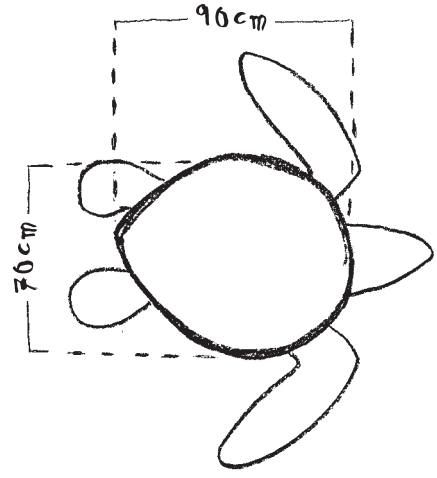
Sea turtles have much larger bodies than land turtles (a sea turtle's carapace measures up to 110 cm long, a tortoise's up to 25 cm long, and a terrapin up to 20 cm), probably because movement in the sea is easier and food is more abundant.

Instructions:

- Each student colours the turtle provided on the worksheet, then cuts and folds it, fixing it with a little glue at the points marked with small circles, squares or triangles
- In groups of 2-4, students draw an actual-sized sea turtle on the ground in chalk, using a measuring tape and the dimensions given.
- Ask a student to lie down next to the drawing and trace their own outline next to the turtle's. Afterwards, they can draw a picture of a student next to a turtle on the ground, or you can even take a photo of the two outlines together.

For discussion:

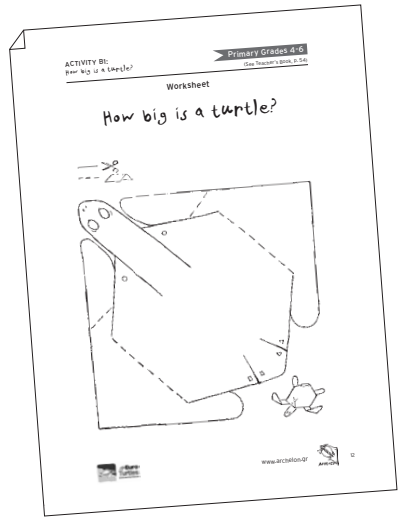
- 'Do you see something on the turtle's body that helps it move in the water?' 'What is it?' 'Does it help it move on land?'
- 'Is a sea turtle as big as you had imagined it to be?' 'Would you be afraid of it swimming next to you?' 'Do you think you would be in danger?' 'Or do you think that maybe it would be in danger from you?' 'Why?'



Sources:

ARCHELON, 'The Sea, Turtles and Me', educational material on marine biodiversity and the role of humans, p.14.

'Dinosaurs, Giants of Patagonia', Educator's Guide, p.11, https://www.si.edu/Content/SE/Educator%20Guides/Dinosaurs%203D%20-%20Giants%20of%20the%20Patagonia.pdf



ACTIVITY B2:

Make a mobile

Age: 8+
Time: 1-2 hours

Materials:
- Worksheet (1 for each group of 3 students)
- Scissors (1 for each group)
- Thin twine (1.5-2 m for each group)
- Thick needle or thin pin (1 for each group)
- Thin pieces of wood or twigs (2-3 for each group)
- Coloured pencils or crayons (1 set for each group)

Number: 3+

Place: Indoors

Season: All year round

Goals:
- Students will work together to complete a project.
- Students will become acquainted with scientific classification.
- Students will develop their observational skills.

Introduction:

The world is a very complex environment, filled with countless creatures and objects, obligations and needs, and people and material goods.

In order to organize our lives, we create some order in the world around us by grouping similar things into categories. It is much easier to handle a limited number of categories of things rather than handling a great many individual things.

Usually, we group organisms and objects based on similarities, which can be functional (i.e., related to meeting survival needs) or structural (i.e., related to their physical components). We start by forming a few large categories, and then divide each category into smaller ones.

Many different species of animals live in the sea. We can sort them according to their means of surviving (e.g., they hunt or graze, walk or swim), or their appearance (e.gg how many legs they have).

Food chain levels indicate the status of each animal in the marine ecosystem: Algae and phytoplankton belong to the 1st level (i.e., they are 'producers', who make their own food using sunlight and raw materials in the water), followed by 2nd level animals (i.e. 'first-level consumers') who eat the 1st level species, and so on up the chain.

Glossary:

Criterion: An item which can be used to judge, evaluate, or classify something.

Classification: The categorization of a set of objects, organisms, etc. in a systematic way, based on one or more criteria.

ANIMAL	Where it belongs	Where it lives	What it eats	Food chain level
Turtle	Vertebrate (Reptile)	Surface	Jellyfish	4
Dolphin	Vertebrate (Mammal)	Surface	Small fish	4
Grouper	Vertebrate (Fish)	Seabed	Small fish	4
Sardine	Vertebrate (Fish)	Surface	Plankton	3
Jellyfish	Invertebrate (Cnidaria)	Surface	Plankton	2
Crab	Invertebrate (Decapod)	Seabed	Small animals	3
Starfish	Invertebrate (Echinoderm)	Seabed	Shellfish	3
Conch	Invertebrate (Mollusc)	Seabed	Plankton	2

Instructions:

- Students think of ways to classify themselves into groups. The criteria can be gender, height, clothes, etc. Discuss the benefits of each classification.
- Each group of students makes a mobile: First, they place the front side of the Worksheet on a glass window and trace the animal pictures onto the back of the Worksheet. Then they colour both sides of the animal picture and cut it out. (Note: The sizes are not drawn to scale).
- With a pin, they pierce the top of each animal, tie a piece of string to it, and hang it on one of the twigs.
- Each group organizes the animals of its mobile by a criterion of their choice. Animals Use twine of different lengths to distinguish one group from another when attaching them to the twig. Make sure that the animals do not touch each other. Hang the mobile in a door frame to swing in the wind.

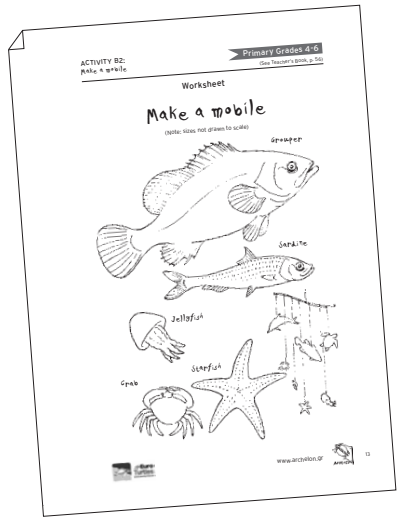
For discussion:

- 'Can we organize these objects using different criteria?'
- 'Is there only one correct classification criterion?'

Sources:

ARCHELON, 'The Sea, Turtles and Me', educational material on marine biodiversity and the role of humans, p.16.

DucksUnlimited Canada, Wetland Ecosystems III, Educator's Guide, High School Science Grades 9-12, p.14. Retrieved 3/12/2013 from: http://www.teacherfreebies.com/directory/PDF/DucksUnlimited/99981341.pdf


ACTIVITY B2:
Make a mobile

Primary Grades 4-6
(See Teacher's book, p. 56)

Worksheet

Make a mobile

(note: sizes not drawn to scale)

Grouper

Sardine

Jellyfish

Seastar

Crab

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13

ACTIVITY B3:

Beach observation

Age: 8-12

Time: 1-2 hours (can be extended to 2 hours outdoors and 1 hour in the classroom)

Materials:

For both versions:

- Worksheet A (1 for each group)
- Pencils, coloured pencils or crayons (1 for each student)

Additional – For extended version

- Worksheet B (1 for each group)
- White sheets of A3 size paper (1 for each student)
- Pencil (1 for each student)
- Coloured pencils or crayons (for each group)
- Scissors
- Adhesive tape
- Empty carton from fresh milk (for each group)
- Transparent plastic bag (for each group)

Number: 15-30 (in groups of 4 students)

Place: Outdoors (on the beach)

Introduction:

Natural landscapes are ideal places for one to look for wild animals. Flowers frequently have bees, butterflies, beetles, and colourful spiders on them. A beach brings animals from both the land and the sea together. The shallow water of a tidal pool resembles a window, through which one can observe the life in the sea depths. The sand on the beach is like a piece of paper with the footprints of sea birds and beetles recorded on it.

A researcher keeps notes, because it is the only way to keep a record of all the details they have observed. They do not note down everything they see, but only those things that are important to what they are studying. This means that they record different things each time their interest and the theme of their work changes.

With their notes, a visitor or naturalist creates a journal of everything of interest to them which they have seen. Thanks to these notes, which often include drawings, sketches, and maps, they can remember what they have seen, no matter how many years have passed.

When taking notes, it is useful to record the location, the date and a few words about the weather conditions.

Instructions:

- Students are divided into groups of 4. Each team is assigned to observe an area of the shore and look for the creatures listed in Worksheet A. When they find one, they can put a tick (✓) next to its picture.
- You can easily make an improvised type of 'looking glass' like the one fishermen used to use many years ago. Slightly dip its plastic-covered end into the water of a tidal pool on the shore and you will see the bottom-dwelling sea animals

Season: Spring or summer

Goals:

- Students will develop their observational skills
- Students will realize the diversity of organisms in Nature
- Students will record their findings

Glossary:

Pollination: The transport of pollen from one plant to another so that it can reproduce.

Predator: An animal that kills and eats other animals.

Prey: An animal that is eaten by other animals.

Omnivore: An animal that eats both meat and plants.

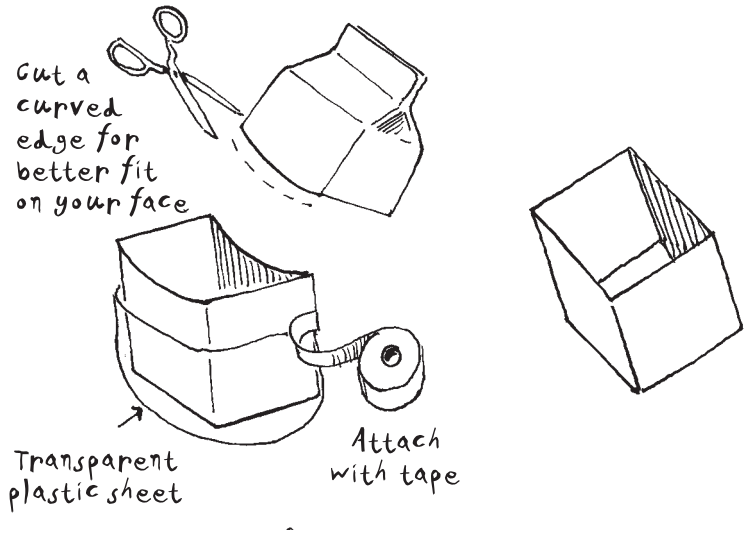
Camouflage: The ability of certain animals to 'change' their colours so that they match the colours of the environment in order to protect themselves from predators.

Carnivore: Meat-eating animal.

Herbivore: Plant-eating animal.

Additional Activity: *An explorer's journal*

- Explain to students that scientists always take notes of what they observe and then study their notes to draw conclusions. They always have small notebooks with them where they keep 'field notes', with text and drawings. In the times when there were no cameras, the sketches and drawings were critical for preserving scientific observations.



- Students use large sheets of paper (e.g. A3 size) to make their own field notebooks, as shown on Worksheet B. They can write 'Field Notes', 'Beach Journal', or whatever they want on the cover. They can divide the 3 interior pages into 3 separate themes (e.g., landscape, plants and animals, and humans), or write about each topic in the same order as they encounter it.
- Students spread out along a piece of the shore and note whatever attracts their attention. You can move among them to answer questions and help where needed.
- After returning to the classroom, the students spread out their journals and wander around to look at each other's notes.
- You can ask some questions about the experience of visiting and recording (e.g., 'How did you choose what to record?', 'Did you see something you would like to remember?', 'Do you think the journal will help you remember what you saw and learnt?', 'Are you proud of

your journal?' 'How could you make it even better? '). Let them think for a few minutes and then discuss their ideas all together.

For discussion:

- 'What animals or plants did you see?' 'Where were they?'
- 'Do these animals and plants also exist in school?' 'Why?'

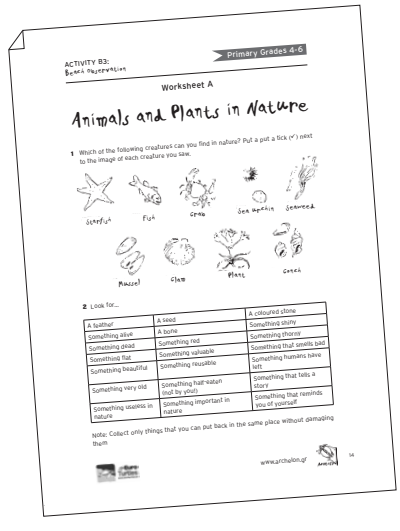
Sources:

Cornell J. (1994), Let's Share Nature with Children, Observer Publications, p. 80.

Coastcare (2002), Putting a toe in the water: a teacher's guide, getting started with coastal and marine studies in Tasmania, p.60-62, http://www.environment.gov.au/coasts/discovery/teachers/ pubs / coastcare.pdf

Surfrider Foundation, Beach explorers, Respect the beach – Beachology – Unit 1, p.1-2, 13-16, http://www.respectthebeach.com/beachology%28K-5%29/RTB_Unit1.pdf

Harold S. & Eckert K. (2005), Endangered Caribbean Sea Turtles: An Educator's Handbook, WIDECAST Technical Report No.3, p.53, http://www.dnr.sc.gov/seaturtle/education/Harold%26Eckert% 20 (2005)% 20Carib% 20Sea% 20Turtles-% 20Educators% 20Handbook.pdf


ACTIVITY B3:
Beach Exploration

Primary Grades 4-6

Worksheet A

Animals and Plants in Nature

1 Which of the following creatures can you find in nature? Put a put a tick (✓) next to the image of each creature you saw.

Starfish Fish Crab Sea urchin Seaweed

Mussel Clam Plant Cactus

2 Look for...

A feather	A seed	A coloured stone
Something alive	A bone	Something shiny
Something dead	Something red	Something thorny
Something flat	Something valuable	Something that smells bad
Something beautiful	Something reusable	Something humans have left
Something very old	Something half-eaten (not by you)	Something that tells a story
Something useless in nature	Something important in nature	Something that reminds you of yourself

Note: Collect only things that you can put back in the same place without damaging them

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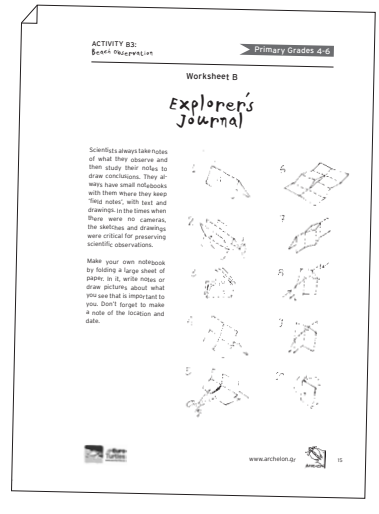
ACTIVITY B3:
Beach Exploration

Primary Grades 4-6

Worksheet B

Explorer's Journal

Scientists always take notes of what they observe and then study their notes to draw conclusions. They always have small notebooks with them where they keep "field notes", with text and drawings, in the times when there were no cameras, the sketches and drawings were critical for preserving scientific observations.

Make your own notebook by folding a large sheet of paper, in it, write notes or draw pictures about what you see that is important to you. Don't forget to make a note of the location and date.

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ACTIVITY B4:

Which beach do I want?

Age: 6+
Time: 1-2 hours

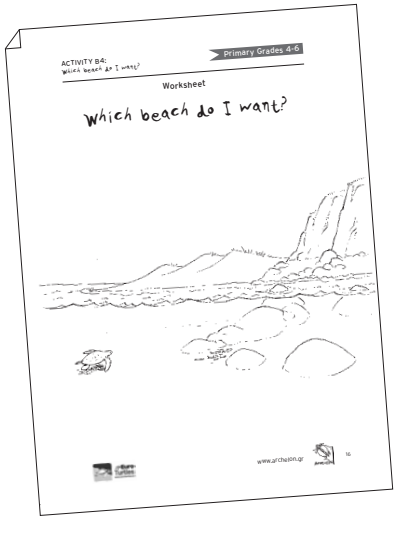
Materials:
- Worksheet (2 copies per student)
- Coloured pencils or crayons (1 set for each student)

Number: Small group

Place: Indoors

Season: All year round

Goals:
- Students will approach Nature with imagination.
- Students will develop their critical thinking skills.



Introduction:

People have been living on the beaches of the Mediterranean since prehistoric times. Until recently, their impact on the beaches was slight: There were few houses, boats and harbours were small, and fishing nets were small and all made with natural materials (stones, wood, iron, leather, fibres, and wool).

Since the 18th century, the coastal population has been increasing, and ships and ports have become larger.

From the 20th century onward, people have been building thousands of holiday homes on the beaches, using many plastics that – when thrown away – end up in the sea, using harmful pesticides in agriculture which are washed into the rivers and the sea by the rains, and fishing with huge nets, moving further and further from the shore and reaching deeper and deeper into the sea.

Today, it is more difficult to find the large schools of fish that had previously existed, but it is even harder to find a beach or a sea bottom without trash.

Instructions:

Each student uses two Worksheets to colour two versions of the same beach: One as they would like it to be, while the other containing something which would trouble them if it were on the beach.

For discussion:

- 'Which of these two beaches do we most often find?' 'Why?'
- 'What can we do to make beaches the way we wish they could be?'

Sources:

ARCHELON, 'The Sea, Turtles and Me', educational material on marine biodiversity and the role of humans.

ACTIVITY B5:

Travelling trash

Age: 8+
Time: 50 minutes

Materials:
- Worksheet (1 per student)
- Many small pieces of plastic, cloth, glass, rubber, metal, paper, wood, food (e.g., fruit peels and pits)
- An electric fan (1)
- A bucket with water (1)
- A watering can (1)
- A shallow tray (1)

Number: Small group

Place: Indoors

Season: All year round

Goals:
- Students will discover some particular characteristics of trash.
- Students will collaborate on an experiment (e.g. analysis, classification, hypothesis, observation).

Glossary: None required

Introduction:

Trash contains solid objects that are discarded by people as useless (in contrast, sewage is a liquid waste). In the past, trash consisted of organic materials (e.g. leftover food, fabrics, wood, etc.). These could easily be decomposed by microorganisms.

Over the last 70 years, however, trash has come to contain more and more synthetic substances (e.g., plastic, nylon, PVC, synthetic resins, etc.) and metals which do not rust, (e.g. aluminium, stainless steel). Synthetic substances are extremely resistant to decomposition by microorganisms or sunlight, and can last for many years or even centuries in the environment. The sun and the waves break the plastic into tiny pieces, which can 'survive' for tens or hundreds of years. Also, rubbish that decomposes in a few weeks or months – like paper – is much more abundant today.

Most rubbish is deposited in landfills or dumps, but much is also illegally dumped in isolated places, streams, or at sea. The wind and floods carry it from the land to the nearest river, and from there to the sea.

Most rubbish is produced by households, industries and factories, roads and sewers, ships, people using beaches, and others.

A great deal of rubbish would not reach the sea if it were recycled instead of being discarded in open areas. In addition, the amount of rubbish could be reduced by some changes in the marketing of products (e.g., glass instead of plastic bottles, paper packaging instead of plastic, and multi-item packs rather than individual packaging, etc.).

Instructions:

- Talk about trash: What kind of objects and materials do

they contain? Can they be transported from landfills to the sea? How?

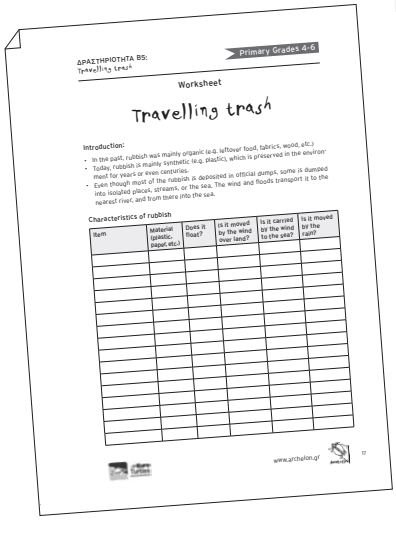
- Students separate the pieces of rubbish into different piles depending on their material. Each one fills in the first two columns (Object, Material) of their Worksheet.
- Place each pile in turn in the bucket of water and note which trash floats.
- Place each pile in turn in front of the fan (representing the wind) and note which trash is carried or moved by the wind on land.
- Place each pile in turn on the shallow tray with water in front of the fan and note which trash is being dragged by the sea wind.
- In turn, arrange the shallow tray at a slight angle and place each pile on it; then use the watering can to sprinkle it with water (representing the rain), and note which trash is moved.
- Discuss how the above features of each type of rubbish affect whether it will reach the sea.

For discussion:

- 'What would a world be like without rubbish management (i.e., recycling, collection, organized rubbish disposal areas)?'
- 'What problems would each of us have?'
- 'What could we do?'

Sources:

National Oceanic and Atmospheric Administration's (NOAA) Marine Debris Program (2012), Turning the Tide on Trash: A Learning Guide on Marine Debris, p.20-22 https://marinedebris.noaa.gov/sites/default/files/TurningTideonTrash_GL % 20edition.pdf


ΔΡΑΣΤΗΡΙΟΤΗΤΑ 8Β:
Travelling trash

Primary Grades 4-6

Worksheet

Travelling trash

Introduction:

- In the past, rubbish was mainly organic (e.g. leftover food, fabrics, wood, etc.)
- Today, rubbish is mainly synthetic (e.g. plastic), which is preserved in the environment for years or even centuries.
- Even though most of the rubbish is deposited in official dumps, some is dumped into isolated places, streams, or the sea. The wind and floods transport it to the nearest river, and from there into the sea.

Characteristics of rubbish

Item	Material (plastic, paper, etc.)	Does it float?	Is it moved by the wind over land?	Is it carried by the wind to the sea?	Is it moved by the rain?

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ACTIVITY B6:

The life cycle of trash

Age: 8+

Time: 1 hour for preparation, 0.5 hours for checking each result, about a 4-month decomposition period.

Materials:
- Large flower pot with soil (1 for each group)
- Fruit peels
- Cloth (in pieces)
- Paper (pieces of photocopies, newspapers, paper bags, etc.)
- Plastic (pieces from bottles, packaging, cups, straws, etc.)

Number: Small group

Place: Indoors

Season: All year round

Goals:
- Students will form hypotheses and verify them.
- Students will associate the slow decomposition of many materials with marine pollution.

Glossary: None required

Introduction:

In the past, rubbish consisted only of organic materials (such as food waste, vegetable and animal waste, ceramics, and wood). Sunlight and microorganisms (e.g. fungi, bacteria, etc.) decompose most organic materials in a few months or years.

Since 1950, rubbish has been comprised of many synthetic substances (e.g. plastic, nylon, PVC, synthetic resins and fibres, etc.) and forms of metal which do not rust (e.g., aluminium and stainless steel). These materials are extremely resistant to decomposition by microorganisms or sunlight and can last for many years or even centuries in the environment. The sun and the waves break down the plastic into tiny pieces ('microplastics'), which can 'survive' for hundreds of years. But even the rubbish that decomposes in a few weeks or months – like paper – is much more abundant today than it used to be.

Most rubbish is disposed of in landfills or dumps, but much is dumped illegally in isolated places, streams or the sea. The wind and floods carry them from land to the nearest river, and from there to the sea.

Households, industries and factories, roads and sewers, ships, people who use the beaches, and others produce the majority of rubbish.

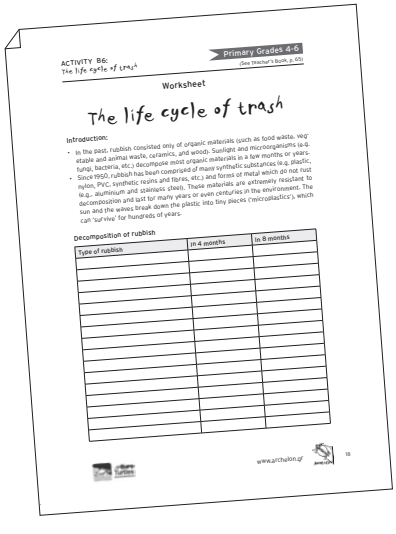
A great deal of rubbish would not reach the sea if it were recycled instead of dumped in open areas. There would be less trash if the volume of plastic we use was reduced, with changes in marketing and our daily habits (i.e., glass instead of plastic bottles, textile bags instead of nylon shopping bags, paper instead of plastic, and multi-item packs rather than individual packages, etc.).

Instructions:

- Talk about how many different materials we find in the trash, about how they decompose, and the different resistance of each material to decomposition.
- Students bury most objects in the soil and also place samples of every material on the surface of the soil. Put the flowerpot in a sunny place and water it every 2-3 days.
- Every 4 months, students examine the objects and observe how many and which ones have remained unchanged. The changes can be in shape, colour (i.e., Has it faded?), or durability (i.e., Does it split into pieces when pulled from both sides?).
- Students record the changes they observe in each material. This can be done with text, photos or both.
- Finally, discuss your observations: 'Which materials decomposed and which ones did not?' 'Were there differences between the material that was on the surface and exposed to the sun, and the same material that was buried in the soil?' 'Is material which decomposes slowly more likely to be found in the sea?' 'Is material which slowly decomposes more dangerous to marine animals?' 'Why?'

For discussion:

- 'Think about the various items you use in your daily life. How many of them contain plastic?'
- 'Can you replace these plastic items with objects made from other materials?'


ACTIVITY B6:
The life cycle of trash

Primary Grades 4-6
(See Teacher's Book, p. 65)

Worksheet

The life cycle of trash

Introduction:

- In the past, rubbish consisted only of organic materials (such as food waste, vegetable and animal waste, ceramics, and wood). Sunlight and microorganisms (e.g. fungi, bacteria, etc.) decompose most organic materials in a few months or years.
- Since 1950, rubbish has been comprised of mass synthetic substances (e.g. plastic, nylon, PVC, synthetic resins and fibres, etc.) and forms of metal which do not rust (e.g., aluminium and stainless steel). These materials are extremely resistant to decomposition and last for many years or even centuries in the environment. The sun and the wines break down the plastic into tiny pieces ('microplastics'), which can 'survive' for hundreds of years.

Decomposition of rubbish

Type of rubbish	in 4 months	in 8 months

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Sources:

ARCHELON, 'The Sea, the Turtles and I', educational material on marine biodiversity and the role of humans, p.17.

National Oceanic and Atmospheric Administration's (NOAA) Marine Debris Program (2012), Turning the Tide on Trash: A Learning Guide on Marine Debris, p.23-29 https://marinedebris.noaa.gov/sites/default/files/TurningTideonTrash_GL%20edition.pdf

ACTIVITY B7:

The right tool

Age: 10+
Time: 1 hour

Materials: Worksheet (1 per student)

Number: Small group

Place: Indoors

Season: All year round

Goals: Students will form hypotheses and verify them.

Glossary:

Adaptation: The process of genetic change which naturally occurs in an organism from generation to generation so that offspring are best suited for conditions in their environment. These changes insure that the genetic code inherited by the next generation is sound and, together with the process of natural selection, ensures that those organisms which have adapted best to environmental conditions leave more offspring.

Evolution: The gradual

Introduction:

All animal species have been adapted to best utilize what their environment has to offer. Adaptation is the result of evolution: Some type of mutation (i.e., a random, minor change in genetic material which has been passed down from a parent to its child) can result in the new organism having a survival advantage over others, thereby living longer and producing more offspring with this positive characteristic, thereby spreading it gradually throughout the population.

Adaptation involves both physical and behavioural changes in an organism. Thus, a sea turtle has flippers (suitable for swimming) and lives in the sea (where it finds food), but gives birth on land (where sand warmed by the sun helps the turtles grow inside their eggs).

Depending on its habitat, an animal must be able to move either on the land, in the water, or in the air, to search for its food (and to able to catch it if it tries to escape), to avoid its enemies, and to protect itself from weather conditions.

An animal's mouth indicates the way it gets its food: Many small teeth are ideal for catching agile fish, while strong keratin beaks are better suited to catch prey which moves slowly. The limbs of an animal indicate whether it walks or swims.

Humans invented tools that resemble animal 'tools' and which perform similar tasks: An oar works like the special membranes on the legs of cormorants. A short knife is as practical in collecting wild grass as the keratin beak of a land turtle. The grey colour of a warship – just like the colour of a dolphin – makes it difficult to spot at sea.

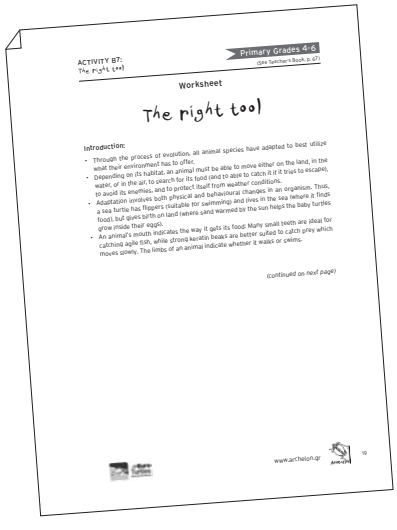
adaptation of species to the conditions of their environment.

Instructions:

- Discuss what kind of problems a species of animal faces because of its lifestyle, how it can be overcome (by adapting), and what consequences those adaptations would have for its physical form.
- Distribute the Worksheet, and give students time to complete it.
- Discuss the adaptations of these species.

For discussion:

- 'What types of problems do animals have to deal with?'
- 'When people face a similar problem, do they solve it in the same way?' 'Can you think of examples?'


ACTIVITY B7:
The right tool

Primary Grades 4-6
(see Teacher's Book, p. 67)

Worksheet

The right tool

Introduction:

- Through the process of evolution, all animal species have adapted to best utilize what their environment has to offer.
- Depending on its habitat, an animal must be able to move either on the land, in the water, or in the air, to search for its food (and to be able to catch it if it tries to escape), to avoid its enemies, and to protect itself from weather conditions.
- Adaptation involves both physical and behavioral changes in an organism. Thus, a sea turtle has flippers (suitable for swimming) and lives in the sea (where it finds food), but gives birth on land (where sand warmed by the sun helps the baby turtles grow inside their eggs).
- An animal's mouth indicates the way it gets its food: Many small teeth are ideal for catching agile fish, while strong keratin heads are better suited to catch prey which moves slowly. The limbs of an animal indicate whether it walks or swims.

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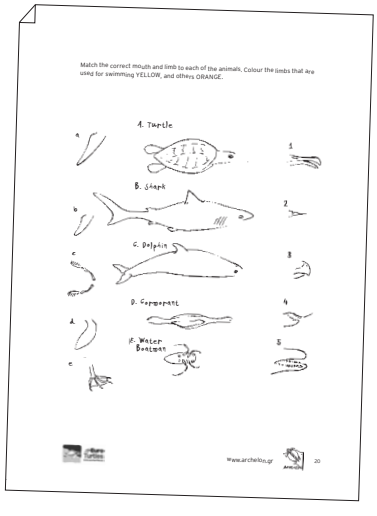
Match the correct mouth and limb to each of the animals. Colour the limbs that are used for swimming YELLOW, and others ORANGE.

A. Turtle

B. Shark

C. Dolphin

D. Cormorant

E. Water Boatman

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Sources:

Ducks Unlimited Canada, Wetland Ecosystems I, Student journal – Elementary science grade 4 to 6, p.13-15, http: /www.greenwing.org/dueducator/ducanadapdf/99993845.pdf

Ducks Unlimited Canada, Wetland Ecosystems I, Educator's Guide – Elementary Science Grade 4 to 6, p.7, http: /www.greenwing.org/dueducator/ducanadapdf/teachersguide1.pdf

Harold S. & Eckert K. (2005), Endangered Caribbean Sea Turtles: An Educator's Handbook, WIDECAST Technical Report No.3, p.20, http://www.dnr.sc.gov/seaturtle/education/Harold%26Eckert% 20 (2005)% 20Carib% 20Sea% 20Turtles-% 20Educators% 20Handbook.pdf

Worksheet Answers:

A-3-3 Sea turtle (mouth like tongs, limbs like an oar)
B-a-4 Shark (mouth like a knife, limbs like a rudder)
C-b-5 Dolphin (mouth like pliers, limbs like a rudder)
D-e-1 Cormorant (mouth like tongs, limbs like scuba-diving flippers)
E-g-2 Water boatman (mouth like a straw, legs like a paddle)

ACTIVITY B8:

Trapped in Trash

Age: 10+
Time: 1 hour

Materials:
- Rubber bands (1-2 for each student)
- Worksheet (1 per student)

Number: Small group

Place: Indoors

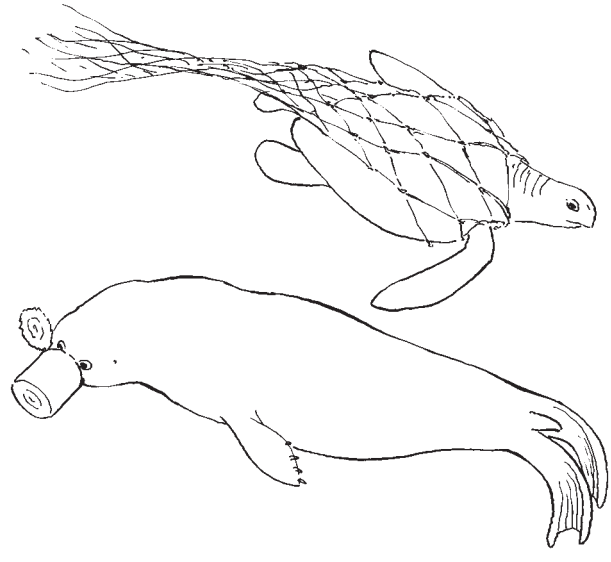
Season: All year round

Goal:
- Students will recognize that marine pollution is dangerous to both marine animals and humans

Glossary:
Pollution: Introduction by humans of substances or energy into the environment, with harmful effects on living organisms.
Pollutants: Substances which damage the environment.

Introduction:

Almost all solid waste that ends up in the sea comes from the land and has reached the sea by the action of wind and torrents. They are items used in households, factories, and farming.



Solid waste mainly causes aesthetic pollution, but it is often dangerous to wildlife (e.g. batteries and old engines release toxic liquids and oils, plastic bags cause sea turtles that confuse them with jellyfish to suffocate, the ropes and fishing nets become wrapped around the animals' necks and limbs, and small animals can become trapped inside bottles and cans.

Proper waste management requires properly designed dumpsites (i.e. areas which have been built for the safe and sanitary disposal of waste) which prevent toxic liquids from leaching into the ground and contaminating surface and groundwater.

To reduce the volume of solid waste, some materials

(such as paper, glass, metals, minerals, batteries) can be recycled and reused. A recycling program has high financial costs, a part of which is offset by income from the sale of recycled materials, but also a great environmental benefit, i.e., a reduction in the mass of rubbish and less area needed for dumpsites. However, recycling requires the good-will and cooperation of local people in order to be successful.

Instructions:

- Talk about the objects around us. Are they few or many? What materials are they made from? How long have we been using them? Where do they end up when they become useless?
- Give each student a rubber band and show them how to put it on the thumb and on the little finger of their left hand.
- Each student tries to remove the rubber band without using any other part of their body (such as their right hand, elbow, feet, teeth, face, etc.).
- As students are trying to free themselves, ask them to imagine that they are marine animals (e.g. turtles) that are entangled in ghost nets or other trash and find it difficult to swim or hunt. How would they feel if they struggled to set themselves free all morning? How would they feel if they were unable to eat at noon and in the evening? What would happen the next day if a shark chased them?
- Discuss what students thought or felt while they were trying to free themselves.
- Distribute the Worksheet. Every student imagines being one of the animals pictured and writes one paragraph about what it's like to be trapped in trash. For the description, they can use information from the images on the worksheet and try to describe as many sensations and feelings as possible.

For discussion:

- 'Where do most of the objects we find along the beach come from?' 'Were they used at home, in a field, or in a factory?'
- 'How did the trash get to where we find it?'
- 'Are marine animals at risk from trash? In what ways?'

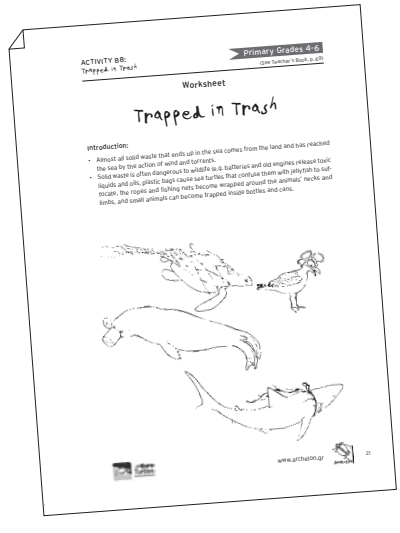
- ‘Are people at risk from trash in the sea or on the beach?’ ‘In what ways?’
- ‘What else could we have done with the discarded trash?’
- ‘What can we do to prevent or clear a site full of garbage?’

Sources:

National Oceanic and Atmospheric Administration’s (NOAA) Marine Debris Program (2012), Turning the Tide on Trash: A Learning Guide on Marine Debris, p.53-55, 56-58, 59-63, https://marinedebris.noaa.gov/sites/default/files/TurningTideonTrash_GL%20edition.pdf

Marine Debris: A Lesson in Conserving the Ecosystem, Project Oceanography, http://www.marine.usf.edu/pjocean/packets/f99/f99u1le1.pdf

ARCHELON, ‘The Sea, Turtles and Me’, educational material on marine biodiversity and the role of humans, p. 22-23.



ACTIVITY B8:
Trapped in Trash

Primary Grades 4-6
(See Teacher's Book, p. 67)

Worksheet

Trapped in Trash

Introduction:

- Almost all solid waste that ends up in the sea comes from the land and has reached the sea by the action of wind and torrents.
- Solid waste is often dangerous to wildlife (e.g. batteries and old engines release toxic liquids and oils, plastic bags cause sea turtles that confuse them with jellyfish to suffocate, the ropes and fishing nets become wrapped around the animals' necks and limbs, and small animals can become trapped inside bottles and cans.

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ACTIVITY B9:

Animal Wordsearch

Age: 8+
Time: ½ – 1 hour

Materials:
- Worksheet (1 per student)
- Pencil (1 for each student)

Number: -

Place: Indoors

Season: All year round

Goal:
- Students will learn about the food some marine animals eat.

Introduction:

The Mediterranean Sea is home to 18 species of cetaceans (whales, sperm whales, dolphins, etc.), 750 species of fish, and thousands of invertebrates. Although its size is less than 1% of the world's seas, it hosts 5.6% of the marine animals and 16.9% of the marine plant species.

Some of these animals co-exist in the same part of the sea: in the waves of the open sea, in the dark abyss, on the shallow sandy shelf, among the rocks with their many crevices and holes, and in the underwater meadows of Posidonia (a marine plant that grows only in the Mediterranean). This is possible because each species needs different food and shelter.

Instructions:

- Students look for the hidden names of the animals depicted. The name of each prey intersects with the name of its predator.

For discussion:

- 'Are there animals that eat the same food?' 'If so, how do they share it?'
- 'Are there similar animals that eat different foods?'
- 'Do all animals eat food smaller than themselves?'

Worksheet Answer Key:

F			S	W	O	R	D	F	I	S	H				O			
I								I							C	R	A	B
S	E	A	G	U	L	L		S							T			
H							J	H							O			
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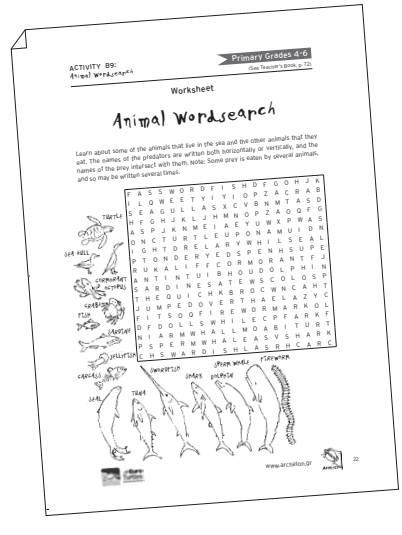


ACTIVITY B10:

Biodiversity diorama

Age: 8+
Time: 1 hour

Materials:
- Brown wrapping paper (3x1m, plus 1x1m for the rocks)
- Crepe Paper – yellow and two different shades of green
- Old magazines
- Paper glue
- Scissors (2-4)
- Marker, pen or pencil (1 for each student)

Number: Small group

Place: Indoors

Season: All year round

Goals:
- Students will realize the variety of animals in the sea.
- Students will develop their collaborative skills by working together to complete a project.

Introduction:

For the creatures who live in it, every corner of the sea is different.

The surface of the pelagic zone has plenty of light, tiny plants (phytoplankton that need light just like land plants), and tiny animals (zooplankton, which eat phytoplankton). Many small animals – such as jellyfish, sardines, anchovies, newborn fish, etc. – find plenty of food here, but many large animals – turtles, tuna, swordfish, dolphins, sharks, etc. – come here to eat the smaller ones. Pelagic animals have a dark back and white belly because it makes them difficult for their hunters to spot.

The abyss (the very deep part of the sea) is cold, dark, and quiet. Abyss animals are almost blind, swim very slowly, and eat dead animals that sink to the bottom from higher zones.

The rocks have crevices and holes which provide shelter and a stable surface for plants and animals to cling to. Many marine plants – algae, seaweed and lichen – and animals (such as sponges, anemones, corals, limpets, sea urchins, starfish and crabs) cling to the rock or walk on it slowly, searching for food. Other animals (such as octopuses, lobsters, Moray eels, and groupers) hide in crevices or openings during the day and go out to hunt at night.

The zone that receives the powerful impact of the breaking waves alternates between being above and below the sea. Few animals (such as mussels, limpets, crabs and blennies) can live in it.

The sandy beaches that are constantly shifted around by the sea currents are home to a few specialized marine species. The few marine plants (sea weed and *Posidonia*) form underwater meadows where small fish find shelter.

Most invertebrates (mussels, worms) hide themselves in the sand, but so do some fish (such as sole, tongues, skates, and weever fish).

Mudflats in lagoons, along with river estuaries, are extremely rich in invertebrates (e.g., plankton, worms, and shrimp) due to their warm, shallow water and the abundant nutrients carried by rivers. Many fish species (soles, mullets, and sea bass) travel to mudflats to hunt and to breed, while many birds visit the areas to fish.

Instructions:

- Students glue pieces of the crepe paper on the brown wrapping paper to make a representation of the sea bottom, with sand (horizontal strips of yellow paper), *Posidonia* meadows (vertical strips of green paper, which can be crumpled), and rocks (crumpled pieces of brown paper).
- On the pages from old magazines, each student draws one or more marine animals (they can also write the name of each animal on the drawing), cuts them out and glues them on the brown paper seabed, in the place they think the animal lives. It doesn't matter if one covers the other, or if there are many of the same species.

For discussion:

- 'Is there any part of the seabed without any animals?' 'Can you imagine why?'
- 'Is there an animal that lives in only one part of the seabed?' 'Any who live in different parts of the seabed?'
- 'How do animals hide among the rocks, in the *Posidonia* meadows, in the sand, in the water?'

Sources:

ARCHELON, 'The Sea, Turtles and Me', educational material on marine biodiversity and the role of humans, p. 31.

Harold S. & Eckert K. (2005), Endangered Caribbean Sea Turtles: An Educator's Handbook, WIDECAST Technical Report No.3, p.155, http://www.dnr.sc.gov/seaturtle/education/Harold%26Eckert % 20 (2005)% 20Carib% 20Sea% 20Turtles-% 20Educators% 20Handbook.pdf

Coastcare (2002), Putting a toe in the water, A teacher's guide, Getting started with coastal and marine studies in Tasmania, Marine Education Society of Australasia (MESA), p.9.http: //www. environment.gov.au /apps/coasts/discovery/teachers/pubs/ coastcare.pdf

ACTIVITY B11:

Everything is connected

Age: 12+
Time: 1 hour

Materials:
- A ball of twine
- Cards or A4-size paper cut into 4 equal pieces (1 card per student)

Number: 10-40

Place: Indoors

Season: All year round

Goal:
- Students will recognize that all species in an ecosystem are important.

Glossary:
Habitat: A combination of ecological factors (e.g., soil, climate, vegetation) where a species lives.
Ecosystem: All living organisms and the physical characteristics of a place.
Biotic element: Living organisms in a habitat.
Abiotic element: Any element of a habitat that is not a living organism.

Introduction:

In any one place, living organisms interact both with each other and also with abiotic landscape elements such as water, soil, nutrients, and other elements), forming an *ecosystem*. There are many kinds of relationships within an ecosystem:

Predation, when one species hunts and eats the other (e.g., sea turtle and jellyfish).

Parasitism, when on species gradually eats the other, but without killing it (e.g., crustaceans which live on the skin of whales).

Mutualism, when one species cooperates with another to more effectively hunt a third species (pelican and cormorant, fishing side by side).

Symbiosis, when two species live peacefully near each other and both benefit (e.g., shrimp and grouper).

Competition, when two species need the same scarce resource, e.g. food, nesting places, water, nutrition, etc. (such as dolphins and humans).

An ecosystem is full of such relationships, of species 'pressuring' each other, resulting in the creation of an apparent state of equilibrium. This balance is easily disturbed when one of the 'pressures' changes, e.g. if the population of a species is reduced or increased too much.

Many of the changes we see today in the sea are due to humans, who have greatly reduced some species by overfishing or by polluting the water.

Instructions:

- Make a list of natural elements that exist in the sea or on a beach (e.g., biotic elements such as animals, plants, but also abiotic elements such as soil and water). Write

Predation: The relationship between two different species, in which one kills and devours the other.

Parasitism: The relationship between two different species, in which one (the parasite) lives at the expense of the other (the host), but without causing the death of the host.

Symbiosis/Co-existence: Relationship between two different species which benefits both.

Competition: The relationship between two different species, both of which want to exploit the same natural resource (e.g., food, breeding site).

Erosion: The deterioration and loss of the land surface by natural processes.

the name of each item on a card. (The same item can be written on several cards.) Each student picks a card, fastens it to their chest, and plays the role of that element.

- Students stand in a circle. Start from any point, give the student with the corresponding card the edge of the twine to hold, and ask them to look for another 'link' related to the first (For example, ask the first student 'Who do you eat?', 'Who could eat you?', 'Who do you need to live?', 'Who needs you to live?'). Then give the ball of twine to the second student so that two students are connected.
- Continue in the same way until all the students are connected with the twine, which now forms a net among them. Then the students should step back a bit to tighten the net. You have made your own model of an ecosystem.
- Now imagine that something is happening that affects an element of the ecosystem, (e.g., a fisherman takes all the sardines). The affected student pulls the string they holds. In turn, those who feel the pull also pull the strings they hold.
- Discuss how the other elements are affected when one of them is removed from the ecosystem.

For discussion:

- Is there any element that is completely independent of the others?

Sources:

Cornell J. (1994), Let's Share Nature with Children, Observer Publications, p.

Ducks Unlimited's Teacher's Guide to Wetland Activities, Ducks Unlimited Canada, p.16, retrieved 23/10/2003 by: http://www.greenwing.org/dueducator/ducanadapdf/teachersguide.pdf

Wetlands: Webbed Feet Not Required, Teacher's Guide, Ducks Unlimited Canada, p.53, retrieved 6/10/2008 from: http://www.environment.gov.ab.ca/edu/pubs/6278_Wetlands_Teacher_Guide.pdf

ACTIVITY B12:

Card stories

Age: 10+
Time: 2 hours (card creation: 1 hour, story creation: 1 hour)

Materials:
- Pictures related to the sea (see Worksheet)
- Thin cardboard or sheets of paper
- Pair of scissors
- Paper glue
- Pencils, pens, markers

Number: Small group

Place: Indoors

Season: All year round

Goals:
- Students learn to identify elements that are part of the sea
- Students improvise episodes of a story

Glossary: None required

Introduction:

Oral stories are popular with people of all ages, and they are a powerful tool for environmental awareness. The plot of the story is less important than the process of its creation.

The hero is at the core of the story, which is created to describe the obstacles they encounter and how they overcome, until the goal is finally reached. The goal of the hero and the end of the story need not be known from the beginning; rather, twists and surprises bring the story to life.

A story can refer to events that can actually happen (e.g., a turtle eats a jellyfish), but also to completely imaginary events: Magic is an integral part of fantasy and fairy tales.

The only thing needed to give birth to a story is imagination, but the cards are a visual aid for those students who feel insecure about their abilities.

Instructions:

- You will need 50-100 cards of the same size. Cut the cardboard into equal pieces (e.g. 7 x 10 cm). Alternatively, cut the sheets of paper into 4 or 8 pieces.
- On every card, students write a one-word subject related to the sea (e.g., plant, animal, landscape, occupation, fishing gear, etc.) and – if they want – draw or paste a picture of it. (They can look for pictures in old magazines, in books or online.)
- Stack the cards into a single deck with only the blank side visible. Pick a card and begin a story with the subject on it. Each student in turn picks up a card from the deck and creates the next episode of the story. Each episode should be reasonably linked to the previous one, but it is not necessary for the story to move in only one direction – there can be a change of course (for example, start one episode with the word 'Fortunately', and the next one with

the word 'Unfortunately'. The story ends wherever and whenever you want – it may end with the last student, who should provide an ending to it.

For discussion:

- 'How could you improve your story? If you chose another hero? An animal? A plant? A human? If you chose other themes for your cards?'
- 'Could you use the cards in other ways?'

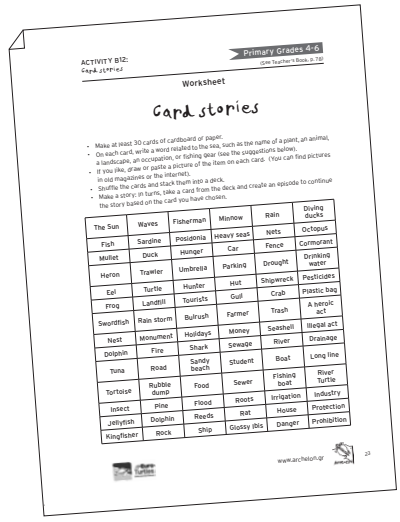
Additional activities:

- Determine from the beginning that one card will represent something positive about the item depicted, and the next card something negative. Can students find, for example, the negative side of a turtle and the positive side of trash?
- Make cards that depict actions (e.g., the hero falls into a trap, the hero is saved, the enemy approaches disguised, what looks easy is difficult, no one comes out victorious, the hero escapes destruction, etc.) and mix them into the others. Is the story more interesting?

Sources:

Rodari T. (1985), Grammar of the imagination, Prescription editions, pp. 91-104.

Tim Bowley, storyteller (personal communication).



ACTIVITY BIZ: Card stories

Primary Grades 4-6

(See Teacher's Book, p. 78)

Worksheet

Card stories

- Make at least 30 cards of cardboard or paper.
- On each card, write a word related to the sea, such as the name of a plant, an animal, a landscape, an occupation, or fishing gear (see the suggestions below).
- If you like, draw or paste a picture of the item on each card. (You can find pictures in old magazines or the Internet).
- Shuffle the cards and stack them into a deck.
- Make a story: in turns, take a card from the deck and create an episode to continue the story based on the card you have chosen.

The Sun	Waves	Fisherman	Minnow	Rain	Diving ducks
Fish	Sardine	Posidonia	Heavy seas	Nets	Octopus
Mullet	Duck	Hunger	Car	Fence	Cormorant
Heron	Trawler	Umbrella	Parking	Drought	Drinking water
Eel	Turtle	Hunter	Hut	Shipwreck	Pesticides
Frog	Landfill	Tourists	Gull	Crab	Plastic bag
Swordfish	Rain storm	Bulrush	Farmer	Trash	A heroic act
Nest	Monument	Holidays	Money	Seashell	Illegal act
Dolphin	Fire	Shark	Sewage	River	Drainage
Tuna	Road	Sandy beach	Student	Boat	Long line
Tortoise	Rubble dump	Food	Sewer	Fishing boat	River turtle
Insect	Pine	Flood	Roots	Irrigation	Industry
Jellyfish	Dolphin	Reeds	Rat	House	Protection
Kingfisher	Rock	Ship	Glossy ibis	Danger	Prohibition

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ACTIVITIES
Gymnasium grades 1-3

ACTIVITY C1:

Everything is connected

Age: 12+
Time: 1 hour

Materials:
- Worksheet A (1 per student or group)
- Hexagon template
- Scissors (1 for 2-3 students)
- Glue or removable tacking adhesive
- Coloured pencils
- Paper (1x2m)

Number: 15-30

Place: Outdoors or in a large room

Season: All year round

Goal:
- Students will understand that an ecosystem includes relationships between biotic and abiotic elements.

Glossary:
Habitat: A combination of ecological factors (e.g., soil, climate, vegetation) where a species lives.
Ecosystem: All the living organisms in a place, and the physical characteristics of a place.

Introduction:

In a habitat, each living organism affects those around it and is affected by them: One species may eat another, steal its food or nesting place, live on it as a parasite, and so on.

Abiotic habitat elements (soil, water, air) are also related to the living organisms in it. A limpet needs rocks to attach itself onto, and waves that will bring food (plankton) to it. Posidonia (a marine plant of the Mediterranean) cannot grow at depths where sunlight does not reach.

In any one ecosystem, we can find thousands of different kinds of relationships, and we can group them into a few categories:
- organism – organism (e.g., predation, parasitism, competition, cooperation, symbiosis/co-existence)
- organism – abiotic element (e.g. nutrient intake, toxic effect, enrichment of the area with nutrients)
- abiotic element – abiotic element (e.g., erosion caused by water or wind)

Instructions:

- Distribute the Worksheet A to students, asking them to look (outdoors, in printed sources or online) for biotic or abiotic natural elements that coexist in the sea. Then they identify the relationships between these elements and complete the table in Worksheet A.
- Distribute the worksheet with the hexagons. In one hexagon, students write the name of one element or one relationship, continuing to fill in a separate hexagon for each element or relationship they have found.
- Students colour the hexagons according to the content: Red for animals, green for plants, and blue for abiotic

Biotic element: Living organisms in a habitat.

Abiotic element: Any element of a habitat that is not a living organism.

Predation: The relationship between two different species, in which one kills and devours the other.

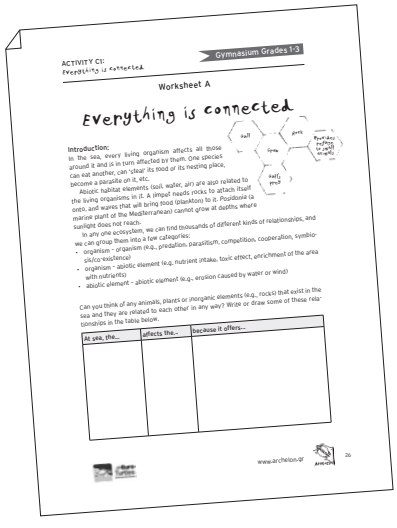
Parasitism: The relationship between two different species, in which one (the parasite) lives at the expense of the other (the host), but without causing the death of the host.

Symbiosis/Co-existence: Relationship between two different species which benefits both.

Competition: The relationship between two different species, both of which want to exploit the same natural resource (e.g., food, breeding site).

Erosion: The deterioration and loss of the land surface by natural processes.

Toxic Substance: A substance that damages living organisms.


ACTIVITY C1:
Everything is connected

Gymnasium Grades 1-3

Worksheet A

Everything is connected

Introduction:
In the sea, every living organism affects all those around it and is in turn affected by them. One species can eat another, can 'clear' its food of its nesting place, become a parasite on it, etc.
Abiotic habitat elements (soil, water, air) are also related to the living organisms in it. A limpet needs rocks to attach itself onto, and worries that will bring food (plankton) to it. Posidonia (a marine plant of the Mediterranean) cannot grow at depths where sunlight does not reach.
In any one ecosystem, we can find thousands of different kinds of relationships, and we can group them into a few categories:
- organism – organism (e.g., predation, parasitism, competition, cooperation, symbiosis/co-existence)
- organism – abiotic element (e.g. nutrient intake, toxic effect, enrichment of the area with nutrients)
- abiotic element – abiotic element (e.g., erosion caused by water or wind)

Can you think of any animals, plants or inorganic elements (e.g., rocks) that exist in the sea and they are related to each other in any way? Write or draw some of these relationships in the table below.

As sea, the...	affects the...	because it offers...

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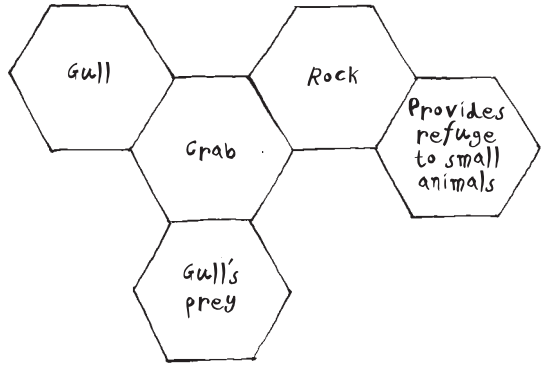
elements. Hexagons which contain explanations of a relationship should be left white.

- Students cut out each hexagon and glue them to the large sheet of paper in this way:
  - Hexagons with associated elements must touch each other as well as the white hexagon that describes the type of relationship.
  - If someone has chosen an item that already appears on the paper, they stick their element over the existing one. The white hexagon with the explanation of relationships should be placed in an empty space near the element.
- Each student selects an animal or plant from the hexagons on the board and writes on a separate piece of paper what they imagine would happen to the habitat if that animal or plant suddenly disappeared

For discussion:

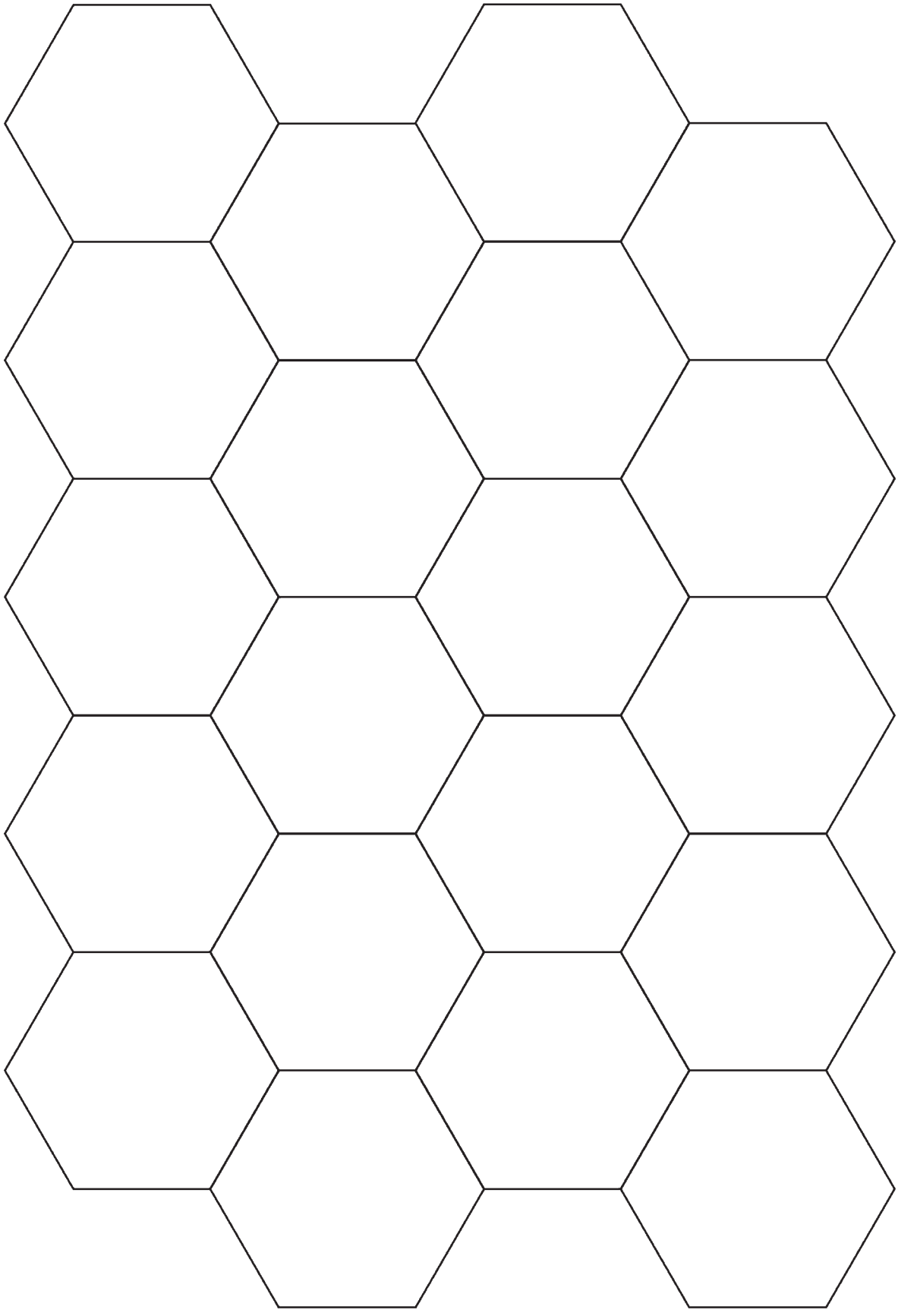
- 'Is there any element in the ecosystem (animal, plant or abiotic) that is completely independent of the others?'
- 'Draw the following table on the board. Then ask students if they can think of examples of relationships for each pair formed between the four boxes on the table.

Organism	Abiotic elements
Abiotic elements	Organism



Sources:

Ducks Unlimited Canada, Wetland Ecosystems 1, Teacher's Guide – Elementary Level Science Grade 4-6, p.3-4, Retrieved 2/11/2011 from http://www.ducks.ca/resource/teachers/lesson_plans/pdf /99993846.pdf



ACTIVITY C2:

All for one and one for all

Age: 10+
Time: 1 hour

Materials:
- 1-meter sheet of paper or wrapping paper
- Pencils, pens, markers
- Office items (e.g., pencils, books, notebooks)

Number: 4+

Place: Indoors

Season: All year round

Goals:
- Students will recognize that every human activity causes pollution and has consequences for its neighbours.
- Students will realize that development requires careful planning.

Glossary:
Degradation: The decomposition (by microorganisms) of dead organic material into its inorganic components.
Pollution: Introduction of

Introduction:

All human activities cause changes in their environment: some alter the soil (by excavations, landfills, etc.), while others introduce substances that have been transported from elsewhere (metallic ores, industrial products, food, etc.) or produce pollutants which decompose slowly (plastics, metals, chemicals substances, etc.).

The introduction of harmful substances is called *pollution*, and it can seriously alter both the aesthetic value and ecological processes of an area. The rivers and the underground aquifers (i.e., the strata through which water flows) facilitates and accelerates the diffusion of pollutants into the natural environment.

Often we can identify the source of pollution (i.e., *Point-source pollution*), but when it comes from multiple sources (e.g., agricultural fertilizer or illegal urban sewage dumps), it is impossible to find its source (i.e., *Non-point source pollution*).

Every human activity affects its neighbours. Sometimes the profit from one activity is less than the amount of damage it causes to another.

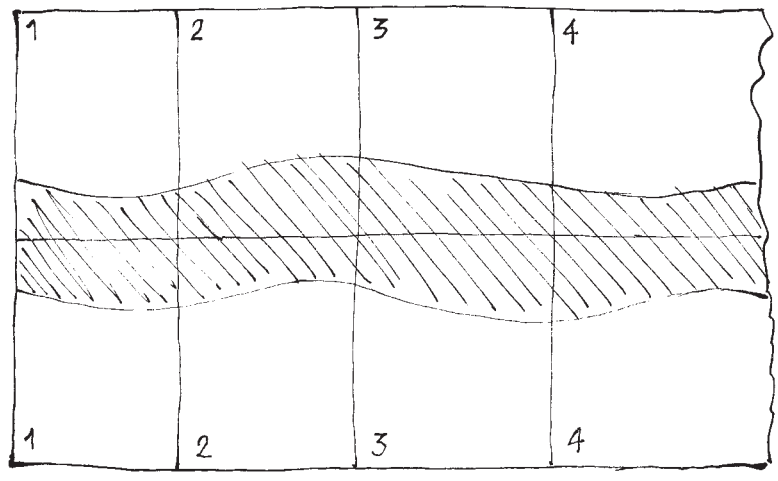
Instructions:

- With a blue marker, draw a river horizontally across the centre of a large piece of paper. Cut the paper vertically into approximately equal pieces (each should include a part of the river) and number them in the outer corner (see indicative drawing).
- Distribute the pieces to the students. Tell them that each has inherited a piece of land and an amount of one million euros, with which they can use to develop their piece of land. Explain that the blue part of the paper

harmful substances or energy into the environment by humans.

Nonpoint source pollution: Large-scale pollution (e.g., agricultural pesticides, road runoff) which comes from a large area, and its exact source cannot be traced.

Point Source Pollution: A source of pollution which can be specifically identified.



represents the river, while the rest is dry land.

- Each student uses pencils and pens to draw or write on their piece of paper what they will do to develop the piece of land that belongs to them. Then, they connect the pieces with the help of the numbers marked in the corners.
- In turn, each student explains how they used both the land and the water, and identifies the pollution that their plan has caused. They should place an object in the river (e.g., a pencil, book, paper clip, piece of paper, etc.) that represents that type of pollution. They move the objects in the direction of the river flow. As they touch each object to move it, they announce the kind of pollution it represents. The activity continues until the pollution reaches the land of the last student.
- Talk about development and pollution. How did the students in the lower part of the river feel? Has pollution affected their plans for developing their land, and how?
- Students take back the objects they had used to represent pollutants. Explain to them that the recognizable objects (such as books and notebooks) represent the Point-source pollution, while the other objects represent Nonpoint-source pollution, which came from a number of different places and its precise source cannot be identified.

For discussion:

- 'How could you reduce the pollution you are responsible for?'
- 'Has everyone the right to develop his land as they want, or are they limited by those whose land is located further down the river?' 'How does this situation apply to your area?'

Sources:

Trout Unlimited, Coldwater Conservation Education Guide, p.22,http://www.tu.org/sites/default/files/COE_CCEG_ALL.pdf

ACTIVITY C3:

Looking for trash

Age: 12+
Time: 2 hours (1 hour for preparation, 1 hour for fieldwork)

Materials:
- Worksheet A (Shopping Questionnaire; 1 for each group)
- Worksheet B (Optional Recording Sheet; 1 for each group), or alternatively A4 Sheets of Paper instead of Worksheet B)
- Pencils

Number: Small group

Place: Outdoors (beach)

Season: All year round

Goals:
- Students will realize that without proper management, a lot of waste pollutes the sea.
- Students will discover that much rubbish originates from households.

Glossary:
Recycling: The sorting of certain materials (e.g., paper, glass, metals, plastics, etc.) from rubbish, and using them as

Introduction:

In the past, rubbish consisted only of organic materials (such as food waste, vegetable and animal waste, ceramics, and wood). Sunlight and microorganisms (e.g. fungi, bacteria, etc.) decompose most organic materials in a few months or years.

Since 1950, rubbish has been comprised of many synthetic substances (e.g. plastic, nylon, PVC, synthetic resins and fibres, etc.) and forms of metal which do not rust (e.g., aluminium and stainless steel). These materials are extremely resistant to decomposition by microorganisms or sunlight and can last for many years or even centuries in the environment. The sun and the waves break down the plastic into tiny pieces ('microplastics'), which can 'survive' for hundreds of years. But even the rubbish that decomposes in a few weeks or months – like paper – is much more abundant today than it used to be.

Most rubbish is disposed of in landfills or dumps, but much is dumped illegally in isolated places, streams or the sea. The wind and floods carry them from land to the nearest river, and from there to the sea.

Households, industries and factories, roads and sewers, ships, people who use the beaches, and others produce the majority of rubbish.

A great deal of rubbish would not reach the sea if it were recycled instead of dumped in open areas. There would be less trash if the volume of plastic we use was reduced, with changes in marketing and our daily habits (i.e., glass instead of plastic bottles, textile bags instead of nylon shopping bags, paper instead of plastic, and multi-item packs rather than individual packages, etc.).

raw material for the production of new materials.

Decomposition: The breakdown (by microorganisms) of dead organic material into its inorganic elements.

Pollution: Introduction of substances or energy into the environment by human activities, with harmful effects on living organisms.

Pollutants: Polluting substances.

Landfill (Rubbish Landfill): Specially constructed site for the sanitary disposal of rubbish on soil that has been made waterproof with a special membrane to prevent contamination of the soil and aquifers. When a landfill cannot hold any more rubbish, it is usually covered with soil.

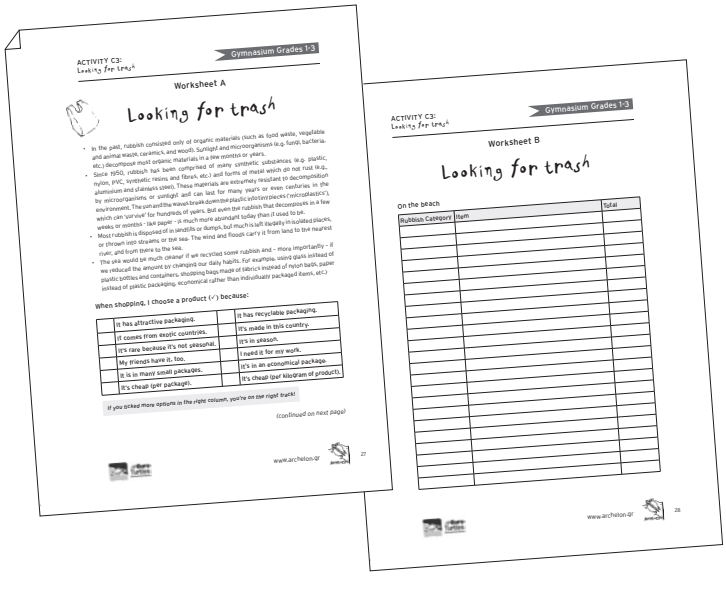
Dump: Illegal site for rubbish disposal that allows liquids to drain from the trash into the soil and groundwater, and solid trash to be swept away by the wind.

Instructions:

- Talk about the objects around us. Are they few or many? When we shop, how do we choose which product to buy? What materials are they made from? How long do we use them? Where do they end up when they become useless?
  - Divide students into groups of 2-4, and each group receives and completes Worksheet A.
- Distribute Optional Worksheet B (or, alternatively, students create their own on an A4-size sheet of paper. Students walk slowly along the beach, and each group records the trash it finds. During the recording, new categories of rubbish may be added at the bottom of Worksheet B, if necessary.
- Discuss the results of what they have recorded.

For discussion:

- 'Which are the 10 most common categories of trash found on the beach? What item of rubbish is the most common?'
- 'Where do most of the objects we find thrown outdoors come from? Were they used at home, in farming, or in factories/businesses?'
- 'When shopping for a product, what criteria do we choose (e.g., because it's useful, it's beautiful, our friends have it, it can be recycled, etc.)?'
- 'How did the trash get to where we found it?'
- 'What else could we have done with the useless items?'
- 'What can we do with a site full of garbage?'


ACTIVITY C3: Looking for trash

Gymnasium Grades 1-3

Worksheet A

Looking for trash

When shopping, I choose a product (✓) because:

	It has attractive packaging.		It has recyclable packaging.
	It comes from exotic countries.		It's made in this country.
	It's rare because it's not seasonal.		It's in season.
	My friends have it, too.		I need it for my work.
	It is in many small packages.		It's an economical package.
	It's cheap (per package!).		It's cheap (per kilogram of product!).

If you ticked more options in the right column, you're on the right track!

(continued on next page)

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ACTIVITY C3: Looking for trash

Gymnasium Grades 1-3

Worksheet B

Looking for trash

On the beach

Rubbish Category	Item	Total

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Sources:

ARCHELON, 'The Sea, Turtles and Me', educational material on marine biodiversity and the role of humans, pp. 22-23.

National Oceanic and Atmospheric Administration's (NOAA) Marine Debris Program (2012), Turning the Tide on Trash: A Learning Guide on Marine Debris, p.38-44, https://marinedebris.noaa.gov/sites/default/files/ TurningTideonTrash_GL% 20edition.pdf

ACTIVITY C4:

Identifying the beach zones

Age: 12+
Time: 3-4 hours (2 extra hours for plant identification guide)

Materials:
- 30-meter tape measure (1 for each group)
- Folding measure or sewing tape measure (1 for each group)
- Outdoor thermometer (1 for each group)
- Sampling frame (1x1m or a circular hoop used for gymnastics)
- Worksheets A, B, and C (1 of each for each group)

Number: 10-40

Place: Outdoors (on the beach)

Season: Spring or summer

Goals:
- Students will become acquainted with scientific methodology.
- Students will learn to identify different types of vegetation in an area.
- Students will be able to

Introduction:

Beaches are formed by grains of sand (i.e., microscopic pieces of rock created by the erosion of mountains and coasts), which the rivers and the sea waves drag and deposit on the shore.

When a sandy beach forms, the wind carries sand from the edge of the sea towards the land. The grains of sand continue their journey by bouncing and gradually forming higher and higher dunes, until the sand is trapped by the roots and branches of plants. Plants grow almost everywhere except for beside the sea, where salt is abundant and sand is unstable. They can, however, put down roots in an area located far enough from the waves where the land is relatively stable and the plants are watered by the rains.

Between the coast and the interior of the land, vegetation forms successive zones: Behind the inhospitable sea edge, there is a zone of 'pioneer' species (i.e., the first sparse grasses which grow on bare ground), then a zone of sparse shrubs or trees, and finally (but not always) a forest zone.

Over time, dune vegetation thickens and prevents sand and sea water spray to pass through them. In this way, the vegetated dunes protect the inland areas from sand and salt, but also from corrosive waves.

When the sea is relatively calm, the waves deposit sand on the beach. When the sea is rough, the waves erode the beach, dragging sand away from the shore and dropping it into the sea near the beach. That same sand is again transported back to the shore when the sea calms down.

associate the presence of some species with local conditions.

Glossary:

Wave: The normal movement of the sea surface.

Dunes: Formations of sand 'hills' created by the wind.

Data: Recorded observations or information collected.

Data Sheet: A standardized paper 'document' where we record our observations.

Sampling: Collection of data.

Station: The place that we choose for sampling.

Sampling frame: The specific, limited ground area (usually square or round) which will be observed and from which data will be collected.

Instructions:

- Tell students to use one of the two options for Worksheet A and search (online or in books) for information about plant species which are common to local beaches and prepare a brief plant identification guide.
- Then, with the help of Worksheet B, students carefully look at the beach they are researching and decide which stage of dune-building the beach is in. If their beach is in an intermediate stage from those depicted, they draw a plan of it and discuss what led them to that conclusion.
- Select and mark a sampling path that includes alternate zones of vegetation (e.g., from wave to dune). If it is difficult for all the students to follow the same route, then select two shorter routes.
- Divide students into groups of 2-4. Each group is assigned one of the recording tasks in Worksheet C.
- Every 30 meters (or wherever the vegetation changes) lay out a 'station' (i.e., a 1 square meter sampling area) by either placing the sampling frame on the ground, or simply measuring the necessary area and pushing sticks into the ground at the four corners to mark the boundaries.
- Discuss the results.

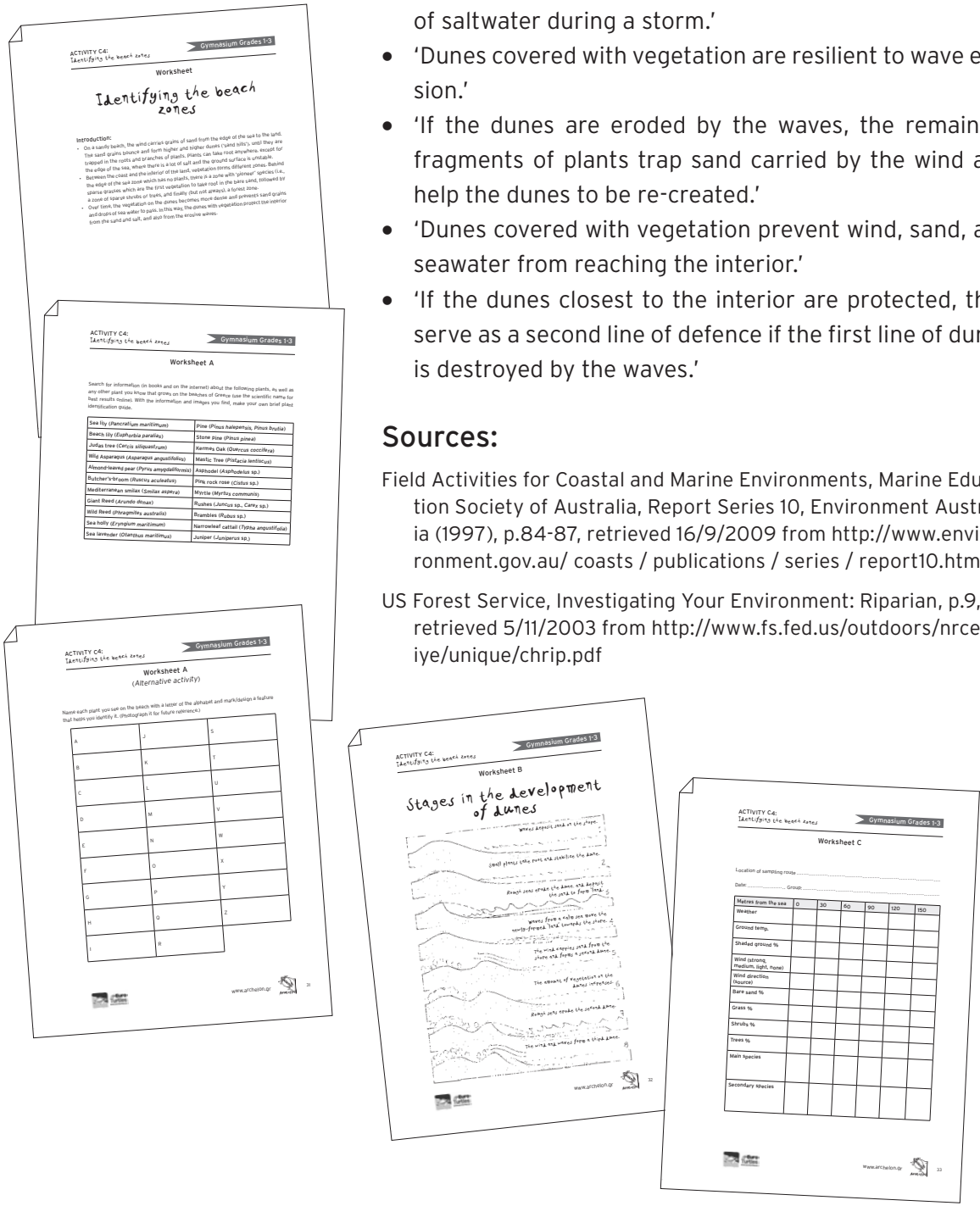
For discussion:

- 'What is the most common form of vegetation?' 'At what part of the beach is it found?'
- 'Does the percentage of bare sand remain the same as you move away from the shore?'
- 'How does wind affect the dunes?' 'Are there any signs that that the wind blows often and strong here (e.g., grasses bent to the side, deformed trees, etc.)?'
- 'Is there fresh water?'
- 'Do people and pets come often?' 'How do you conclude that?'
- 'Has any effort been made to protect the dunes and their vegetation?'

Additional activities:

- Turn the statements below into questions. Use the results of your research and the worksheet to prove that the suggestions do apply. Are they all valid? Are any of these not valid, or do you not have enough evidence to prove it?

- 'Dunes act as dams against the action of waves and tides, and also supply the coast with sand during the process of erosion.'
- 'Dunes protect the land from the waves and the invasion of saltwater during a storm.'
- 'Dunes covered with vegetation are resilient to wave erosion.'
- 'If the dunes are eroded by the waves, the remaining fragments of plants trap sand carried by the wind and help the dunes to be re-created.'
- 'Dunes covered with vegetation prevent wind, sand, and seawater from reaching the interior.'
- 'If the dunes closest to the interior are protected, they serve as a second line of defence if the first line of dunes is destroyed by the waves.'



Sources:

Field Activities for Coastal and Marine Environments, Marine Education Society of Australia, Report Series 10, Environment Australia (1997), p.84-87, retrieved 16/9/2009 from http://www.environment.gov.au/ coasts / publications / series / report10.html

US Forest Service, Investigating Your Environment: Riparian, p.9, retrieved 5/11/2003 from http://www.fs.fed.us/outdoors/nrce/iye/unique/chrip.pdf

ACTIVITY C5:

How would I manage a beach? (role-playing game)

Age: 13+
Time: 2 hours

Materials:
- Coloured pencils or markers
- Inexpensive large sheets of paper
- 2-page Worksheet A (1 per student)
- (Optional: 2-page Worksheet B; 1 per student)

Number: 15-30

Place: Indoors

Season: All year round

Goals:
- Students will recognize that a natural area meets the needs of many species, including humans.
- Students will understand that people can affect the natural world both negatively and positively.
- Students will realize that protecting the natural environment is not necessarily

Introduction:

Environmental management is not always about a virgin forest on the other side of the world. Often, we have to decide how to manage a river or a beach next to the place we live. In this case, we will need to sacrifice some of our comforts to preserve the natural environment of our neighbourhood. But how will we sacrifice as little as possible and keep as much as possible?

Whenever we need a new project in our area, the first question always is 'Where will we create it?' We need to follow a series of steps, the same followed by scientists and local authorities in similar actual cases:

First, we evaluate the necessity of the project: What need will it meet? How pressing is this need? Are there any alternatives?

We also evaluate the environmental value of the site: Does it contain habitats, plants or animals that are threatened or protected in our country or the European Union? Does it contain landscapes of particular beauty or cultural value (e.g., rock formations, traditional rural landscapes, old buildings, archaeological sites)? Does it have elements of ecotourism value (e.g., trails, sights)?

Then, for each project being proposed, possible alternatives are considered. Where is the suitable soil conditions (e.g., dry, stable, sloping, etc.)? Where is access to it available (e.g., via a nearby road)? How near is it to those who will use it? Should one large project be undertaken, or would two smaller ones work?

Finally, we put all of the above considerations on the same table and discuss possible solutions.

contrary to the interests of humans.
- Students will develop their hypothesis-forming skills.

Glossary:

Development: Anthropogenic changes in an area, resulting in improved living conditions for its inhabitants.

Habitat: The place where an animal lives. It provides all the essential natural elements (e.g. soil, climate, vegetation, shelter, etc.) which the animal needs to survive.

Ecotourism: Tourism which respects the natural environment and uses it as a means of attracting visitors.

Natural resources: Any materials which exist in nature (e.g., wood, water, minerals, etc.) and can be used by people to meet their needs.

Land use: How natural resources in an area are utilized.

Instructions:

- Students will play the roles of members of different groups of people involved with the management of the natural world.
- Explain the scenario:
- Imagine that next to the school there is a beach with dunes (sandhills) and a shallow lagoon (a brackish lake) separating it from the neighbouring farmland.
- The City Council wants to level and extend part of the beach (or lagoon) by bringing in soil or rubble in order to create space to build a parking lot and canteen. If the project is done somewhere else, it will be more expensive because land will have to be bought. (Only the beach and lagoon belong to the city).
- Distribute both pages of Worksheet A. Tell the students to read it by themselves, and give them 10 minutes to think of possible solutions for exactly where the project could be constructed.
- Ask students to tell each one their own suggestions. Write them briefly on a large sheet of paper you have posted on the wall and set aside.
- Divide students into small groups and let each group choose the management category it will represent. Below are some guidelines, but students can do their own research in the area they have chosen.
- A group of citizens wants the project to be done, as the beach receives many visitors in summer and needs space to park their vehicles. The canteen will contribute to the municipality's revenue (which can use this money to clean the beach).
- Another group of people does not want the beach to be spoiled, because it is one of the few places in the area where turtles are bred by. Moreover, it is the only natural spot where one can enjoy nature in an area dominated by crops and buildings.
- A group of farmers does not want to lose fertile agricultural land, which will happen if the work is done in the neighbouring fields.
- Environmental scientists do not want the project to be done in the coastal zone (the coastal zone where the waves reach the worst weather – 50-100m on a sandy beach - and which is common) nor in habitats with protected species.

- The contractor and the construction company workers want the project done because then they will have a job. The exact site of the construction is of no interest to them.
- The students have a meeting, where each group presents its arguments and – if possible – suggests alternatives. Try to come up with a decision on what will eventually happen.
- Compare these suggestions with those made at the beginning of the activity.
- The students come out of the roles they have had so far and summarize what they decided during the activity.

Additional activity 1 (optional):

- Distribute both pages of Worksheet B, which contains all the information students need to complete the activity.
- Tell students to imagine using a drone (UAV / unmanned aerial camera equipped with a camcorder) to explore sampling routes on four beaches (Preveza, Kotychi, Kyparissia Bay, Lakonikos Bay). Each sampling route is 1 km long, and they should measure the number of turtle nests (recognizable by the turtle tracks that connect each nest to the sea).
- Students then calculate the total number of nests on each beach by extrapolating from the number of nests in the sampling area to the total length of the beach. The number of nests shows how important each beach is to sea turtles.
- Students choose one of the beaches and imagine living close to it. If they had to protect sea turtles and nesting beaches, on what criteria would they choose how many and which beaches to protect? Would they also choose to protect their neighbouring beaches? Why?

Additional Activity 2 (optional):

- Students imagine that they are having a beach party with their friends. They light a big fire, put loud music on the stereo, shoot off fireworks ... Is there any problem? Does any neighbour complain?

For discussion:

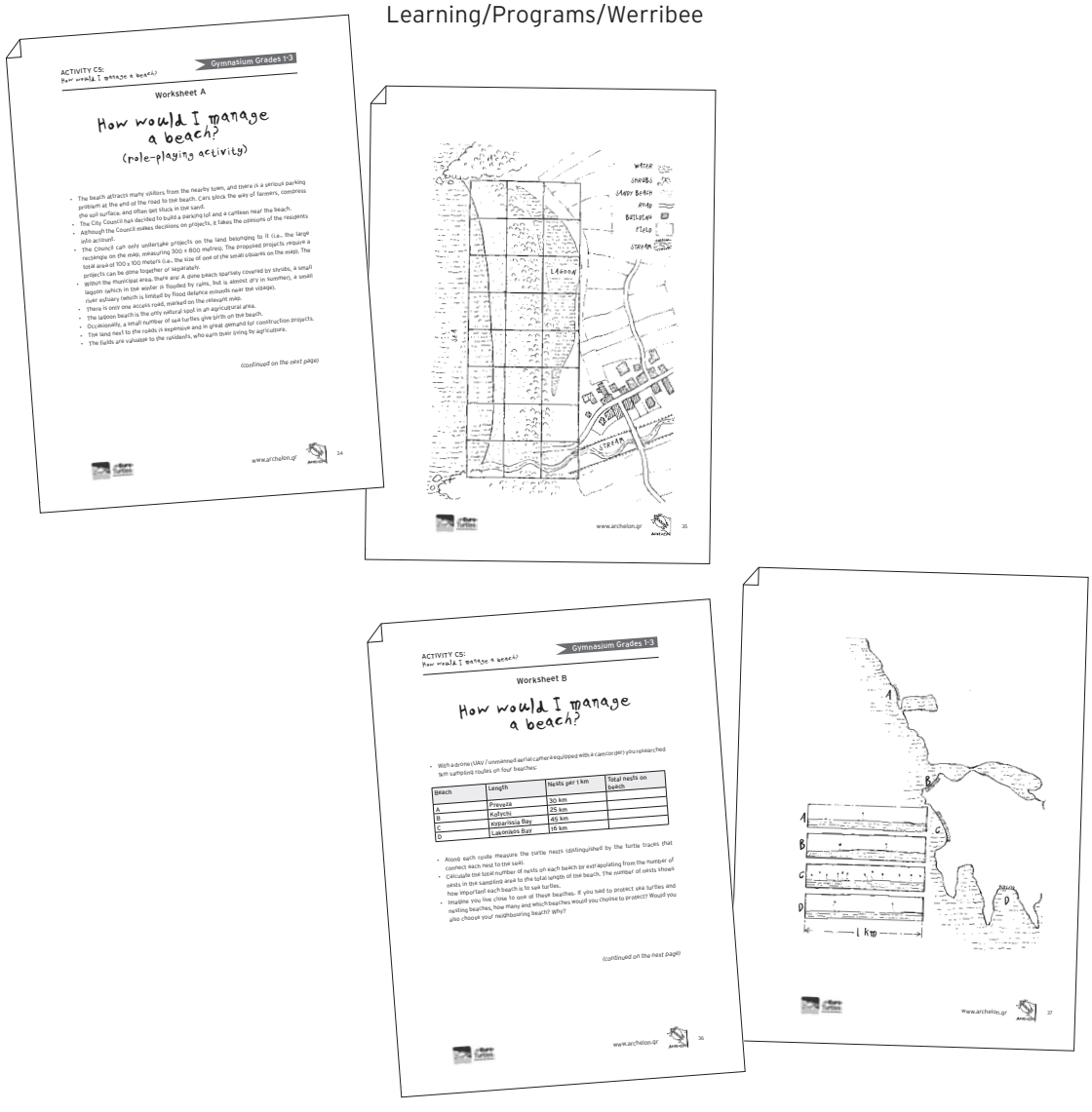
- 'What issues has this role-playing game made you aware of?'

- 'How did everyone feel during the activity?' 'Did they feel personally involved in the role?' 'Why?'
- 'Have you reached a decision acceptable to everyone?' 'If not, what prevented it?'

Sources:

Harold S. & Eckert K. (2005), Endangered Caribbean Sea Turtles: An Educator's Handbook, WIDECAST Technical Report No.3, p.140, 144, http://www.dnr.sc.gov/seaturtle/education/Harold % 26Eckert% 20 (2005)% 20Carib% 20Sea% 20Turtles-% 20Educators% 20Handbook.pdf

Werribee Open Range Zoo, Endangered But Fighting Back!, Teacher Notes, p.8. Retrieved 20/11/2003 from: http://www.zoo.org.au/Learning/Programs/Werribee



ACTIVITY C6:

Tracking a sea turtle

Age: 12+
Time: 1 hour

Materials:
- Worksheet (1 per student)
- Pencils

Number: Small group

Place: Indoors

Season: All year round

Goals:
- Students will become familiar with the geographical coordinate system.
- Students will explore knowledge via scientific methods, and will be able to recognize the difference between opinion and fact.
- Students will develop their research and reporting skills.

Glossary:
Satellite Monitoring: Scientific monitoring ('following') an animal which has a small transmitter attached to it. The signals from the transmitter is processed by satellites, which

Introduction:

The *Caretta caretta* and all sea turtles have – like tortoises – a hard carapace, but cannot retract their heads or limbs inside for protection as tortoises can. All sea turtles have flippers rather than legs. Adapted to the sea, they spend their entire life swimming, moving forward with their front flippers, with their back flippers acting as rudders.

A sea turtle travels long distances at the surface of the sea, but can dive to great depths if it is in danger. Although it must come to the surface to breathe air, it can remain submerged for hours or even days. It eats slow-moving creatures, which live below the surface or on the sea floor, such as jellyfish, shellfish, limpets, sea urchins, sponges, crabs, etc.

Although it lives in the sea, a sea turtle gives birth to land, where the sand warmed by the sun allows the turtles inside the eggs to grow. No matter how far she travels, a female turtle always returns to the same place where she was born to give birth.

Because turtles in the sea are difficult to follow, in recent years scientists have been tracking them with the help of satellites. When a turtle is captured, a small satellite tracking transmitter (GSM tag) is attached to its carapace with epoxy resin. The transmitter signals the location of the turtle and with the help of 3-5 satellites, the coordinates and the date are sent to a remote computer which has the appropriate software. (For example, latitude 36.80 N or 36º 51′ 55″ N and longitude 20.50 E or 20º 32′ 04″ E.) A database is gradually developed with thousands of turtle locations, each with the corresponding date and name of that turtle.

can determine the animal's geographical location and in turn send the information to a remote receiver.

Coordinates: The geographical north-south/vertical distance (i.e. Latitude) from the Equator (0°) and east-west/horizontal distance (i.e. Longitude) from the Prime Meridian (0°). They are expressed in decimal degrees (e.g., 36.80 N) or in degrees, minutes and seconds (e.g., 36° 51′ 55″ N), and determine the geographical location of a point.

Geographic data: Geographical location data relating to a multiple number of points.

From satellite data, we have learnt that some turtles stay in the same area (e.g., in Amvrakikos Bay), while others travel very far: In fact, one turtle swam about 3,500 kilometres from western Greece to the Gibraltar region.

Instructions:

- Present a brief introduction to the biology of sea turtles, including the long distances they travel, and the modern method of monitoring them with the help of satellites.
- Distribute the Worksheet. (Note that the routes were based on actual turtle movements and have been published in scientific journals.)
- Each student selects a turtle and marks the points along its route on the map. While they are still plotting the route, ask them to make assumptions about the final destination of the turtle they are tracking.
- When they have finished done, discuss their findings. Was each turtle's destination the place which they had originally picked? Why?
- Alternatively, give each student the starting point and destination of a route (e.g., Kyparissia Bay → Adriatic Sea; Zakynthos → Tunisia; Ambrakikos Bay → Turkey; Saronikos Bay → Egypt; Cyprus → Libya) and allow them to map the routes and find the coordinates for each route.

For discussion:

- 'Are there any marine areas where turtles are most at risk from ships (i.e., shipping routes)?'
- 'Can you find a route that begins with the birth of a turtle and one that begins with its release from captivity?'

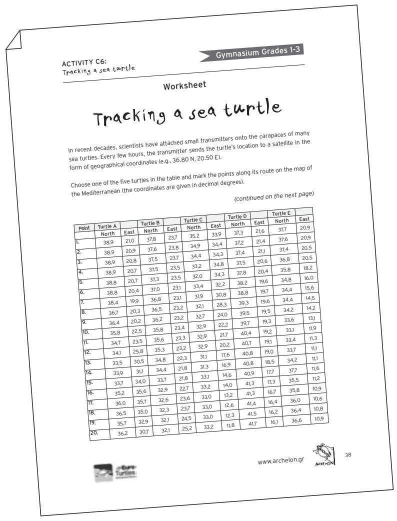
Additional Activity:

- You can sign up (free of charge) at http://www.seaturtle.org/tracking/teachers/ to access real-time data from sea turtle satellite tracking.

Sources:

Sea Turtles, A Journey of Survival, An Educator's Guide to Sea Turtles, Newport Aquarium, Wave Foundation, p.10.21, http://www.seychellesseaturtlefestival.org/uploads/5/2/1/0/52108149/educators_guide .pdf

Harold S. & Eckert K. (2005), Endangered Caribbean Sea Turtles: An Educator's Handbook, WIDECAST Technical Report No.3, p.68-73, http://www.dnr.sc.gov/seaturtle/education/Harold % 26Eckert% 20 (2005)% 20Carib% 20Sea% 20Turtles-% 20Educators% 20Handbook.pdf


ACTIVITY C6:
Tracking a sea turtle

Gymnasium Grades 1-3

Worksheet

Tracking a sea turtle

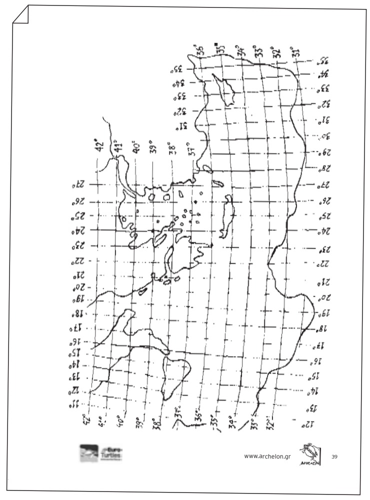
In recent decades, scientists have attached small transmitters onto the carapaces of many sea turtles. Every few hours, the transmitter sends the turtle's location to a satellite in the form of geographical coordinates (e.g., 36.80 N, 20.50 E).

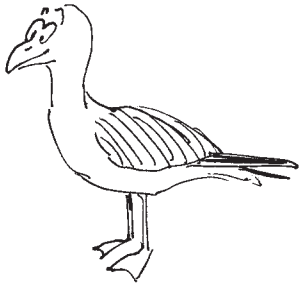
Choose one of the five turtles in the table and mark the points along its route on the map of the Mediterranean (the coordinates are given in decimal degrees).

(continued on the next page)

Point	Turtle A		Turtle B		Turtle C		Turtle D		Turtle E	
	North	East	North	East	North	East	North	East	North	East
1.	38,9	21,0	37,8	23,7	35,2	33,9	37,3	21,6	37,7	20,9
2.	38,9	20,9	37,6	23,8	34,9	34,4	37,2	21,4	37,6	20,9
3.	38,9	20,8	37,5	23,7	34,4	34,3	37,4	21,1	37,4	20,5
4.	38,9	20,7	37,5	23,5	33,2	34,8	37,5	20,6	36,8	20,5
5.	38,8	20,7	37,3	23,5	32,0	34,3	37,8	20,4	35,8	18,2
6.	38,8	20,4	37,0	23,1	33,4	32,2	38,2	19,6	34,8	16,0
7.	38,4	19,9	36,8	23,1	31,9	30,8	38,8	19,7	34,4	15,6
8.	36,7	20,3	36,5	23,2	32,1	28,3	39,3	19,6	34,4	14,5
9.	36,4	20,2	36,2	23,2	32,7	24,0	39,5	19,5	34,2	14,2
10.	35,8	22,5	35,8	23,4	32,9	22,2	39,7	19,3	33,6	13,1
11.	34,7	23,5	35,6	23,3	32,9	21,7	40,4	19,2	33,1	11,9
12.	34,1	25,8	35,3	23,2	32,9	20,2	40,7	19,1	33,4	11,3
13.	33,5	30,5	34,8	22,3	31,1	17,6	40,8	19,0	33,7	11,1
14.	33,9	31,1	34,4	21,8	31,3	16,9	40,8	18,5	34,2	11,1
15.	33,7	34,0	33,7	21,8	33,1	14,6	40,9	17,7	37,7	11,6
16.	35,2	35,6	32,9	22,7	33,2	14,0	41,3	17,3	35,5	11,2
17.	36,0	35,7	32,6	23,6	33,0	13,2	41,3	16,7	35,8	10,9
18.	36,5	35,0	32,3	23,7	33,0	12,6	41,4	16,4	36,0	10,6
19.	35,7	32,9	32,1	24,5	33,0	12,3	41,5	16,2	36,4	10,8
20.	36,2	30,7	32,1	25,2	33,2	11,8	41,7	16,1	36,6	10,9

www.archelon.gr 38





Visit

LIFE EUROTURTLES Program (in English):
http://www.euroturtles.eu/

EuroTurtle (information and training activities for Mediterranean sea turtles, in English):
http://euroturtle.org/

ARCHELON The Sea Turtle Protection Society of Greece:
http://www.archelon.gr/

NOAAFISHERIES (information about turtles in the world, in English):
http://www.nmfs.noaa.gov/pr/species/turtles/loggerhead.html

Read

Katharine M. Butterworth, *Turtle Facts*, 3rd edition, 2004, ARCHELON The Sea Turtle Protection Society of Greece, available at: https://www.archelon.gr/files/publications/Turtle_Facts.pdf

Kremezi-Margaritouli Anna, *Caretta*, 1997, Erevnites Publications-ARCHELON The Sea Turtle Protection Society of Greece

ARCHELON The Sea Turtle Protection Society of Greece, *Sea Turtles*, 2014

Please give us your opinion

How effective and easy to use did you find these activities? Your opinion would be very helpful. Please indicate your views on with the following statements, based on the options from 1-5:

1 agree **2** generally agree **3** don't know/no answer **4** generally disagree **5** strongly disagree

A	The information that accompanies the activities has helped me teach ecology and habitat management.	1	2	3	4	5
B	The structure of the activities made it easy for me to use the information contained therein.	1	2	3	4	5
C	The introductory chapters well prepared me for each topic.	1	2	3	4	5
D	The instructions for each activity are easy to understand.	1	2	3	4	5
E	The suggested time is sufficient for each activity to be performed.	1	2	3	4	5
F	The activities are attractive to students.	1	2	3	4	5
G	The activities are effective (i.e., sensitize students and help them understand the subject).	1	2	3	4	5
H	The activities are quite simple (i.e., they do not require sophisticated equipment, specialized knowledge, unusual skills).	1	2	3	4	5
I	The activities are accessible to everyone.	1	2	3	4	5
J	Outdoor activities do not pose a risk to the participants.	1	2	3	4	5
K	The activities can also be implemented in other areas of the country.	1	2	3	4	5
L	The worksheets are easy to understand and easy to use.	1	2	3	4	5

M Suggestions for how the materials could be improved:

N Other comments:

ACTIVITY B3:
Beach observation

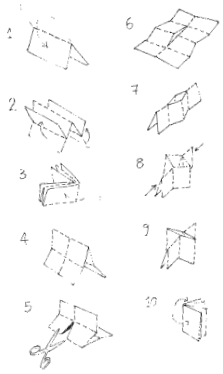
Primary Grades 4-6

Worksheet B

Explorer's Journal

Scientists always take notes of what they observe and then study their notes to draw conclusions. They always have small notebooks with them where they keep 'field notes', with text and drawings. In the times when there were no cameras, the sketches and drawings were critical for preserving scientific observations.

Make your own notebook by folding a large sheet of paper. In it, write notes or draw pictures about what you see that is important to you. Don't forget to make a note of the location and date.



ACTIVITY B9:
Animal Wordsearch

Primary Grades 4-6

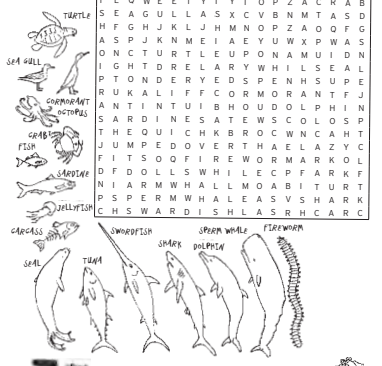
(See Teacher's Book, p. 72)

Worksheet

Animal Wordsearch

Learn about some of the animals that live in the sea and the other animals that they eat. The names of the predators are written both horizontally or vertically, and the names of the prey intersect with them. Note: Some prey is eaten by several animals, and so may be written several times.

F	A	S	S	W	O	R	D	F	I	S	H	D	F	G	O	H	J	K
I	L	Q	W	E	E	T	Y	I	Y	I	O	P	Z	A	C	R	A	B
S	E	A	G	U	L	L	A	S	X	C	V	B	N	M	T	A	S	D
H	F	G	H	J	K	L	J	H	M	N	O	P	Z	A	O	Q	F	G
A	S	P	J	K	N	M	E	I	A	E	Y	U	W	X	P	W	A	S
O	N	C	T	U	R	T	L	E	U	P	O	N	A	M	U	I	D	N
I	G	H	T	D	R	E	L	A	R	Y	W	H	I	L	S	E	A	L
P	T	O	N	D	E	R	Y	E	D	S	P	E	N	H	S	U	P	E
R	U	K	A	L	I	F	F	C	O	R	M	O	R	A	N	T	F	J
A	N	T	I	N	T	U	I	B	H	O	U	D	O	L	P	H	I	N
S	A	R	D	I	N	E	S	A	T	E	W	S	C	O	L	O	S	P
T	H	E	Q	U	I	C	H	K	B	R	O	C	W	N	C	A	H	T
J	U	M	P	E	D	O	V	E	R	T	H	A	E	L	A	Z	Y	C
F	I	T	S	O	Q	F	I	R	E	W	O	R	M	A	R	K	O	L
D	F	D	O	L	L	S	W	H	I	L	E	C	P	F	A	R	K	F
N	I	A	R	M	W	H	A	L	L	M	O	A	B	I	T	U	R	T
P	S	P	E	R	M	W	H	A	L	E	A	S	V	S	H	A	R	K
C	H	S	W	A	R	D	I	S	H	L	A	S	R	H	C	A	R	C



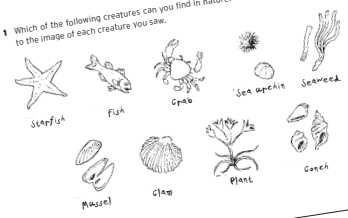
ACTIVITY B3:
Beach observation

Primary Grades 4-6

Worksheet A

Animals and Plants in Nature

1 Which of the following creatures can you find in nature? Put a put a tick (✓) next to the image of each creature you saw.



2 Look for...

A feather	A seed	A coloured stone
Something alive	A bone	Something shiny
Something dead	Something red	Something thorny
Something flat	Something valuable	Something that smells bad
Something beautiful	Something reusable	Something humans have left
Something very old	Something half-eaten (not by you)	Something that tells a story
Something useless in nature	Something important in nature	Something that reminds you of yourself

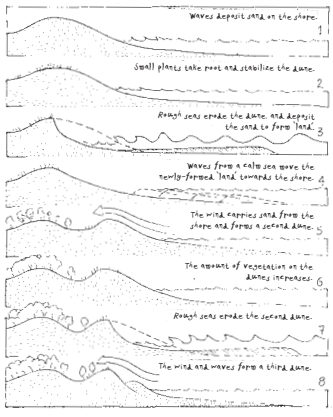
Note: Collect only things that you can put back in the same place without damaging them

ACTIVITY C4:
Identifying the beach zones

Gymnasium Grades 1-3

Worksheet B

Stages in the development of dunes



Life Euro Turtles
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