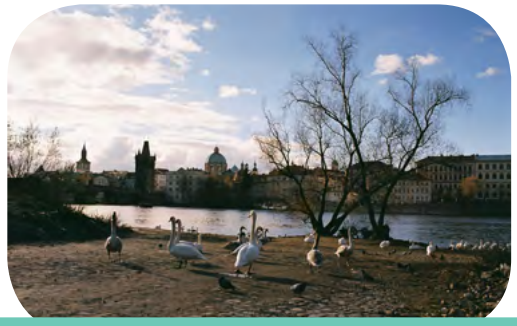
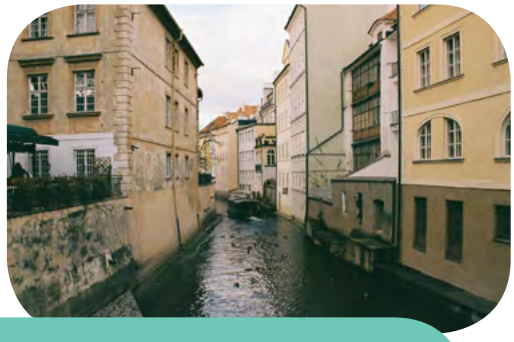




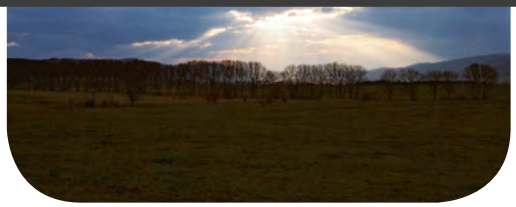
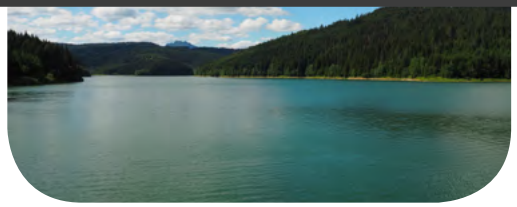



TEACHING GREEN

HANDBOOK

For Practical Environmental Education at School

Teach Locally, Think Globally



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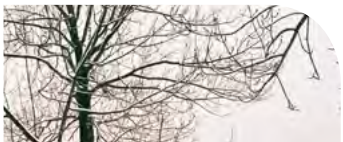
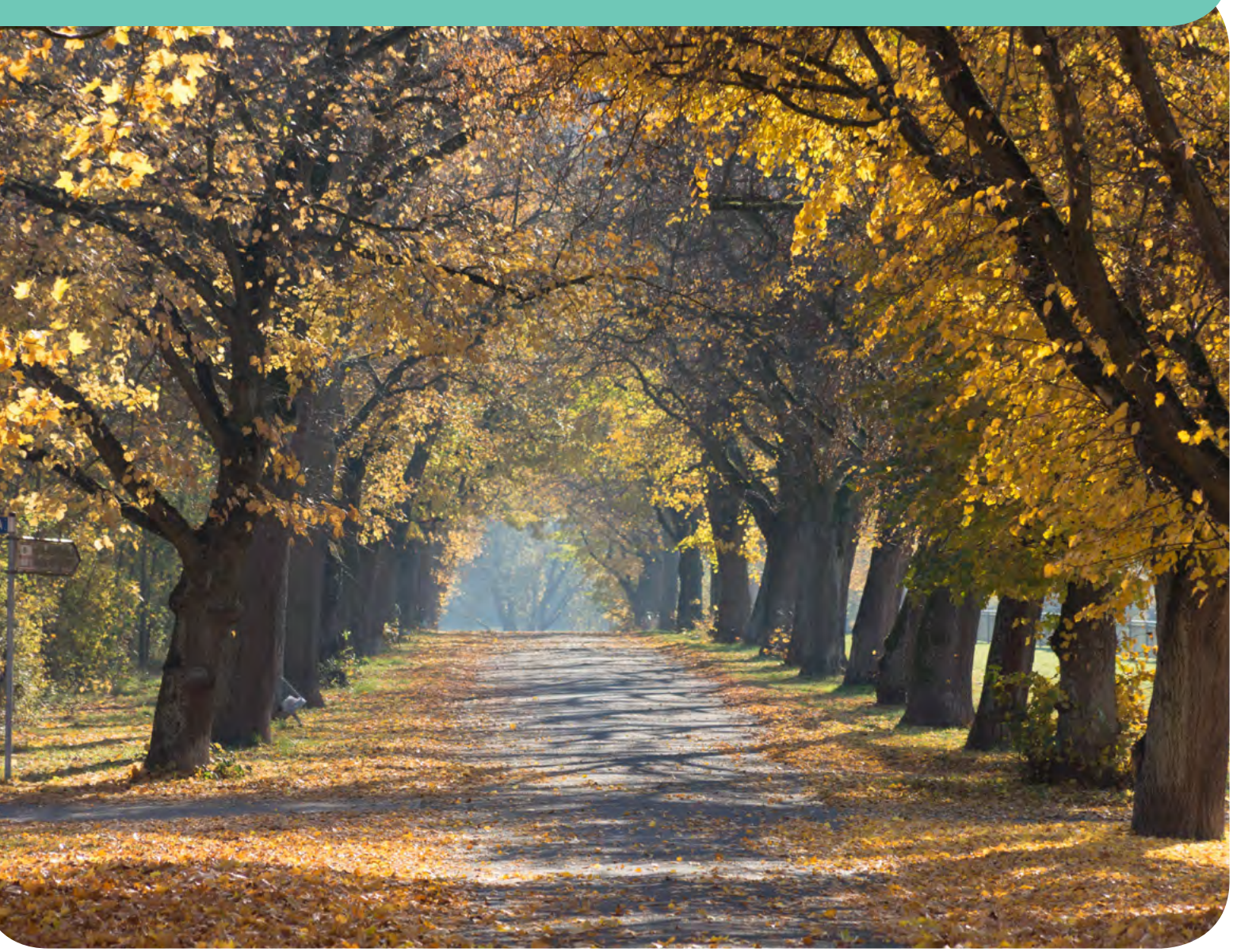


CONTENTS

INTRODUCTION



This handbook is an open educational resource (OER) designed to provide essential materials about the key environmental issues. It is designed to support the teachers of primary and secondary schools, pupils and students, pre-graduate students of teaching professions and supporting professionals.

Throughout the book we will encourage you:

- to strengthen your knowledge in the field of environmental issues,
- to familiarize with 7 the most relevant environmental topics: water, biodiversity, natural and cultural heritage, air, energy, waste, and human environment,
- to implement gained knowledge into your daily practice,
- to acquaint with the new environmental approach and research-based activities,
- to reflect on the importance of the environment,
- to take any action and do something to make this world a little better place for all living beings.

We hope this handbook, along with training programme Environmental minimum, Indicators book for research of pupils and Collection of research reports, will provide teachers with reliable materials for environmental education and help them to implement key issues into daily practice.

Within this Handbook you will find under each section:

Our Message pointing out to information that we believe is key to the topic.
Indicator reference informing you about the possibility to carry out a research-based activity on a given topic which you can find in Indicators Book.

Take Action encourages you to do something for your surroundings.

Activity reference acquainting you with the idea of activity on a given topic for your students.

Did You Know reference informing you about interesting facts on the concrete topic.

Facts References where you can find further links to the resources on the website.

Be inspired by us – let`s lead the students to re-read and focus on their surroundings, the current state of the country and the changes that are taking place in it. If you want students to cherish and protect the country they live in, they must first get to know and experience it.

So read on and then take your students outside!

ABOUT THE PROJECT

TEACHING GREEN

We believe in the power of change and that the best gift we can give to future generations, the most valuable legacy we can leave behind us is a world of educated and environmentally conscious people equipped with the sustainable attitude which is so sorely lacking in today's society.

Environmental education in Slovakia, and also in other European countries, doesn`t comply with its elementary mission and it`s more symbolical or theoretical than practical or real (Zborník, 2018). Teachers in secondary schools should implement environmental education into daily education of general subjects, though they might be missing relevant skills, knowledge or, more often, motivation for environmental education. Therefore there is an **urgent need** for the appropriate training programme and teaching materials for teachers in practice aimed at practical environmental education and its implementation into schools, to strengthen their skills and competences and to gain the knowledge about environmental issues.

The answer to this need is the ERASMUS + project "BIOPROFILES - Implementation of practical environmental education in schools". The project involves 6 partners active in the area of environmental education from 4 countries, Slovakia (INAK, Strom zivota, Constantine the Philosopher University), Italy (CNR-IBE), Spain (VITA XXI) and United Kingdom (Learning through Landscapes). It focuses on the development of innovative materials for practical environmental education for the target group of teachers and students aged 10 - 15 years, leading them towards increased interest in local communities' life.

The project aims at:

- Supporting the professional development of teachers and their skills in active use and implementation of environmental topics into teaching.
- Providing teachers of primary and secondary schools with innovative teaching materials, while integrating the practical environmental concept into the teaching process.
- Delivering high-quality teaching and adopt a

new student-centred method of research-based learning.
- Increasing the environmental awareness of teachers and students through monitoring of the local environment.

To reach these overall project goals there are 4 main project outcomes developed within the project lifetime:

- TRAINING PROGRAMME as ENVIRONMENTAL MINIMUM for teachers,
- HANDBOOK for practical environmental education,
- INDICATORS BOOK for research of pupils,
- COLLECTION OF BIOPROFILES research results, which all together provides complex teaching and learning materials to support practical environmental education in schools.

If you are looking for:

- Reliable teaching materials to support your environmental education,
- Inspiration to provide practical real-life activities rather than formal and theoretical environmental education,
- Ready-to-use materials for research-based learning, supporting critical thinking of students in the environmental context,
- Possibility to attend a training programme for teachers in practice to gain skills and knowledge required for effective and practical environmental education,
- Materials to increase the environmental awareness of your students through monitoring of local environment and motivating them to become active citizens,

project BIOPROFILES and its outcomes are just for you.

All information could be found on the website teachinggreen.eu.

PARTNERS

Learning through Landscapes, United Kingdom

Learning through Landscapes is based in the UK but work worldwide. Learning through Landscapes vision is a society where the benefits of regular time outdoors are valued and appreciated, and outdoor learning, play and connection with nature is recognised as a fundamental part of education, at every stage, for every child and young person. Learning through Landscapes aim to enable children to connect with nature, be more active, and be more engaged with their learning.

For this project Learning through Landscapes has coordinated Collection of Bioprofiles, research-based activities of students in the UK and contributed to the handbook and training.

www.ltl.org.uk

VITA XXI, Spain

VITA XXI is a micro consulting firm focused on education for sustainability, training, learning outside the classroom and environmental issues. VITA XXI started in 2005 working for a Spanish Regional Government, coordinating the Volunteer Environmental programme in Natura 2000 sites in Murcia Region. 5 different environmental action projects were established from marine habitats, passing through dunes, salt works, Peri-urban green areas to Mediterranean forests. After 8 years, those actions projects were transformed in civil society organizations which are now partners of the participatory management plan on each protected area. Accompanying this process was a highly valuable experience for VITA XXI. This allowed VITA XXI to work together on volunteering, participation and association initiatives, including collaborating in writing a participation regional law, thank one of its freelance professional international networks. Additionally, VITA XXI collaborates with Hippocampus Association since 2008 in a citizen science project to protect seahorses in el Mar and also in a circular economy project.

Since 2007, VITA XXI has been working on European projects participating in a large network of EU organizations, mainly developing educational materials and Online Open educational resources for environmental education in several environmental fields. VITA XXI is also involved in solar energy as a local photovoltaic producer, sending 5Kw a year of green energy to the grid and promoting the use of alternative energy locally. VITA XXI has also participated in several initiatives like DIF (Disruptive Innovation Festival), and use educational materials to promote the circular economy, cradle to cradle, biomimicry on international cooperation projects in EU and Latin America.

Recently, VITA XXI is collaborating with Wastewater Planet to promote water treatment solutions at the family, community, and sector, urban or rural scale using a Percolation-Oxygenic Treatment (POT) technology. Finally, VITA XXI has been appointed as Murcia Branch of the SINER Network, for working on Industrial symbiosis (Circular economy in Action) to promote synergies between public, private partnerships to optimise natural resources use with a virtual platform and supporting community environmental training.

VITA XXI believes in project-based learning and learning by doing outdoors on daily basis with the support of technological and digital media, respecting local wisdom and fostering better life for all.

For this project, the VITA XXI has contributed to the handbook and training and has coordinated research-based activities of students in Spain.

www.vitaxxi.com

CNR-IBE, Italy

The Institute of Bioeconomy (CNR-IBE) of the National Research Council of Italy researches the following main thematic areas: Primary production and biodiversity; Wood technology and derivatives; Utilizations, agroforestry mechanization and woody biomass; Climate, meteorology and oceanography; Biotechnology, bioenergy, process and product technologies; Sustainable use of natural resources and ecosystem services.

CNR-IBE has a strong interdisciplinary and excellent value and numerous human and project resources. CNR-IBE is also deeply involved in science dissemination at the local, regional, national and international level for more than 20 years. In this period, CNR-IBE developed and applied teaching units and activities targeting teachers and students (10-18 years old) based on innovative learning methodologies, such as Inquiry-Based Learning, Intergenerational Learning, Learning in Natural

Environment, and innovative tools like Location-Based Games, e-quiz, geographic information systems.

For this project, the CNR-IBE has contributed to the handbook and training and has coordinated research-based activities of students in Italy.

www.ibe.cnr.it/en

Consiglio Nazionale

delle Ricerche

Istituto per la BioEconomia

Strom života, Slovakia

Strom života (Tree of Life) is an educational non-profit organization focusing on environmental and outdoor education, inquiry-based learning, active lifestyle, and youth and children's personal development. Activities of Strom života are based on more than 40 years of continual programming in all regions of Slovak republic. We collaborate with various partners, such as various experts, non-profit organizations, governmental and municipal institutions, schools and universities, business partners and foreign organizations.

Our programs are implemented through these main activities:

- Publishing children's and youth magazines
- Year-round programs for schools, families and broad public in an online Academy
- Various educational activities (expert training, workshops, field trips, seminars and conferences)
- Volunteering programs for children, youth and adults

For this project, Strom života has coordinated the development of Indicators book, contributed to the training and handbook and has coordinated research-based activities of students in Slovakia.

www.stromzivota.sk

STROM ŽIVOTA

Department of Ecology and Environmental Science, Faculty of Natural Science, Constantine the Philosopher University in Nitra, Slovakia

Department of Ecology and Environmental Science, FNS CPU in Nitra is focused on pregradual training of teachers of ecology, environmental science and environmental education from its foundation in 1994. Training of teachers is realized via the study program Teacher training studies in academic subjects in combination with ecology in two study levels: bachelor and master degree. The department has also an accredited bachelor's, master and doctoral degree in the single-subject study program Applied Environmental Studies. In a research area, DEES contributes to the development and application of new methods in the fields of ecology and environmental sciences.

Scientific research is focused mainly on landscape and land-use changes, evaluation of agricultural and urbanized landscape, biodiversity, ecosystem functions and services, remote sensing of Earth and environmental education. Research activities are realized especially through participation in national and international projects and international cooperation.

For this project, Constantine the Philosopher University proposed training programme and its content, organized training along with other partners and contributed to the handbook.

www.kee.fpv.ukf.sk

INAK, Slovakia

INAK is an NGO that tries to do things DIFFERENTLY/"INaK", if possible, „Innovatively and Creatively". „INaK" was established in 2014, as the team of people experienced in the field of using innovative approaches, activating methods and ICTs in education, with the experience of development of didactic materials, running of educational training, as well as the other activities from the field of innovative education. Through our activities, we aim to support the implementation of environmental education and outdoor learning into daily practice.

We focus on the use of innovative approaches, using creative methods in the educational process and whilst working with a variety of target groups – children, youth and adults. Our projects enhance lifelong learning and help to develop learners´ key competences. We try to implement our ideas and bring them into practice through local, national and international projects, usually in strong partnership with a variety of institutions.

INAK, SK initiated this partnership based on the results of needs analysis carried out in spring 2018 and an online survey carried out in March 2017 with 356 teachers and students expressed their interest in the project focused on practical environmental education and research-based activities, as well as based on positive previous experience with similar educational projects.

For this project, INAK has coordinated the partnership and project management and also coordinated this handbook.

www.trochuinak.sk

GLOSSARY

GLOSSARY OF ENVIRONMENTAL TERMS

Before you start reading this handbook, the authors would like to clarify some of the terms used in the content. Each of these terms has several definitions and can be explained differently in other countries, so we offer you our understanding of some key terms.

CLIMATE CHANGE:
A change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable periods. Anthropogenic climate changes may be due to the increase of greenhouse effect and other changes induced by human activities.

ECOSYSTEM:
Is the basic functional unit which includes both the organisms (biotic) and the non-living (abiotic) environment, each influencing the properties of the other and both necessary for the maintenance of life as we have it on the Earth.

ENVIRONMENT:
It is all physical surroundings and contains everything living and everything nonliving, with their complex interrelationships. It includes the built environment, the natural environment and all-natural resources, including air, land and water.

HUMAN ENVIRONMENT:
It refers to the artificial environment where people live and which they have created. It includes buildings, roads, cities as well as the society that humans live in. At the same time, the human environment includes everything natural around us, from the universe itself to the bacteria that live with us.

HUMANITY:
While writing this publication, we made an effort to ensure a gender balance approach when referring to persons. Therefore, in the texts we prefer to use the terms “humanity” or “human” as the inclusive terms in order to best express gender equity.

LANDSCAPE:
An area of land, as one can see it, and that contains a mosaic of ecosystems. This includes landforms, flora, fauna and human elements, e.g. human activity or the built environment. It is possible to understand the landscape as nature, territory, geographical area, and environment, a system of systems, natural resource, habitat, scenery, daily environment, and surroundings. The landscape is also the expression of the dynamic interaction between natural and human forces in the environment.

NATURE:
Is the sum of all things and phenomena in the world, not created by human beings. Nature is everything that belongs with the Earth: ocean, trees, flowers, fish, birds, mountains, deserts, air, rain, storms, volcanoes, but also the Sun, the Moon, the planet, and humans themself belongs here.

If you find the terms in the text whose meanings are not quite clear to you, try to look them up in some environmental online glossaries, for example:

- GEMET, or General Multilingual Environmental Thesaurus,
- IPBES, or The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.

FOREWORD

or Landscape as an Image of Human Being

We live in times when the landscape around us faces major changes and challenges. Though reluctant to admit it, human society is heading for trouble, plundering the landscape for its natural resources and raw materials, ignoring prospects for a sustainable future. Original forest habitats shrink considerably, making a recess for new human activities to flourish. Vegetation, which gives the landscape its distinctive character and finds its natural home in meadows and pastures, is no longer as varied in species as it used to be. Rivers, the arteries of the landscape, get clogged with waste and sewage. The air that once smelled good with the scent of flowering meadows is now full of pollutants that we inhale...

IMPORTANT

It seems like we don't even realise the fact that we, and our future generations, depend on the landscape. The facts are that the water we pour from the tap in the morning is sourced from the landscape; the air we breathe in our homes is produced by the greenery growing outside and the fruit and vegetables we buy at a supermarket are planted and grown by someone somewhere too. Many of today's environmental issues are not only about climate change or the overall condition of the landscape, but also about our relationship to water, air, food, and energy. We take their quality and availability for granted. The issues that were once respected and considered with utmost caution have been narrowed down to ones of technology and economy.

There is no doubt the landscape is changing, and it is changing dramatically. We could doubt whether it is in our powers to revert the wrong course, but there should be no doubt that we can still do something about it. We are not completely powerless! There is still something we can do to help the landscape.

Back in the 1970s, a group of scientists, the authors of The Limits of Growth, warned that too many sources of pollution had exceeded their sustainable limits, making the current state of affairs unsustainable in reality.

FACT BOX

Acquaint yourself with international agreements that contain a comprehensive plan of action at an international level to improve the situation in the areas in which humans impact on the environment. One of the most important is Agenda 21, adopted in 1992 and Agenda 30 from 2015. However, despite these agreements, we are constantly postponing the adoption of real actions to improve the state of nature and the landscape.

They were critical of the ever-increasing consumerism of the population, advocating the need to adopt new rules and limits to apply to the development. Forty years after their calls, the situation has grown considerably worse. What happens if we keep things going the way they have been going by now? What happens if we keep living in a society favouring individual and group interests over those of the general public? Sadly, the answers to these questions vary, and no one knows exactly where the limits of the landscape are. This may be one of the reasons why environmental issues have not been actively addressed (Meadows, Meadows, Randers, 1992).

The challenge we face today may be one of the greatest in human history – one to rebuild the economy and energy systems to make them sustainable and renewable. What we need is energy and economic cycles to put an end to this destructive war with nature (guess who is on the losing side) and change our human behaviour as consumers and living beings.

But we have good news for you – you have your eyes and ears to see and hear what is going on around you. You also have been given the gift of reason and intuition to take up messages from the world and make

conclusions of what you learn. Last but not least, you have free will, but you also have a responsibility – you have a responsibility to act, and you have a free will to decide how to act.

Now join us in taking a closer look at some of the environmental issues to inspire you to pay attention to your surroundings, the current condition of the landscape, and the changes taking place in it. The quality of the environment with conditions suitable for life, clean water, and clean air are no longer things to be taken for granted in many parts of the world.

As the authors of this publication, we believe there are people in every country who are committed to trying to make a difference and change things for the better. And this keeps us hoping that we can succeed in preserving the landscape for future generations so they too can see how beautiful it is.

"Many little people, in little places, doing little things, can change the world."
Eduardo Galeano

THEME 1: WATER

Landscape and Water

The Journey of Water into Our Taps

Pollution and Water Treatment

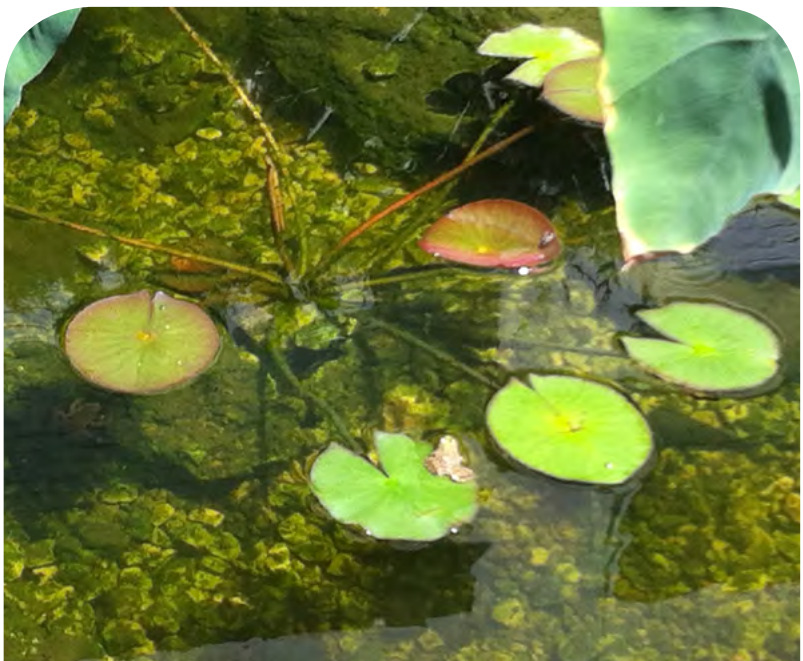
Water-Saving

Water and Its Importance for Human Existence

LANDSCAPE AND WATER

Have you ever wondered why the landscape is so diverse? And how many factors determine its shapes and forms, the way it looks? Water is one of those factors.

The flow of water smooths the surface of rocks, shaping the land to form plateaus. The river flowing through the landscape shapes its bed and floodplain, washing out a deep valley. At the merge of land and sea, the water whips the coast, biting off large chunks of land, eroding it over time to form archipelagos, islands, and cliffs. Under the ground, water can mould picturesque karst formations. Even in its solid-state, like glaciers, water can change the landscape dramatically; as a huge rolling mass, it flows slowly, but with immense force, abrading everything in its path. But on the other hand, glaciers are often behind one of the most stunning natural phenomena – waterfalls.



IMPORTANT

Water is an essential precondition for life on Earth. There is life only where there is water. Life was born in water and progressively continued to evolve into a myriad of forms. Without water, there would be no animals, or plants, or even humans. For many organisms, water is the only environment to live. Water is in constant motion. Back in the sixth century BC, the ancient Greek philosopher Heraclitus of Ephesus said his famous adage, "No man ever steps in the same river twice." What do you think he meant?

Sadly, water sources of the planet are increasingly depleted. Even the countries that abounded with water sources for thousands of years, as with Slovakia or Spain (and many others) are at risk of facing water scarcity in the future. Water is scarce and will be even scarcer. In many countries today, the progressing climate change and irrational water management result in severe problems, even loss of life. Access to quality drinking water is one of the vital needs of man and one of the most fundamental human rights.

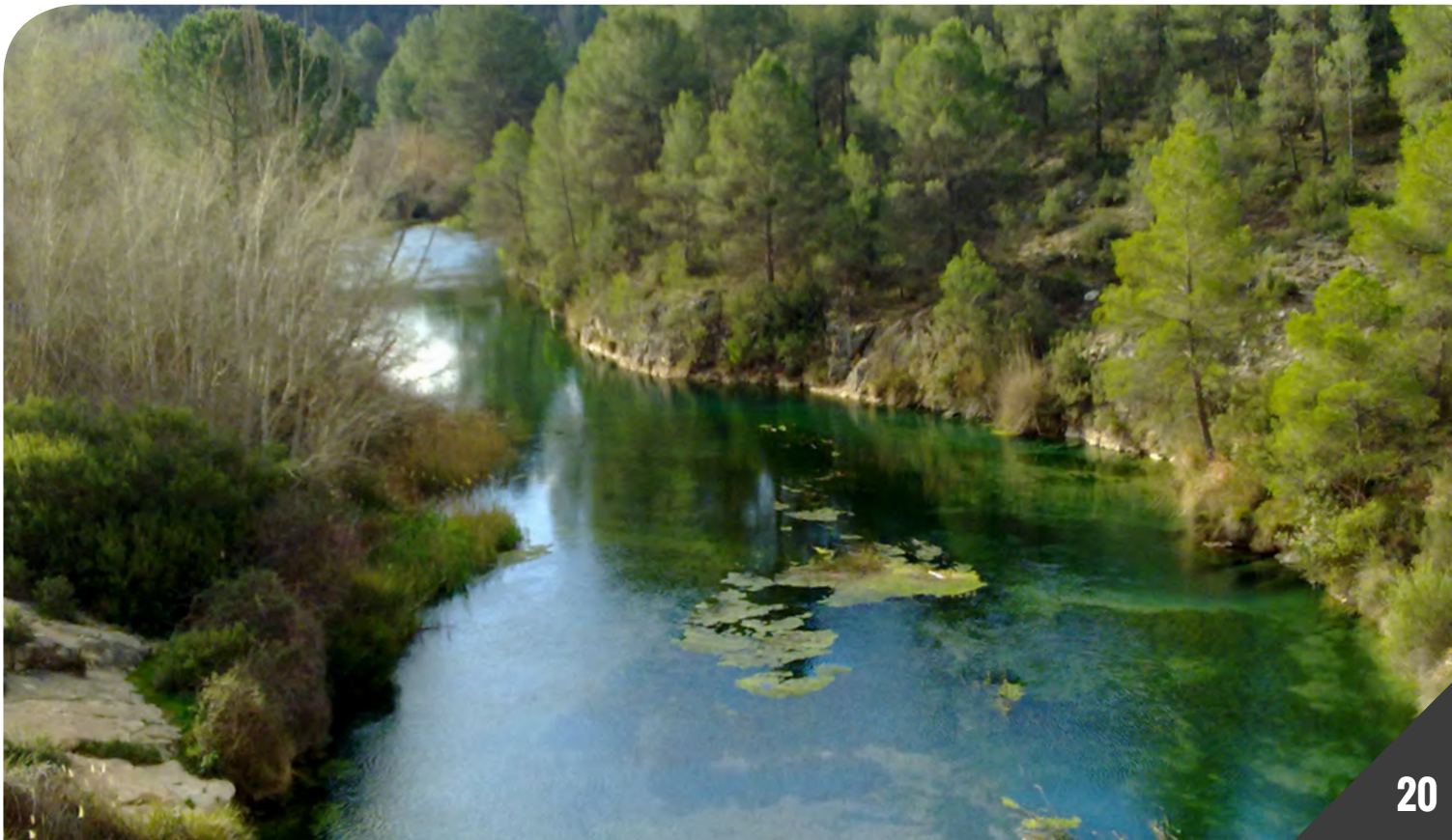
Waterlogged soil has its charm, too. Have you ever heard of wetlands, marshlands, peat bogs, and swamps? These water-soaked areas are often found around rivers and are home to distinctive plant and animal species creating unique ecosystems which are sensitive to external changes.

Water is being depleted not only due to climate change and uneconomical management but also as a result of human intervention in the landscape. With his actions and activities, including roofing, concreting, and asphalting, man is reshaping and transforming the landscape dramatically, affecting its natural ability to retain water (i.e. water-retention capacity). Experts agree that the natural water-retention capacity has decreased significantly in water basins in recent years while accelerating surface rainwater runoff, which has resulted in increased risks and frequency of floods as well as more severe droughts. This, among other things, results in gradual diminishing of water supplies across Europe (and the whole world).

How does a decline in water retention capacity like this occur at all? One of the main causes is the removal of water-retention and erosion-control elements from the landscape – in particular, by deforestation, drying of marshes, improper ploughing, or excessive draining of lands in the mountains and highlands to quickly channel the water into nearby watercourses. The risk of surface runoff acceleration is also increased by timber logging when runoff

water also entrains soil. A similar process can be seen in the agricultural land where layers of the most fertile soil are carried away by heavy rains. Another problem is in expanding the road network and constructing industrial production facilities, which results in increasingly larger built-up areas reducing agricultural land and permeable surfaces. Increased water abstraction by industry is just as dangerous because reduced water flow in rivers means e.g. higher concentrations of harmful substances. All these interventions in the landscape bring about changes in runoff conditions, increasing the risks of local floods. At the same time, the rapid surface runoff of rainwater and its insufficient infiltration into the soil cause the landscape to dry out, leading to reduced groundwater reservoirs and changes in the microclimate conditions in the basin (Cílek, 2017).

If we want to improve the landscape's water-retention capacity, we need to involve competent institutions in the decision-making process and focus on promoting water management principles throughout the river basin, including beyond the river bed. We need to change the current rain and surface water management respecting relevant principles to slow down to the greatest extent possible, the rainwater and surface water runoff in the river basin through some area-specific measures. Examples of measures to improve the water-retention capacity of an area include: restoring wetland ecosystems (also helpful are small lakes or depressions to retain water for a period of time); making baulks and bosques across long fields; building dry polders and other areas for occasional river spills; etc.



INDICATORS

What do you think about your nearby landscape and the condition it is in? Does it retain enough water, or rather, does it support its faster runoff? If you want to learn more about its water-retention capacity, try a student research project on "Water-Retention Capacity of an Area".

www.teachinggreen.eu

ACTIVITY

Announce a photo contest on the "Forms of Water" among students. Invite them to try and take pictures of various forms of water - including ice, rain, icing, flowing river, sea, etc. Collect the digital format photos and use them to make a slide show. You can print out the best photos and post them around your school, for example on World Water Day, on the 22nd March.

DID YOU KNOW?

... Wetland is a common term for wetland areas, such as marshlands, peat bogs, and swamps. Although there are differences, such as in water level, flooding frequency etc., their common feature is no or very slow water runoff, with vegetation slowing it even further. Even if you do not know what exactly a marshland or a peat bog is, it is important to remember that these unique ecosystems are sensitive to change and therefore deserve our protection.

... In 1971, the Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat was signed to ensure protection and sustainability of wetlands.

... The team of researchers from the University of California found that a square kilometre of wetlands saved an average of $1.8 million per year in terms of property damage. (Source: Earth & Space Science News)

... During the summer heat wave of 2008, the city of Barcelona, Spain, imported drinking water by ship from Marseille, France.

THE JOURNEY OF WATER INTO OUR TAPS

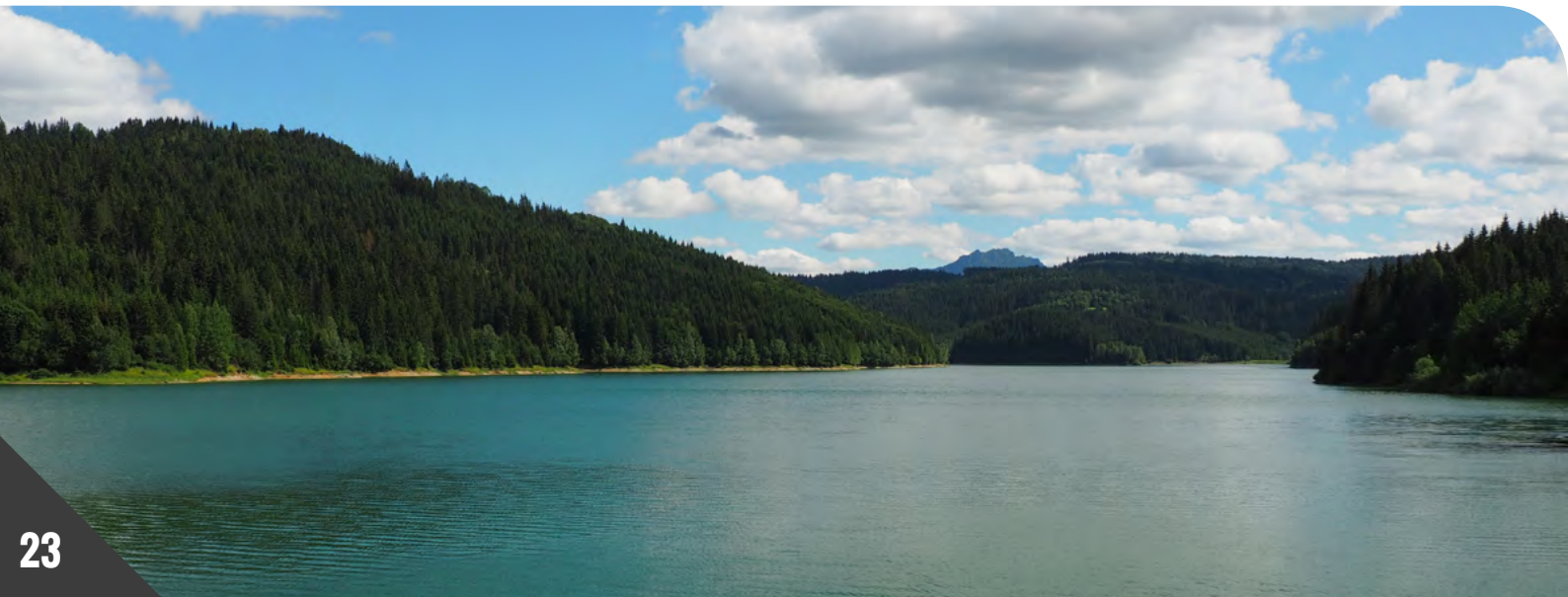
Water is in constant motion in the country. But no worries, the filthy water you have just used to flush the toilet does not travel straight into your tap to fill your glass. What we mean is the water cycle in nature, also known as the hydrologic cycle. It is a process in which water evaporates into the atmosphere only to get back to the ground in the form of precipitation (as rainfall or snowfall), then it is soaked into the ground or flows above ground to form streams and rivers streaming into lakes and seas. Groundwater springs back up to the surface in the form of water springs and then flows into rivers and seas. Part of the rainfall evaporates again, and the cycle goes on and on – with no beginning and no end. This steady circulation of water between ocean, atmosphere and land, driven by solar radiation and Earth's gravity, is called a **large water cycle**.

You may also have heard of a **small water cycle**. This is a closed water circulation in which water evaporates and precipitates over the same area – either over the ocean or over blind drainage areas of land. By the way, have you noticed how water changes in state from gaseous to liquid to solid in different phases of the cycle?

The hydrologic cycle has a huge mass of water available to exchange – up to 1,385 mils. km3 which is the estimated volume of water on Earth. Pretty much, isn't it? Basically, about two-thirds of the Earth's surface is covered with water, of which 97 per cent is the ocean and seawater (saltwater), and the remaining three per cent is freshwater. Given that two per cent of this freshwater is bound in glaciers, we are only left with one per cent of water in lakes, rivers, and under the ground to potentially use as sources of freshwater. Which isn't all that much after all, is it?

There is a wise Chinese saying: “When you drink water, think of its spring.” Every sip of water we swallow makes a long journey from its source into our stomach. Along this journey, water is changed in quality due to the environment it flows through but also as a result of human interventions wherein water is treated to be made drinkable. As such, drinking water is any water that has been treated and is acceptable for drinking, cooking, food preparation or other purposes, irrespective of its origin or manner of supply – whether it was supplied from the water supply network, tanks, or as prepacked water. Only exceptionally, drinking water is meant natural water in its original state, on condition it is of satisfactory quality. Complying with drinking water quality standards and limits, drinking water is safe for health as long as it does not contain any microorganisms, parasites or other substances which, at certain concentrations, may pose risks to human health. The drinking water quality limits are set by countries through government regulations in compliance with recommendations from the World Health Organisation (WHO) and the Council Directive 98/83/EC on the quality of water intended for human consumption.

The quality of drinking water largely depends on the quality of the source. In Europe, groundwater and surface water are generally used as sources of drinking water supplies; drinking water is also produced by desalinating seawater (e.g. in Spain). Groundwater, unless contaminated, is generally of better quality than surface water because it is less exposed to pollution and contamination.



Groundwater is the main source of drinking water in Slovakia and Italy, unlike in Spain or the United Kingdom where drinking water is mainly collected from surface water.

The quality of drinking water depends not only on the geological bedrock in the river basin where the river flows or springs but also on the pollutants leaking from its surroundings. If there is a farm anywhere around the water source, there will be a high risk of water pollution – either due to nitrogen fertilisers used for crop production or as a result of faecal contamination from livestock production. Transportation is another problem, as it entails polluted rainwater and its seepage into the ground. The industry also contributes to water pollution, mostly by releasing toxic substances into water sources. Even though the contaminated water undergoes treatment, the quality of the output water is not always suitable for drinking.

The most common contaminants found in water include bacteria, lead, pesticides, nitrates, nitrites, chlorine, copper, and iron. You may not know it but drinking water may also contain microplastics (these are no longer to be found in seas and oceans only). This is mostly polypropylene, used to produce plastic bottle caps for bottled water.
The elements whose presence in drinking water (in limited amounts) may be beneficial to health include calcium, magnesium,

IMPORTANT

Chemically, drinking water is never a pure H_2O compound; rather, it is a system of water-soluble gases, minerals, and organic substances. Two aspects are considered in assessing the quality of drinking water: the absence or minimum content of harmful substances, and the presence of substances beneficial to health.

phosphorus, fluorine, sodium, and potassium, wherein calcium and magnesium have been best studied so far in this regard. Other relevant water quality indicators include acidity (pH) and hardness. Now let us look into some trace elements and contaminants that may be present in water to see their impact on our health.

FACT BOX

Visit the website for more information about *Types of drinking water contaminants*.

The drinking water pH

The pH factor indicates the acidity, neutrality and alkalinity of water. Tap drinking water pH level usually ranges from 6.5 to 8, while natural rain acidity is around 5.6. It is affected by the composition of the soil around the source and the watercourse, e.g. the presence of limestone, which to some extent acts to neutralise the acidity of water. Besides, water acidity can be affected by plants and organic material around it; with their decomposition, carbon dioxide (CO_2) is released, acting with water to produce weak carbonic acid.
Last but not least, we should not forget about human activity. Industry and agriculture release large amounts of chemicals into the air and water, and these toxic substances are coming back to us like a boomerang in acid rains and contaminated soil and groundwater - in a changed, filtered or otherwise transformed form, or latently present. Some experts argue that the pH factor has no direct effect on our health.

"Hard" calcium and magnesium

In general, water hardness refers to a combined amount of calcium (Ca) and magnesium (Mg) in water. Calcium and magnesium enter the water from dissolved limestone and dolomites, which is why the hardness of water often varies in different geological areas. Calcium and magnesium contained in the water are desirable to a limited extent as their effects on human health are largely beneficial, for example, in cardiovascular diseases, and they are also prophylactic against other diseases. Moreover, hard water tastes better than soft water. But beware, too much of a good thing can be bad for you - for example, excess magnesium can cause diarrhoea, even unconsciousness. In practice, water hardness is measured by a hardness scale: soft, medium-hard (optimum), hard, and very hard. If hard water is available in your home, you may experience minor limescale deposition, such as in electric kettles, pipes, water heaters, etc. But there are two sides to every coin - so, the next time you are removing that nasty limescale residue from your kettle, do not forget to remember the health-beneficial effects of these elements :)
(Koppová, Kľúcová - Adamčáková, Eperješi, 2017)

Microbiological quality

Is there any livestock kept near the water source? Or are there any cesspools nearby? If either or both are the case, we can assume that the water will contain dangerous bacteria that can cause serious health issues such as diarrhoea, nausea, and vomiting. When monitoring the microbiological quality of water, we mostly check for the occurrence of coli form bacteria, *Escherichia coli*, or intestinal enterococci, as these are often indicative of faecal pollution.

Lead

Lead (Pb, from the Latin Plumbum) can enter groundwater and surface water by seeping of wastewater from industrial production and the mining industry. However, its occurrence in groundwater usually does not exceed the specified limits. Lead often penetrates drinking water from old lead-made water pipes that were in use until the mid-20th century. It harms the nervous system and red blood cells and largely accumulates in the bones. It increases blood pressure, damages the kidneys, and causes anaemia.

FACT BOX

Visit the recommended website for more information about pH and water.

FACT BOX

Learn more about Lead in drinking water from the internet.

Copper

Copper (Cu, from the Latin Cuprum) rarely gets into the water. It is usually released from the geological subsoil or copper water pipes. Effects of copper on human health may be either acute (vomiting, nausea, and other digestive problems), or chronic - as copper damages the kidneys and the liver.

Iron

Iron (Fe, from the Latin Ferrum) of natural origin is often found in groundwater. In larger quantities, it gives water a bitter taste and brownish turbidity, creating a suitable living environment for ferric bacteria. Iron in spring water does not pose a significant health risk; rather, it may have unappealing effects on the taste and olfactory properties of water, discolouring it to rusty-brown or turning its neutral taste to slightly bitter. In significantly excessive quantities, however, iron can damage the liver and disrupt blood formation (haematopoiesis).

A cocktail called pesticides

Pesticides are a chemically diverse group of substances used to control pests and weeds in agricultural fields. Basically, there are four main routes for the pesticides to reach waters: directly by spraying, as droplets; by seeping through the soil; by being washed up from the soil; or by being released into the environment, accidentally or intentionally. The effects of pesticides on human health vary from non-toxic to extremely toxic. Their toxicity depends on the chemical composition. They often contain heavy metals, such as mercury or arsenic, which are highly harmful to humans. Most often they cause headaches and damage the kidneys, liver and nervous system.

Nitrates and nitritest

Nitrates pose the greatest threat to waters nowadays. The main sources of nitrogen compounds in the environment are chemical fertilisers, leaking cesspools and septic tanks, whose contents get into surface waters by rainfall and surface washout and to groundwater by seepage. The worst health risk of nitrates (NO_3) is in their chemical conversion to more toxic nitrites (NO_2) in both human and animal bodies, as those are considered one of the most potent carcinogens. Recent research also suggests that nitrates are suspected of affecting reproductive functions in living organisms. Moreover, the insidious danger of the nitrates is they do not change the taste or smell of the water, thus remaining inconspicuous. Chemical analysis needs to be performed to detect contamination.

Let's not forget about chlorine...

Talking about drinking water, we must not forget about chlorine which is added to drinking water as an effective agent for disinfection and treatment. Chlorine (Cl, from the Latin Chlorum) is reliable in killing bacteria and viruses but also has some negative sides. Its contact with other substances commonly found in water can lead to the formation of toxins that exacerbate certain diseases such as asthma, eczema, or heart diseases. Moreover, these toxins are carcinogenic substances. Despite all this, chlorine is currently considered one of the most effective agents worldwide to ensure water safety and prevent waterborne diseases.

FACT BOX

For more information about nitrates, check the article The Nitrates Directive.

ACTIVITY

Take a little test to sample the taste of the water and drinks you normally drink. Divide the students into two groups and provide each with samples of different water drinks, e.g. prepacked water, mineral water, tap drinking water (a freshly poured sample and one left to stand for at least 15 minutes). One group prepares a taste test for the other as follows: students pour the samples into glasses, each with a different drink in it, and then put numbers on each glass for identification. The other group (or its selected members) is blindfolded to taste the samples and assess their taste by rating which they liked the best and which they liked the least. Then the groups swap roles and do the taste-testing again. To conclude the taste session, they compare their results to see if they match or differ.

DID YOU KNOW?

... Water springs were worshipped and revered by people in the past. In pagan times, springs were often associated with gods, while the Christian world often considered them to be healing places or dedicated to saints. Water has a symbolic meaning in many religions, e.g. in Christianity. The ritual use of water in baptism, when an infant is sprinkled with or immersed in water, is intended to wash away the original sin.

... More than two billion people worldwide have no access to drinking water in their homes. The worst situation is in India, Ethiopia, Nigeria, and China.

... According to the World Health Organisation (WHO), eight million people worldwide have no access to clean drinking water. More than 3.5 million people die per year as a result of diseases associated with the lack of drinking water and the drinking of contaminated water.

... The presence of nitrates in baby food causes a condition known as the "blue baby syndrome". The most obvious symptom is a bluish discolouration of the skin, especially around the eyes and mouth, which is a sign of oxygen deficiency.

... Households in Europe consume 22.8 billion m3 of drinking water per year. (Source: EurEau, Europe`s water in figures)

... In some countries, population growth has reduced the freshwater supply per person to less than 1000 cubic meters per year, the minimum amount needs to satisfy basic needs from drinking, hygiene and food production. By 2050, UN population projections show that 39 countries with 1.7 billion people will be experiencing such water deprivation (Brown - Larsen - Fischlowitz-Roberts, 2002).

POLLUTION AND WATER TREATMENT

Clean water is an essential precondition for human life. No doubt about that. Oddly enough, the notion of "clean water" is quite relative, as natural water is never completely clean. Did you know that the extent of water pollution is assessed by its impact on living organisms? You may have already encountered the notions of contamination and pollution. The term **contamination** is used in the event a higher concentration of certain substances is observed in the water but their negative effects on living organisms are either not present or not detected. The term **pollution** is used to describe a condition when the content of certain substances in the water poses a threat to human health or has negative effects on living organisms. Let us take a closer look at the issue of water pollution.

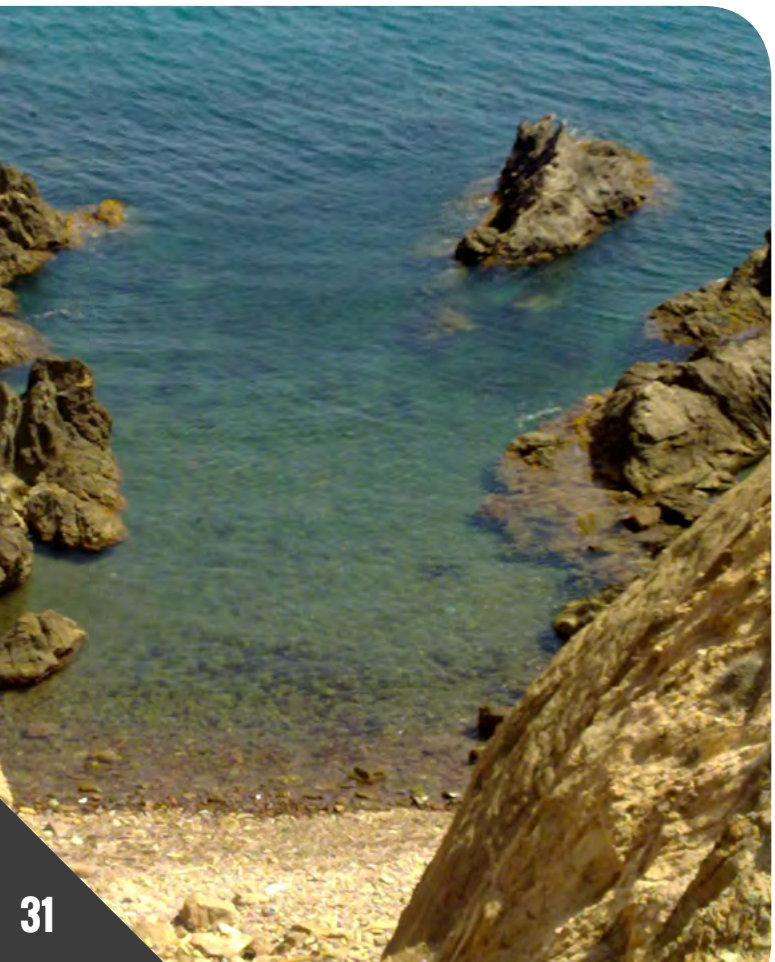
Water pollution

By water pollution, we mean changes in physical properties (such as changes in temperature, colour, or odour), chemical properties (changes in pH, hardness, or mineralisation of water), and biological properties (changes in species composition and concentration of living organisms), that could harm any living beings.

IMPORTANT

Water pollution comes from many sources. It should not come as a surprise that industry and agriculture are the worst water polluters. But make no mistake, polluters can be found in the urban environment, too.

The industry is a huge threat to water. Water is degraded by chemicals, petroleum products, heavy metals, radioactive waste, and sewage. The major polluters include the chemical industry (mainly pulp and paper production) and the oil industry. Have you ever heard of oil spills? Their impact on marine biota is disastrous. One of the worst in history was the Exxon Valdez oil spill near the coast of Alaska in 1989 when an estimated 11 million gallons (some 50 million litres) of crude oil spilt into the ocean. In terms of direct consequences, estimates say this ecological disaster has resulted in the death of 250,000 seabirds, 300 seals, 22 killer whales, and other species. Indirect consequences have not been quantified.



A special chapter in the "nature book of water pollution" is being written by the mining industry. Though mostly locally, its impact on the quality of surface and groundwater is devastating. The mining waste, often containing a lot of heavy metals and chemicals, is discharged from the mines by leaching, which can seriously contaminate ground and surface waters. One of the worst disasters on record was the Baia Mare cyanide spill in 2000 when gold mining wastewater containing cyanide leaked into a nearby river in north-western Romania, killing all life in the River Tisza. It has been the worst environmental disaster in Europe in terms of river contamination since the Chernobyl disaster.
If there is a farm in the vicinity of a watercourse, the risk of surface and groundwater contamination is high, as both surface and groundwater are heavily "supplied" by agrochemicals (mostly by pesticides and nitrates) from crop production and infested with faecal contamination coming from livestock production. The contaminants are further transported with rainwater by being washed out of the soil or get into the water during irrigation. To be fair, however, cities are no innocents in water pollution either. Urban wastewater, pollutants in road runoff water, transport emissions, plastics, and

construction waste often end up in the nearest watercourse, causing all of the pollutants that could not be collected or treated efficiently flow straight into the sea. This means that most marine waste (estimated 80 per cent) is a product of land-based activities. So, the right place to start tackling the serious global issue of marine pollution is on land.

When it comes to marine and ocean pollution, there is a lot of talks recently about waste, especially plastic. Would you believe that waste is present almost everywhere even though about two-thirds of the Earth's surface is covered with oceans and seas? Let us take a closer look at the plastics in the seas.

FACT BOX

If you want to know how a lack of respect for the environment can backfire, read an article: Mar Menor: How nutrients have poisoned Spain's largest saltwater lagoon.

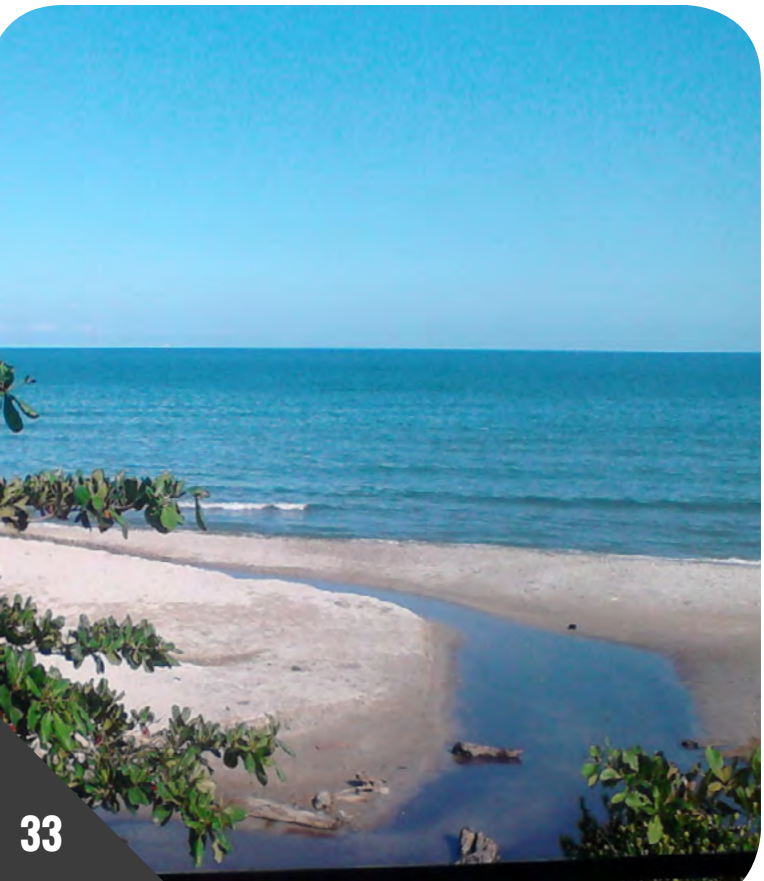
Photo credit: Antonio José Martínez Bermejo (Recorder Productions , Murcia Spain)

FACT BOX

For more information about bodies of water, we recommend this overview: European freshwater.

The journey of plastics into the sea

Some 10 million tonnes of waste end up in the world's seas and oceans every year. The list is very varied: packaging waste, beverage bottles, disposable bags, damaged fishing nets, ropes, sanitary pads, cotton sticks, condoms, cigarette ends, single-use lighters, and the list goes on. Unlike the environment-friendly materials, plastics never degrade. Rather, they accumulate in the environment and mostly end up in the ocean. Sunlight, seawater and waves shatter plastics into increasingly smaller particles. A disposable diaper or a plastic bottle may take up to 500 years to break into such microscopic particles. Not all microplastics are the result of the "shattering" process, however. Some consumer products, such as toothpaste or cosmetics, come with factory-added microplastics.



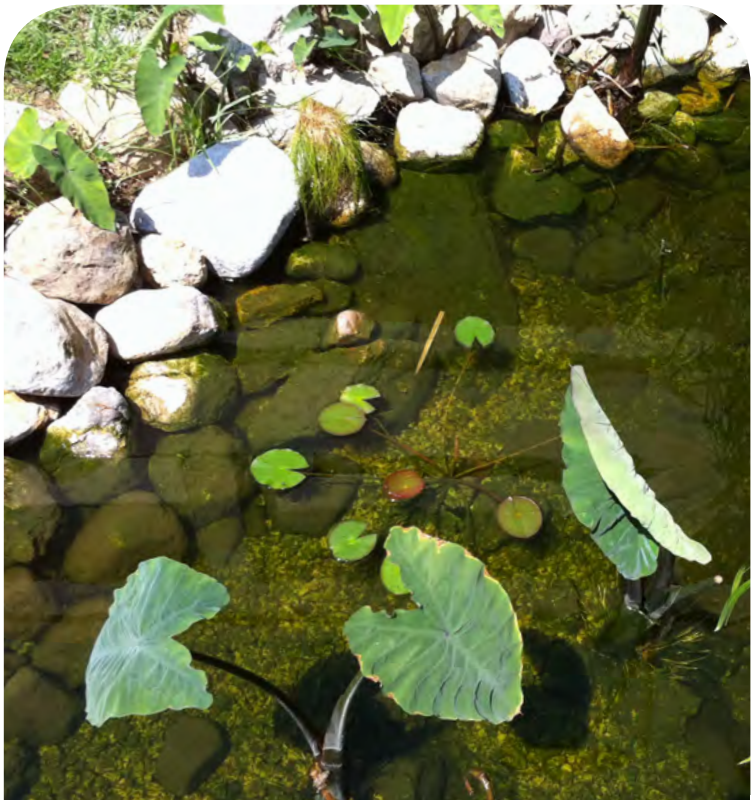
Ocean currents coupled with winds and the Earth's rotation cause the particles to cluster (some of the particles are merely a few micrometres in size), forming large clusters called gyres. The gyres change in size and shape. Estimates say the largest and most studied gyre, the North Pacific Gyre, has formed a cluster of 3.5 million tonnes of waste, spanning an area estimated at twice the size of the United States. Can you imagine that? In addition to this huge floating island of waste, there are five more major rotating current systems in the oceans where waste is accumulating, including the Atlantic.

The full extent of the impact of marine waste is hard to estimate. In 2004, research by a California-based institute found that samples of seawater contained six times more plastics than plankton. Due to its size and prevalence, marine animals and seabirds confuse waste with food. A stomach filled with indigestible plastics can prevent an animal from feeding, ultimately causing it to starve to death. Chemicals in plastics can act as poison and, depending on the dose, seriously enfeeble or even kill the animal. Large pieces of plastics pose a threat to marine life. Many species, including seals, dolphins, and sea turtles get entangled in plastic debris, stuck in fishing nets and ropes left abandoned in the sea. Most of the stuck animals die, as they cannot find a way to reach the water surface

to breathe, take food, or escape predators. If you think this has nothing to do with you, think about the last time you had sea fish sitting on your plate. The truth is, fish that swallow plastics is quite common in our diet. Eating fish exposed to plastics and the related petroleum-based chemicals is risky to human health, even though the ultimate effects are not yet entirely clear.

TAKE ACTION

So, what do we do with all the waste out there in the seas? Although there are initiatives to "fish" for marine waste, what needs to be done in the first place is to prevent it from occurring. If we take a look at what ends up in the seas, we will mostly see items of everyday use. But, do we really need plastic bags every time we go shopping? And what about designing cosmetic products and the related manufacturing processes to ensure they not to contain or form microplastics?



Water treatment

Once water is contaminated and its properties are changed, it is very difficult and costly to restore its original quality.

Humans have not addressed the issue of water pollution for a long time, relying on its natural self-cleaning capability ensured by sedimentation, decomposition of pollutants by microorganisms and the water itself, nutrient consumption by algae, or oxygenation. Nevertheless, when the natural means fail and the self-cleaning capability is outpaced by contamination, the contaminated water must be treated artificially.

As a rule, water treatment is carried out in wastewater treatment plants (WWTP). Interestingly, their mechanism is very similar to that of the natural self-cleaning capability of water.

There are three ways to treat and purify water so it can be safely discharged back into local rivers:

- Mechanically – by sedimentation of sludge;
- Chemically – by the disposal of dissolved harmful substances;
- Biologically – by purification with microorganisms.

In the final stage, the treated water is filtered before being discharged into the river. By the way, the same processes are used to produced drinkable water.

Wastewater treatment plants are usually connected to the sewage system which drains wastewater from households and industrial production and brings it to the WWTP for treatment. Not all residents, however, are connected to the sewage system. If they are not able to connect to the local sewer, their options are, for instance, to collect wastewater in a cesspool and export its contents on regular basis, or to set up a domestic wastewater treatment facility, maintaining the beneficial bacteria in it to facilitate the water treatment process.

There is one more option to consider, with a decorative touch added to the cleaning function: root wastewater treatment plants. They are artificial surfaces mimicking natural wetlands, providing the cleaning

of pollutants with cane, sedge, bat, or pretty blooming yellow iris flowers. Shortly, a system is known for millions of years that we have merely picked up from watching nature, plain and simple. These systems have been around since the 1970s. Like everything in life, they have many advantages but also some disadvantages. The disadvantage, for example, is low efficiency in freezing temperatures.

The main advantages include low operating costs and long-term reliability. They are recommended for small municipalities of up to 500 inhabitants, as their performance is lower compared to conventional treatment plants. Interestingly, a root wastewater treatment plant does not give out any bad smell; rather, it reminds of a wetland in bloom. What a nice idea of treating wastewater, don't you think?

DID YOU KNOW?

... In 2007, a pile of rubber ducks washed up ashore in northern France. Their epic journey started in 1992 when a ship sailing from Hong Kong to the United States lost one of its onboard containers during a storm. There were 28,800 toys in the container. The rubber ducks cruised the world's seas for stunning 15 years before landing in scattered clusters on the shores of Australia, Greenland, the United States, and the United Kingdom.

ACTIVITY

Visit your local government's department of the environment and talk to them about local water polluters. In your area, who is the worst polluter in terms of surface and groundwater pollution?

Find out where the nearest wastewater treatment plant (WWTP) is and the size of the sewage system from which it collects municipal wastewater (area, distance, etc.). Make an appointment with the treatment plant to watch the water treatment process. Find if there are any settlements or homes in your neighbourhood not connected to the public sewer and learn about how they address wastewater management. Make a comparative table with natural filtering systems and check the differences and costs.

WATER-SAVING

Did you ever stop and think about how comfortable it is to turn the tap on to fill a glass of drinking water, or how easy it is to flush the toilet? But not everyone is this lucky. Not even Europe is a place where drinking water is a matter of course. In some homes, water is of such poor quality that it does not meet drinking water requirements, and some homes are even without access to domestic water. Although 95 per cent of Europe's population has access to drinking water through the public water supply system, this is not so in other parts of the world. (For the sake of objectivity, it should be noted that not all the people without access to the public water supply system are without access to drinking water whatsoever; they often draw quality drinking water from the well.) But what about those who have no direct access to water?

There is a proverb attributed to Buddha that says, "If you want to change the world you must first change yourself." This also applies to the management of water, and each one of us has our share of responsibility. Certainly, no one says we should stop using water at the expense of our good health or hygiene. Taking a shower once a week is not an option. But it should be applied wisely and responsibly. So, let us get together and think about the places in our neighbourhoods where water can be used more economically, focusing on households and gardens.

IMPORTANT

Watching the water flow meter in our home for a few days, we come to realise just how wasteful we are of drinking water. In our homes, our connection with water begins with turning the tap on and ends with letting the water drain out - without ever knowing how the water got to us and what happens to it after it is used. Water is the foundation of life, and it should be one of our top priorities. Responsible management of water should be a matter of course for all of us.

TAKE ACTION INDOORS

Look around your house or flat and think about where or how you could save water. Which activities can we do differently? Let's start with a little thing - a dripping tap. Have you ever noticed one? And what about taking a shower versus taking a bath? Which one do you think is more economical in terms of water consumption? The answer is, obviously, a shower; it takes up about 15 to 20 litres of water, while a bath is about three times more demanding. But old habits die hard: if you are used to washing dishes with running water, you may find it hard to break the mould and unlearn it - but it's still worth a try. Next, what is your way of cleaning teeth or taking showers? Do you turn the tap off while brushing your teeth or applying shower gel? Well, you better should! It will save you money and water.

Saving water while washing laundry or washing up in a dishwasher is much more efficient than it was in the past: water consumption dropped by some 75 per cent in saving cycles over the past twenty years. Using energy-saving faucets, lever mixer taps and energy-saving shower heads is also a way of saving water. Besides, we can do the saving in the toilet as well. There are dual-flush toilets available today, offering two push-buttons: one to flush liquid waste (lesser quantity) and one for solid waste (larger amount of water).

A good way of reducing drinking water consumption in the household is to use rainwater. This may be a bit arduous if you live in a flat, as catching rainwater on the balcony is not so easy. But there are more options for you if you are a house dweller. Since rainwater is softer in composition than the drinking water available from the public water supply system, it is suitable for washing or watering gardens. It can also be used for flushing toilets or washing windows and floors, as it does not contain minerals and leaves no white stains after drying. True, it may be a bit too laborious to carry containers of rainwater from the garden to use inside the house, but it is worth the effort, don't you think?

TAKE ACTION OUTDOORS

Good management of water in the garden is based on retaining water in the soil and using rainwater in the most economical way possible. How to do it? By watering the garden in the morning when water evaporation is slower due to the cooler air. Unwanted evaporation can also be prevented by compact and dense vegetation. Proper landscaping can ensure that rainwater does not run away quickly from the plot but infiltrate into the deeper layers of the soil. One of the many ways to provide more moisture to plants is to bury chemically untreated wood close to the plant roots and let the wood soak up the water like a sponge.

Recently, rooftop gardens have been increasingly popular. A rooftop garden, or a green roof, is covered with vegetation or a growing medium to catch rainwater and grow greenery. In this way, green roofs combine the pleasant and the useful: they can grow plants to use and also give you a nice green place to relax. If you use a watering system to water the garden using rainwater, the spray nozzles will not be clogged with limescale. Moreover, rainwater does not contain chlorine which in high concentrations is toxic to living organisms.

Now, what about you? Is your garden a drinking water consumer? If so, you can place a rain barrel under the eaves. It will help you catch the rainwater to later use to water the garden plants. There are even hose pumping systems, or water barrel pumps, available. These can pump the water from the rain barrel onto the plants to spare you from having to carry heavy buckets of water back and forth over the garden. Just consider the many options there are for you and decide for yourself what you are willing to do to save water.

IMPORTANT

One of the absurd signs of the times of wasting is the fact that we flush toilets with drinking water. Every flush means at least 10 litres of drinking water going to waste. This is one of the largest portions of drinking water consumption (and water wasting) in our homes.

INDICATORS

To learn more about your husbandry of water in your home, read up on the student research project "Water Saving".

www.teachinggreen.eu

DID YOU KNOW?

... A dripping tap with ten drops of water per minute equals about 170 litres of wasted drinking water per month.

ACTIVITY

Look around your house or flat and think about where and how you can save water compared to the usual ways of doing it. Before you start saving, check the weekly water consumption in your household. You can do it either by measuring with a water consumption meter or from the water consumption statements for hot and cold water. When done, all you have to do is pick your specific action to save water - for example, turn the tap off while brushing your teeth. Involve other family members in your water-saving efforts. Try and calculate how much water you save per week, and share your findings with your classmates. You may also want to recalculate your water savings to save money. Find out how much you pay per one cubic metre of cold and hot water and make an estimate of your weekly and annual savings.

If you have a garden, try and think about where drinking water could be replaced by rainwater - for example, to water the pots or flowers in the garden. Do it regardless of whether or not you will implement your solution in the end.

WATER AND ITS IMPORTANCE FOR HUMAN EXISTENCE

"Water was given a magical power to become the juice of life on Earth."

Leonardo da Vinci

Water is one of the most common substances on Earth. It is also one of the most vulnerable components of the environment. Water is all around – it is in the air forming the clouds, fog, and rain; it is on the ground and under the ground; it is present in all living organisms and plants. As humans, we are in contact with water from his birth to the last day of his life.

Water is the subject of many proverbs, sayings, idioms, and popular pearls of wisdom.

- We all know that "blood is thicker than water" and "still waters run deep".
- We need to keep in mind "not to go near the water until we learn how to swim" not to enter the "troubled waters".
- Sometimes we try so hard that we "bring water to the sea".
- Life has shown us that "we can lead a horse to water but cannot make him drink".
- Sometimes we feel "like a fish out of water" but sometimes we "take to things like a duck to water".
- But sadly, "a lot of water has gone under the bridge" since we last sipped clean water from a fresh spring amid a field of flowers.

If you know other saying, please share with your class, your community and spread out there in social media.

There is no doubt that water is the most important compound on Earth, an essential component of the biosphere, and a significant substance to ensure human nutrition. Water is indispensable to our everyday life and we do not mean just quenching the thirst. Water is an important raw material for industry, a prerequisite for successful agricultural and forestry production, an important means of energy production, and an important means of transportation and recreation. Also, its role is cultural and aesthetic in cultivating the landscape and the environment. Water is also an essential component of biomass and a major means of transporting nutrients, including their uptake and excretion.
Last but not least, it is a precondition of cleanness, hygiene, and good health. It was not without reason that the 22nd March was designated by the United Nations General Assembly in 1992 as the World Water Day.

IMPORTANT

Water is the most important substance on Earth. But despite its vast reserves, it is becoming increasingly scarce, which makes the world face a serious global problem.
The reason is the water consumption curve is closely related to the population growth curve and the development of industry and agriculture.

FACT BOX

Many cities already face an uncertain future over water. Read the article From Not Enough to Too Much about Cape Town to find out possible solutions.

Water has incredible power known to man since ancient times. There is a saying in the Slovak folk tradition that says, "You can escape the fire but not water." Our ancestors never built their dwellings and settlements near water banks for fear of floods. People of the past tended to respect nature instead of trying to adjust it to make it work for their own needs (but then again, they did not have the means to regulate watercourses the way we do today). Yet still, now and then, they were taken by surprise by high waters flooding their homes and fields and often claiming lives. Nowadays we try to regulate watercourses to prevent such events from happening again.

For all that, the power of water can also be viewed in a more favourable light. Its energy is used to drive mechanical devices (such as watermills), to power hydroelectric power turbines, to transport goods and vessels.

You may not know it but water has its own charter in Europe. It was proclaimed in Strasburg on 6 May 1968 under the title "European Water Charter". In the following 12 points, it sums up the importance of water to humans and the manner we should treat it:

IMPORTANT

Obviously, man can live in harmony with the water - he just needs to understand and respect it.

I. There is no life without water. It is a treasure indispensable to all human activity.
II. Freshwater resources are not inexhaustible. It is essential to conserve, control, and wherever possible, to increase them.
III. To pollute water is to harm man and other living creatures which are dependent on water.
IV. The quality of water must be maintained at levels suitable for the use to be made of it and, in particular, must meet appropriate public health standards.
V. When used water is returned to a common source it must not impair the further uses, both public and private, to which the common source will be put.
VI. The maintenance of an adequate vegetation cover, preferably forest land, is imperative for the conservation of water resources.
VII. Water resources must be assessed.
VIII. The wise husbandry of water resources must be planned by the appropriate authorities.
IX. Conservation of water calls for intensified scientific research, training of specialists and public information services.
X. Water is a common heritage, the value of which must be recognised by all. Everyone has the duty to use water carefully and economically.
XI. The management of water resources should be based on their natural basins rather than on political and administrative boundaries.
XII. Water knows no frontiers: as a common resource, it demands international co-operation.

ACTIVITY

Divide the students into 12 groups. For each group, ask them to study one of the points of the European Water Charter (see text above). Their task will be to find out how their city, region, or country treats the water (in terms of a given point). They will share their findings with others. Finally, try to write your own Water Charter with commitments, as you would like to treat water by yourself. Try to prepare a similar Water Charter for the whole school and present it to others on the occasion of World Water Day.

DID YOU KNOW?

... Water has an anomaly in terms of density. Its density is highest at 3.98°C (39.164°F), which is why it cannot freeze below a certain depth. This property allows aquatic animals to survive winter under the surface of the water.
... Water is the best thermo regulator and stabiliser of microclimate and the weather. This is ensured through direct evaporation, storage the heat during the day and summer by water bodies (and release at night and autumn) or through plants.

THEME 2: BIODIVERSITY

Landscape and its Biodiversity

Disruption of Biodiversity and the Consequences

Biodiversity Protection and Sustainable Development

Forest Biodiversity

Humanity and Biodiversity

LANDSCAPE AND ITS BIODIVERSITY

"All books turn yellow, but the Book of Nature, every year has new, wonderful release."

Hans Christian Andersen

The landscape with all its life forms is unique and incomparable. Wherever you look, there are no two identical landscapes with two identical ecosystems, plants or animals. The diversity of flora and fauna on Earth is called **biological diversity**, or **biodiversity** for short. Biodiversity encompasses the variety of all life forms – the variety of ecosystems (for example, the forest with all the species living in it and their mutual interactions); the variety of species living on Earth (animals, plants, bacteria, or even vegetables); and the differences between individuals of the same species (such as their sizes, shapes, colours or variety of gens).

Can you define what an ecosystem is? Well, the definition may sound a bit too complicated, but this is all you need to know for now: an ecosystem is a community of all living organisms (including not only plants and animals but also lichens, fungi, and bacteria) and of the inanimate environment (air, water, soil, and sunshine) that are interrelated.

IMPORTANT

Biodiversity is all around us and we are part of it. According to scientific data, there are some 1.9 million diverse living species on Earth, though the real number is probably much higher. Optimistic estimates suggest 30 million different species. While many of them are microscopic in size or live deep under the ground or in the oceans, many others have not yet been discovered.

Try to think about where you could find the most diverse ecosystems. If you think tropical forests, rainforests, or coral reefs, you are right; the warmer and closer to the equator, the greater the biodiversity. Of particular importance in this respect are islands, as they are places where many species occur in greater numbers than on land. This is usually due to the lack of predators to regulate their numbers. Island ecosystems, however, are highly vulnerable due to their isolation which not only protects them from predators getting in but also prevents fellow mates of their kind to come to the rescue and save the dwindling population.

In fact, biodiversity is not that hard to explain. What is much harder to explain is its role in nature and why it is important to preserve it – in particular, why it is important to preserve as many species as possible (even if there may be as many as 30 million in the world). You may say, even if there was "only" the confirmed 1.9 million species in the world, it would still be more than enough...

Well, it is hard to say how much is "enough" and how many species or ecosystems we can afford to lose. The various species and ecosystems we have on Earth provide a wide range of "goods and services" that are vital to us. For example, the forest ecosystem provides us with wood and edible products (mushrooms, blueberries, etc.); it produces the oxygen we breathe; it controls the air temperature and humidity; and much more. As for the often abhorrent insects as another example, many of its species are

useful pollinators of flowering plants and crops. Some of the microscopic bacteria are also of great service to us; they convert the atmospheric nitrogen to nitrogen compounds which the plants can further use as nutrients. Regarding the "goods" part, many living organisms play a large role here too; the "goods" are delivered to us as food, medicines, and fuels.

Even though some 1.9 million species living on Earth are charted, we still have little knowledge of their functions or services and goods provided. Many of them are still waiting to be understood as a part of the big living gear or to find their use for medical purposes. But with every extinct life form, our chances to examine it die too. Now, who dares to say which of the species we can afford to lose without experiencing any adverse effect on anything else?

INDICATORS

To learn more about the ecosystem services and goods provided by the biodiversity of species, check out the student project "Ecosystem Service Mapping".

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There is also an aspect of spiritual values to biodiversity. The colourful variety of life invites us to escape from the grim urban reality out into nature. To just roam around, watching the birds nesting and small insects wandering, to explore new places and uncharted territories just around the corner from where we live – these are the unforgettable moments that linger in our hearts and minds long after we close our eyes at night.

IMPORTANT

There is one thing we must never forget: throughout the circle of life, all organisms and creatures living on Earth have as equal a right to their own existence as attributed to humankind, regardless of their present or future use by humans. Is this a reason enough for preserving biodiversity?

FACT BOX

Are you familiar with the popular nature apps?

- iNaturalist helps you identify the plants and animals around you
- iBird introduces you to birding
- PlantNet helps you identify the plants from photos

DID YOU KNOW?

- Scientists describe about 20,000 new species every year.
- Up to 118 out of 150 most frequently prescribed medications in the United States originate in plants, fungi, and other organisms.

ACTIVITY

Take your students out - to a school ground or preferably, a place like a grass field or a park. Divide them into groups and let each group have its own space to explore, such as a piece of the grassy field, an edge of a forest, a riverbank, the local park, etc. Their task will be to find as many plant and animal species on the mapped area as possible. Ask the students to take a picture of each of the species using their smartphone camera and then to identify the species they have discovered (e.g. using the apps mentioned in the text). They may consult their Biology teacher to help them with the task if they wish. In the next lesson, they will present all the species they have found and identified. Compare the groups to see which of them has found the most species in their habitats. Discuss with the students why some areas are inhabited with less plant and animal species than others (for example, compare a regularly maintained park lawn and a natural meadow outside the city). Get together and make a catalogue of local plant and animal species. You can share your observations with other students at your school, e.g. in an awareness campaign, a video report, etc.

DISRUPTION OF BIODIVERSITY AND THE CONSEQUENCES

We are living in a time of unprecedented loss of biodiversity. Ecosystems that have been evolving for millions of years are now being devastated by human actions all over the world. They include not only tropical rainforests, coral reefs, virgin forests, prairies, coastal wetlands or other ecosystems far away from us, but also those in our very neighbourhood. Biologists assume that tens of thousands of species will disappear in the decades to come.

The threat to biodiversity is increasing with the growing human population and its accelerating consumption. Humans consume huge amounts of natural resources (e.g. firewood, coal, oil, fish, or animals), transforming natural habitats into a landscape with predominating agricultural, mining, construction and other human activities.
Unless something is done to avert this appalling trend of species extinction, then many species (such as lynx, panda or whales) will disappear from their habitats forever, with several thousand or even millions of species of bacteria, fungi, and invertebrates following shortly after. The loss of these seemingly inconspicuous species may be devastating to the entire planet and the human race, as these species play a vital role in nutrient recycling and maintain a healthy balance among species.

IMPORTANT

There is an intrinsic value to biodiversity as such. Species and their ecosystems have their own value regardless of their economic, scientific or aesthetic significance for human society. Whatever is done or not done right now will be decisive in terms of how many plant and animal species or entire ecosystems survive. The diversity of species and ecosystems must be preserved; this is an urgent need which most people agree with simply because they value biological diversity.

In recent years, experts have warned of a significant drop in biodiversity, whose direct and unequivocal proof is the actual number of the extinct species. The decline in numbers or outright extinction of species occurs in the following situations:

- As a result of the destruction of the ecosystem in which the species live (e.g. large-scale deforestation resulting in a drop in forest species);
- As a result of the ecosystem fragmentation (i.e. dividing the habitats into smaller areas, which prevents species migration, for instance);
- As a result of their excessive use (e.g. overfishing and hunting).

Once the ecosystem is disrupted or even destroyed, the plants, animals, and other organisms living there have nowhere else to go, and they collapsed.

INDICATORS

Furthermore, biodiversity is disrupted by spreading invasive non-native species into new territories. Invasive species are even considered one of the main causes of the loss of biodiversity. To learn more about the invasive plants in your neighbourhood, check out the student research project "*Invasive Plant Species Mapping*".

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Sadly, biodiversity has many "enemies". Even nature itself is sometimes endangering its own living creatures, such as during floods. But the greatest enemy to biodiversity by any means is the human race. The incessant human demand for products

made of certain species has brought them to the verge of extinction. For example, the northern white rhinoceros is critically endangered - only two adult individuals are remaining in the world, both females. And the list goes on: construction or altered land use leading to a decline in diversity of local species populations; deforestation; pasture grazing by livestock; monoculture planting; resource mining; water and air pollution; excessive hunting... There are myriad of examples of biodiversity being destroyed by humans.

To keep a healthy landscape and its biodiversity means to keep all components of the environment well-maintained. This includes ecosystems, communities, species and their genetic variability. Endangering any of these components can ultimately lead to its complete loss. Humans may degrade ecosystems, reducing them in size or value, but they can always return to their original state as long as their indigenous species survive. Nevertheless, once any of the species dies out, its unique DNA-based genetic information and the special combination of qualities inherent in this information are lost forever. Never again will there be an individual or a population of this species. The ecosystem once inhabited by the species will forever remain deprived of it - and humans will never again benefit from it.

FACT BOX

Some scientists are talking about Anthropocene - a new geological era since humans are now the main changing force on Earth- To find out the reason and their arguments, read A force of nature: our influential Anthropocene period

DID YOU KNOW?

- About 150 thousand km^2 of rainforest grubbed every year. Nearly half of this area is destroyed, while the rest is damaged to such an extent that it brings about a change in species composition and the nature of the ecosystem process in the community.
- Many of the surviving species are on the brink of extinction. Twelve per cent of birds, 23 per cent of mammals, and 29 per cent of amphibians are considered highly endangered.
- The Asian ladybird beetle is deadly dangerous to native lady beetles, butterflies, and other insects.
- Only 15 per cent of the Earth's surface in Europe has remained unchanged by human hand.

ACTIVITY

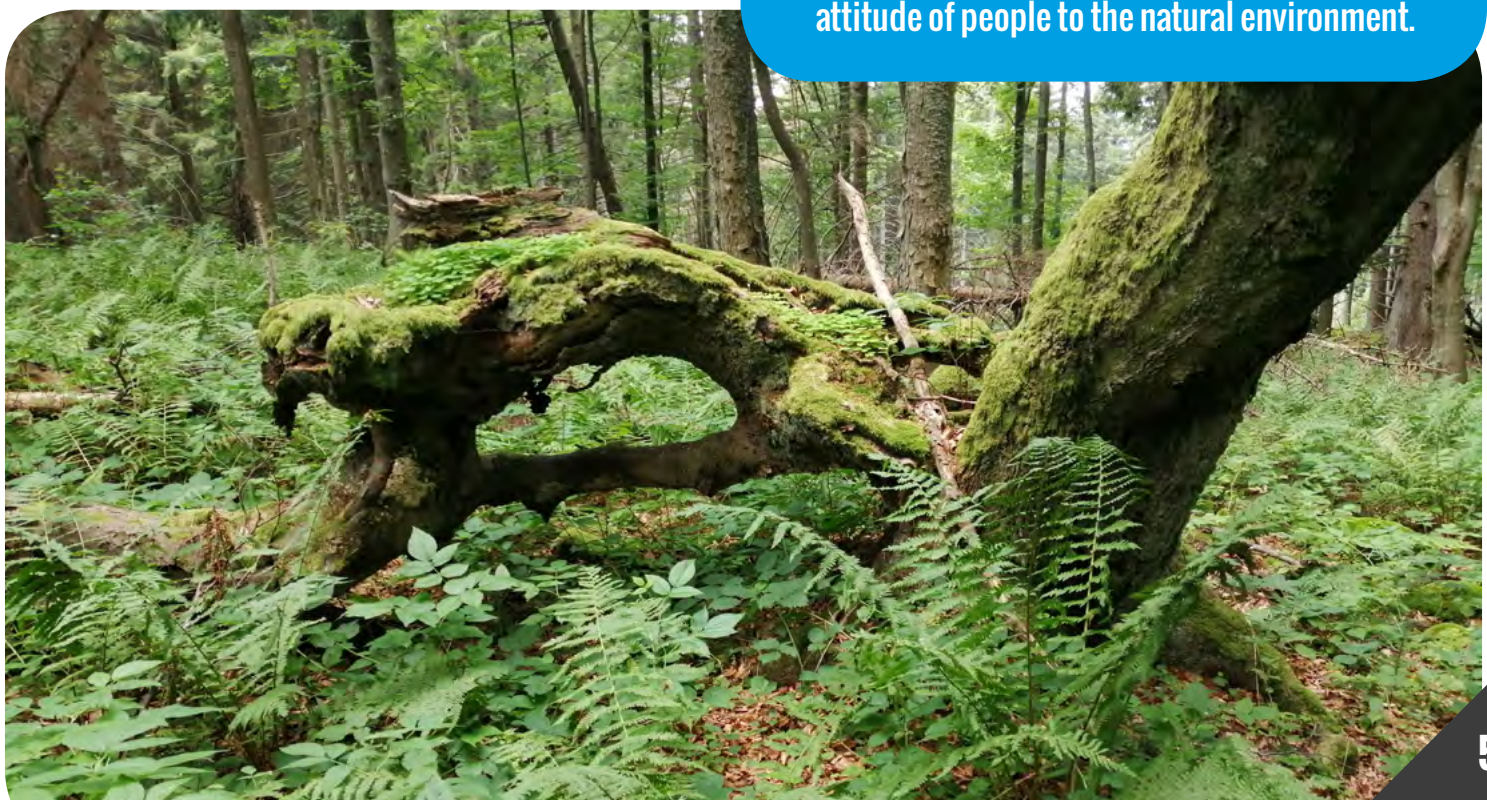
Ask the students to search the Internet to find a plant or animal species that have recently died out or are at risk of extinction. Their task will be to write a "life poem" for the given species, i.e. the fate of the chosen plant or animal species that have died out, as seen from the perspective of the species itself (e.g. I am still alive but there are not more than a few dozen of us left today, allegedly a hundred adults or so; I can only be found in the southwest of Spain today; if I died out, I would be the first known extinct big cat in the past 2,000 years). Make sure the description does not contain the generic name of the species. The students may then read their "species life poems" out to their classmates, with music playing in the background for better dramatization (hint: pick some somber and suggestive music). Alternatively, you can write the names of the endangered species on a blackboard/ flipchart and let the rest of the class guess the species being described.

BIODIVERSITY PROTECTION AND SUSTAINABLE DEVELOPMENT

When talking about the loss of biodiversity, we do not mean the distant future. The decline in natural resources is already seen on a global scale, affecting the quality of life in many parts of the world. Paradoxically, the efforts to maintain biodiversity are often in conflict with human interests. We do not realise how risky or even dangerous the loss of biodiversity is for us. The loss of species entails not only reduced natural but also the economic potential of the landscape. People deprive themselves of potential medicines or food, let alone the fact that the decline of species leads to nature degeneration and permanent decrease in its value. Inevitably, this results in reduced chances of survival of many other species, including humans.

FACT BOX

Since the early 1980s, scientists and conservationists have drawn attention to the need for international interest in biodiversity protection. These efforts culminated in May 1992 when the United Nations Convention on Biological Diversity was signed. The benefits of this document are not only in the compiled measures to preserve biodiversity and its sustainable development but also in its message of the need to protect biodiversity for ethical reasons, out of respect for all life forms, and accountability to future generations. The Convention draws attention to one of the main threats to biodiversity being the indifferent attitude of people to the natural environment.



Human pressure on the natural environment is extremely high, and the constant fragmentation and degradation of habitats is a threat to organisms and their environments. Successful biodiversity protection is based on engaging the public in this process and on building a sense of moral responsibility for their behaviour to the environment. We must realise that economic development must go hand in hand with environmental protection. Without such a sustainable attitude, it will be very difficult, if not utterly impossible, to revert the current development - which can ultimately harm the livings standards of future generations. And it is members of those future generations that will sit in front of you in classrooms, listening to you as you tell them about the loss of biodiversity and the consequences for their future.

Protection of biodiversity is crucial in overall environmental protection. Without preserving the diversity of natural ecosystems, it is not possible to preserve a healthy, safe, and productive environment.

FACT BOX

Finally, we must say that due to global critical health situation (e.g. COVID pandemic in 2020), we can state that preserving biodiversity might control new virus outbreaks. Therefore, if humans continue destroying habitat globally, this will contribute to new virus outbreaks or diseases to emerge. This also brings us to reflect on this old citation from Victor Hugo (1885): „How sad to think that nature speaks and mankind doesn't listen."

For more information read these articles:

- Preserving biodiversity to contain viral outbreaks
- Destroyed Habitat Creates the Perfect Conditions for Coronavirus to Emerge

Now, what is it that you and your students can do to protect biodiversity? You may want to make a student-friendly list of easy-to-do gestures to help biodiversity (see the examples below). Then you can share the importance of preserving biodiversity with your community. Also, you may want to look around your school ground to see if you can use any of the sustainable techniques (for example: create safe passages for animals in the walls; keep the yard free from litter; plant some honey plants, greenery, or a vegetable garden; make an insect house; etc.).

TAKE ACTION

LIST OF EASY-TO-DO GESTURES:

- Do not disturb animals while out in nature
- Prefer local fruits and vegetables
- Move more on foot or bike than by car
- Do exercise outdoors
- Learn about your local plants, animals and birds
- Visit national parks
- Participate in local eco-groups as a volunteer for environmental protection
- Do not replace a smartphone with a new one unless it really stops working
- Use eco-friendly detergents only
- Add some of your own gestures :)

ACTIVITY

Work with your students and develop ten rules to protect biodiversity in your neighbourhood - your very own "Ten Commandments of Biodiversity" to adhere to. Encourage the students to think about how they could contribute to preserving biodiversity.

DID YOU KNOW?

...In 2000, 22nd of May was proclaimed The International Day for Biological Diversity.
...A network of 26,000 protected areas called Natura 2000 has been built in Europe over the past 25 years. Being the largest network of protected areas in Europe, it has been created to protect biodiversity and to prevent its loss.

FOREST BIODIVERSITY

Tropical, deciduous, mixed, or virgin – forests are an integral part of the landscape. Picture a forest or small woodlands in your neighbourhood. What does it look like? What can you find in there? No forest is empty; on the contrary, it is home to many diverse species of trees, plants, animals, birds, insects, fungi, lichens, etc. Forests are irreplaceable in preserving biodiversity.

The forest is not only an environment where plants and animals live but is also important in terms of ecosystem services and goods. By "services" we do not mean hairdressers, massage or cardio training services (although a good run in the woods with a bear in hot pursuit may well fit in the definition of a decent "cardio training" 😊 What we mean is services provided by the forest – like producing the oxygen we breathe (as well as the oceans).

The forest creates economic values: such as allowing for timber production, serving as a food store (wild and game animals, berries, mushrooms). The economic value is clearly quantifiable, which means we can determine the value of the timber or game and how much we get by selling them. In addition to the economic ones, the forest also provides us with ecosystem services and goods that we cannot see or monetise at first sight but all the more use and need them (even without being aware of it) – such as oxygen.

- The forest has a positive effect on the air. Trees, bushes, and all green plants capture and process CO_2, producing oxygen. This is a well-known process called photosynthesis which is essential to life on Earth. Leaves and needles clean the air and kill germs. The forest

captures and removes dust particles dispersed in the air, naturally cleaning it.

- The forest has a positive effect on the water regime in the landscape. Vegetation catches water and assists in its infiltration in the soil, which is important in fighting floods.
- The forest creates and protects the soil. The decomposition of dead parts of the plants creates a soil rich in nutritive substances, known as humus. Vegetation with its root system protects the soil and keeps it from being carried away by water or the wind, significantly reducing the risk of landslides.
- The forest provides shelter to many living creatures. It also creates suitable living conditions for the animals that feed on pests (such as flies, mosquitoes, or voles), protecting us from their infestation and the damage they can cause.

In fact, the forest provides us with these (and many other) ecosystem goods and services for free; all we have to do is use them wisely and economically - which, sadly, is usually the core of the problem. By his ruthless intervention, the man often disrupts a component of the ecosystem, which results in destroying the ecosystem structure. Like any other ecosystem, the forest has its level of tolerance. Once it is exceeded, forest functions and thus the ecosystem goods and services are impaired. All this results in a decline in biodiversity of the environment and large financial costs needed to mend the damaged ecosystem (if still possible).

INDICATORS

To learn more about the services and goods provided by the forest ecosystem (or any other ecosystem), check out the student project "*Ecosystem Service Mapping*".

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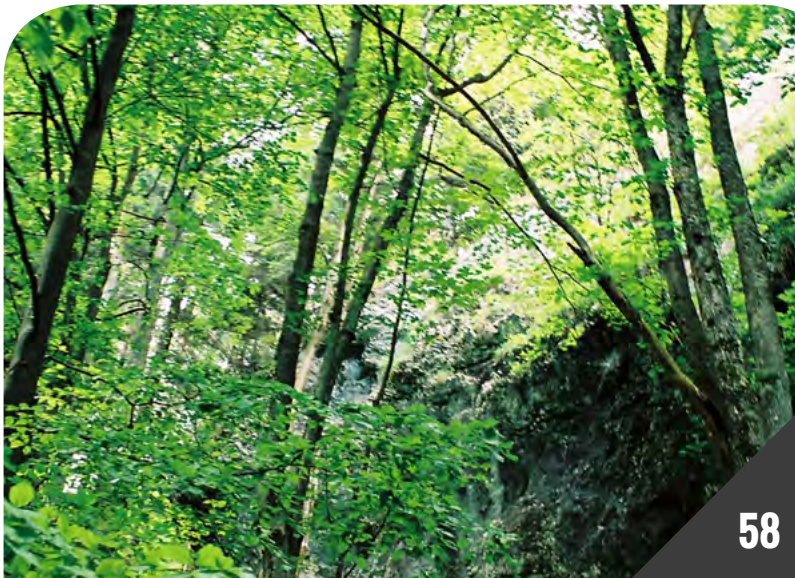
For humans, preserving the forest ecosystem and biodiversity has irreplaceable economic and ecological values, let alone the aesthetic ones. Just to listen to the trees whisper in the wind and the soothing sounds of the forest - can you imagine a better balm to the soul or refresh of the mind?



IMPORTANT

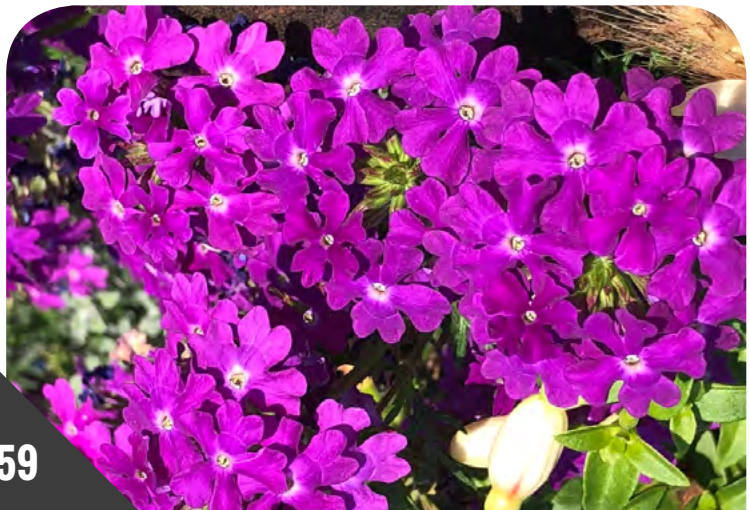
Maintaining the diversity of natural ecosystems, including the forest, is a direct precondition for preserving life on Earth. Every animal, plant, tree or microorganism has its own irreplaceable role and functions in the forest, thus allowing directly or indirectly for many other organisms to live, because no animal, plant or any other species (including humankind) can live on its own, isolated from its surroundings.

ACTIVITY

When was the last time you went to the woods? Invite the students to think about it. Consider how the forest is endangered by man and what the state of its biodiversity is right now. What can you personally do to improve the biodiversity of this particular forest?

DID YOU KNOW?

... Tropical forests boast the greatest diversity of species. Although covering less than 7% of the mainland (and their area keeps decreasing), they are home to more than half of the world's species.
... The air in coniferous forests is virtually free of germs.



HUMANITY AND BIODIVERSITY

"I know of no way of judging the future but by the past."

Patrick Henry

Biodiversity is a result of evolution lasting for 3.8 billion years, and humanity cannot survive without it. The reasons are obvious: we take food, building materials, heat, textiles, or drugs from nature. Besides, nature provides us with other vital functions we cannot do without, such as plant pollination; air, water and soil purification; or preventing floods. But much too often do we forget about the precious gifts of nature. Biological diversity of species is often taken for granted and seen as something that is free and lasts forever. In fact, we put increasing pressure upon nature, seriously threatening the existence of many species. The list of biodiversity-threatening human actions is long indeed.

In many modern societies, people make efforts to protect the quality of the environment and biodiversity through laws, regulations, penalties, and environmental quality assessment and monitoring. But the true change of attitude can only be achieved by changing the fundamental values of human society. The ethical value of nature is defined by the newly established and rapidly developing field of practical philosophy called environmental ethics.

IMPORTANT

As we have said above, man is by far the greatest enemy to biodiversity. Protection of biodiversity will require significant changes in the way we think. People and governments all over the world must understand that diversity of life is extremely precious and indispensable for the continued human existence on this planet. But the much-needed change is only possible if each one us feels in their own heart that something truly valuable is being lost with the continued human destruction of natural communities.

If our society adhered to the principles of environmental ethics, nature protection and maintaining biological diversity would be one of its main priorities. Our ancestors lived in harmony with nature for thousands of years thanks to the ethics (even without needing a field of science) which emphasised personal responsibility and efficient use of natural resources. Our modern society needs something exactly like this as a fundamental principle to live by.

Now let us reflect about why we need to protect rare species, species without apparent economic value, genetic variability within species and the ecosystems:

Scientific understanding

- **Biodiversity is essential to finding the origin of life**
  The three fundamental mysteries of science include the following questions: How did life come about? How did the diversity of life on Earth come about? How did man evolve? Thousands of biologists deal with these issues. If a species dies out, the fundamental keys to answer these questions carried by the species will disappear forever; the questions will become harder to answer, and the issues will be harder to solve.
- **Species are not mutually independent**
  Species interact with one another in a complex way because all of them are part of natural communities. Any loss of one species may have far-reaching consequences on other species within the community, including man.

Belief Systems

- **Do humans have more right to exist?**
  Species are naturally programmed to protect themselves and their kind but humans appear able in most instances to be able to control this instinct. So many humans have adopted a stance that we do not have any right over another species to exist. How do you feel about this?

- **Are Humans the stewards of the Earth?**
  Humans have for centuries believed they need to respect and support biodiversity. This is often reflected in their belief or religious systems for example the North American Indians believe every part of the Buffalo should be used out of respect for the animal. In Buddhism, bad karma will come to those that harm another being. In some forms of Christianity, they believe If God created the world, then all species created by Him are of value. In Jewish, Christian and Islamic traditions, human responsibility for preserving species is clearly part of the Agreement with God. What is our role?

Belief Systems

- **Do we have a responsibility to future generations?**
  Again, if we acknowledge that all species instincts are to protect their own species and species are not mutually independent do we believe that by destroying Earth's natural resources, we destroy ecological communities and bring about the loss of biodiversity? It is thought that as a result, future generations will pay the price by suffering from worse standards of living and quality of life. If we believe this then people of today should sustainably use the resources. They should realise we are merely borrowing Earth from future generations who have a right to take it over in good shape. What responsibilities do you have to future generations?

- **Is the respect for human life and the protection of human interests compatible with respect for biodiversity?**
  If again we acknowledge our interdependence not only can people lead healthier and fuller lives, they live in a healthy environment. Do you agree with this?

- **Can nature have a spiritual and aesthetic value that goes beyond its economic value?**
  In the past, religious thinkers, poets, writers, artists, and musicians of all kinds drew inspiration from nature. Many perceive wilderness and landscape as a positive aesthetic experience and millions of people engage in activities that involve perception and experience of nature - for most this is a taught relationship and something that has been proven to be an important part of the healthy development of children. By losing biodiversity, we lose all these experiences. Do you take part in activities like this? How do you feel about others who do?

ACTIVITY

- See if your students have seen the film Avatar. If they haven't, watch the film together then think about how it is related to biodiversity.
- Ask the students the following questions:
  - What happens if butterflies die out?
  - What happens when all flower meadows disappear from the face of Earth?
  - What happens after the last tree is gone?
  - What would happen if there were no humans in the world?

DID YOU KNOW?

... More than 99 per cent of recent extinctions of species have been attributed to human actions.

THEME 3: NATURAL AND CULTURAL HERITAGE

Landscape as Heritage from Our Ancestors

School ground Landscape or Landscape behind the School

History around Us

Through the Eyes of Students

What Happens to the Heritage from Our Ancestors?

LANDSCAPE AS HERITAGE FROM OUR ANCESTORS

"A concerted effort to preserve our heritage is a vital link to our cultural, educational, aesthetic, inspirational and economic legacies - all of the things that quite literally make us who we are."

Steve Berry

The landscape is human reflection and memory. Every historical period is "written" into the landscape, modelling it and changing it to its own image and needs. Looking back into the past, we see that humanity has increasingly conquered the landscape with its growing capabilities and the advancement of technology. The virgin forests have turned into monoculture forests often dominated by a species which in fact does not belong in there. The meandering rivers have been regulated and forced into canals. Pastures and small farmed areas have turned into large fields of arable land. The former log cabins have now become prefabricated houses or family villas. Small villages have turned into huge cities. And playing online games rather than singing or dancing seems to represent the folk traditions of today. The change in people's minds and in their view of the values that really matter has led to changes in the landscape. (Or, was it the other way round?)

One way or another, the landscape around us still has many treasures to reveal, especially ones that have remained intact, unaffected by historical changes, and still look the same or very much like as when they were created. Some were created by nature, some by man. Both are exceptional because they are unique. The beauties created by humans are the cultural legacy of our ancestors; they are our heritage. The beauties of nature are fortunate enough to have not been changed by man. Cultural or natural, all these intact pieces of heritage are mostly inconspicuously hidden away in the country around.

The UNESCO (United Nations Educational, Scientific and Cultural Organization) was founded in 1945 in response to the two devastating World Wars when the natural and cultural heritage had suffered enormous losses. The international community realised that wars begin in the mind of man, so it is the mind of man that needs to be led to moral solidarity and mutual understanding. The UNESCO seeks to achieve this through education and training programs, sharing knowledge, cultural development and protection of cultural heritage, promoting the proper use of information and communication technology (ICT), and environmental protection. The UNESCO World Heritage Programme was established based on the 1972 World Heritage and Conservation Agreement. The Programme is aimed at cataloguing and preserving cultural and natural sites of particular importance as a common heritage of humanity. Today, the UNESCO list includes around 1,120 sites considered internationally important.

The landscape is a testimony of our history and part of our awareness, of our identity, and our soul. At the same time, it is a value that transcends national boundaries, being of transnational significance, as part of the world cultural heritage, whether

UNESCO-listed or not. As an example, let us look at Tuscany, Italy; in a country that is one of the most industrialised in the world, the traditional character of the cultural landscape has been successfully preserved for the past five centuries. The same can be said about the English, Welsh, Scottish, French or Spanish countryside where the landscape is almost tangibly soaked with history and traditions to the present day (Huba, 2013).

Unfortunately, not every country treats its monuments responsibly. In some places, natural and cultural values are even more at risk than in the times of the two World Wars. The cultural or natural landscape is turning into a building site, a ski slope, an advertising space, a hypermarket, a quarry, or a landfill. Skyscrapers are becoming the signs of the times, while shopping and logistics centres are being built at the cost of loss of the most valuable sites.

We have an enormous richness and diversity of cultural and natural heritage in Europe. It is our commonwealth that has shaped us into who we are today. Future generations are the future administrators of this heritage to ensure their continued protection. If we help the students understand and appreciate the value of their cultural and natural heritage, they will be able to explore its diversity and discover what we all have in common.

IMPORTANT

Landscape as a heritage from our ancestors is passed down from one generation to another. The next generation will come after us to take over the heritage from us - just as we took it over from our predecessors. The landscape with all its treasures of the past is the reflection of our time; it is up to us to preserve it for future generations in all its richness and complexity.

INDICATORS

To learn more about heritage sites in your area, check out the student research project "Heritage around Us".

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IMPORTANT

We must keep in mind that heritage is something we have not created but, somehow, been given both as a gift and a "burden" from those who lived here before us. The opportunity to enjoy this wealth entails an opportunity and responsibility to participate in deciding its fate. A poet would say an attitude to the landscape begins in our human heart. Now let us look into our hearts to see what is in there.

DID YOU KNOW?

... A "cultural landscape" does not mean that a cultural event such as theatre performance or film screening is taking place in the landscape: it means that the landscape is cultivated and affected by human activities. The word "cultural" comes from the Latin "cultura", which has a dual meaning: the cultivation of the soil, and the cultivation of moral values. Where man has settled down permanently, he began to cultivate cultures, changing the natural landscape into a cultivated one. Thus, the attribute "cultural" is to emphasise that the landscape is cultivated, as opposed to a non-cultivated natural environment.

... The United Kingdom and Czechoslovakia were among the first 20 countries that ratified the UNESCO Constitution in 1946 (whereby the Constitution actually came into force).

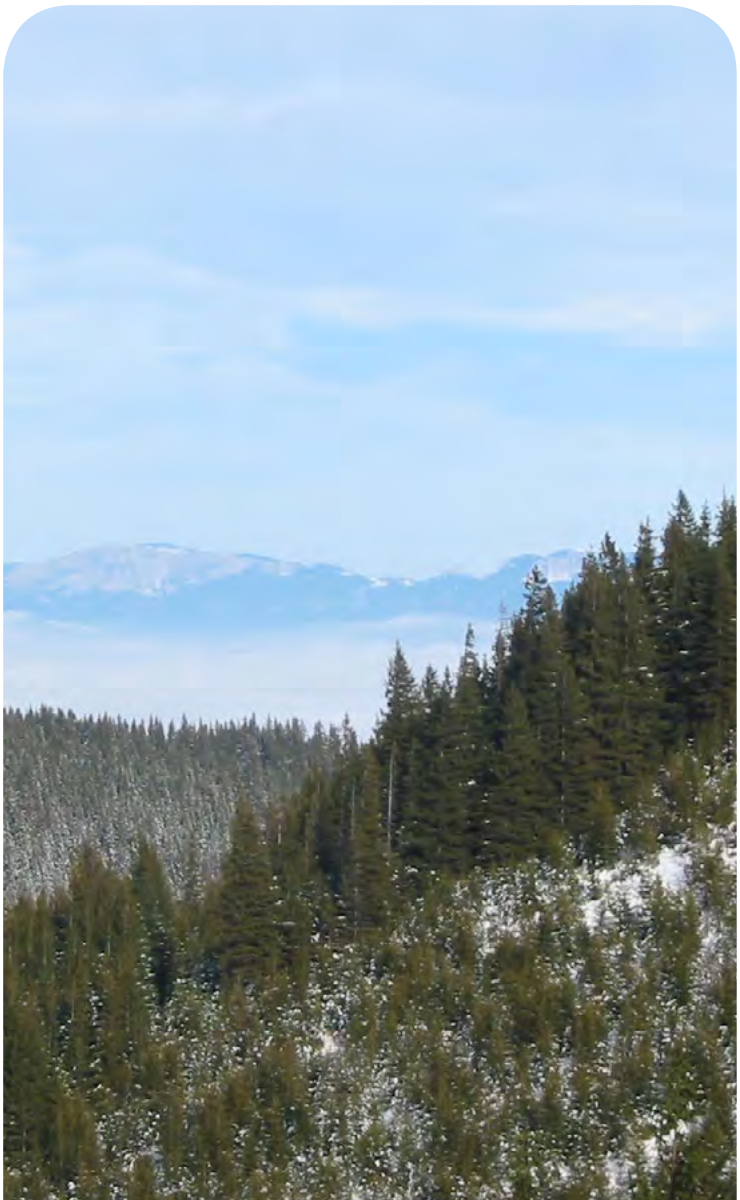
... Today, UNESCO members include 193 member states and 11 associate members. Israel and the United States quit the UN heritage agency in 2019.

ACTIVITY

Work with your students to see how your government treats monuments in your country - to see whether it acts responsibly or not. Find examples of appropriate treatment of cultural and natural heritage sites. Then ask the students to find examples of inappropriate interventions in the landscape that are damaging the cultural and natural heritage of their ancestors.

FACT BOX

Have you heard about Cultural Routes? These journeys through space and time demonstrate how the heritage of the different countries and cultures of Europe contributes to a shared and living cultural heritage. More information could be found on the website of the Council of Europe.



SCHOOL GROUND LANDSCAPE OR LANDSCAPE BEHIND THE SCHOOL

"A nation's culture resides in the hearts and the soul of its people."

Mahatma Gandhi

Each landscape has historically evolved and shaped in harmony with nature. Sunny valleys with a meandering river and grassy fields were a favourable precondition for settlements in ancient times. Contrary, where nature was inhospitable, with steep hills or snow-capped mountains, it did not provide an inviting environment to settlers – and the places now do not carry many traces of human activity.

Humans have transformed the landscape into their needs, often changing it beyond recognition. Where there was a dense forest, there are arable fields there today. Fortunately, there are still places around that are hardly touched by human hands. The most precious of them are considered our natural heritage.

Natural heritage sites around the world are phenomena where we can see how nature has evolved without human intervention; how it regulates its ecosystems; and how the natural environment responds to change (such as climate change) and disruptions (such as wind calamities or floods). National legislations often protect the most significant sites by declaring them as national parks and natural monuments. The sites of unique value to the world are listed in the UNESCO World Heritage List.

By December 2019, the UNESCO World Heritage List included 213 unique natural

sites. These include the Etna Volcano in Sicily, Italy; the volcanic Aeolian Islands (sometimes referred to as the Lipari Islands), Italy; the Garajonay National Park in the Canary Islands with its typical laurisilva forests; the coasts of Dorset and East Devon, East England, with their cliffs capturing 185 million years of history of Earth; and a vast karst system of 712 discovered caves in the Slovak Karst and the Aggtelek Karst, southern Slovakia.

To be listed as a UNESCO site, the natural site must:

- Contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance;
- Be outstanding examples representing major stages of the Earth's history or significant geological processes in the development of landforms;
- Be outstanding examples representing significant processes in the evolution and development of terrestrial, freshwater, coastal and marine ecosystems and communities of plants and animals;
- Contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing endangered species of exceptional universal value in terms of science or conservation.

How about your neighbourhood? Are there any natural heritage sites there to preserve for future generations?

IMPORTANT

Nevertheless, it is not only the UNESCO-listed natural heritage sites that must be preserved for future generations. Of great importance are also natural monuments that may be of local significance only, but their particular character or presence at a given location makes them special or unique just as it does the location itself. Such sites equally deserve our attention and protection because they give their locations a unique character. By learning about these sites and understanding their importance, we build our personal relationship to the place we call home.

ACTIVITY

- Ask the students to find natural sites listed as World Heritage Sites in your country/ region. What makes them unique? Why have they been listed in the World Heritage List? Are any of the sites located in your area? If possible, take your students to the heritage site to learn as much as possible about the place - such as typical features of the site; what kind of problems the site managers face; what the future holds for the site; etc.

- Ask the students to identify major trees in their town or village, then to process some basic facts about them and present their findings. Instruct them to focus on the importance of the trees as memorials of the times but also to emphasise their ecological, environmental, aesthetic, and cultural significance.

- Have you ever heard of "natural tourism"? Try and learn more about it.

FACT BOX

Find out which monuments of natural and cultural heritage in your country are listed by UNESCO World Heritage List.

DID YOU KNOW?

... The Slovak Karst National Park, listed as a UNESCO World Heritage Site along with other caves, is the largest karst area in Central Europe. The park also includes the Ochtinska Aragonite Cave. There are only three aragonite caves discovered in the world so far - one each in Slovakia, Romania and Spain.
... There are 49 UNESCO World Heritage sites in Spain, 56 World Heritage sites in Italy, 7 World Heritage sites in Slovakia and 32 World Heritage Sites in the United Kingdom.
... There are 53 properties already included on the List of World Heritage in Danger.
https://whc.unesco.org/en/danger/

HISTORY AROUND US

"To know nothing of what happened before you is to forever remain a child."

Cicero

The landscape may be also considered a reflection of the culture of the nation. Over the course of several thousand years, cultures of the West and East have alternated in Europe – from Celtic settlements to the Roman Empire with its magnificent buildings; from old Slavic cult places to manor houses and fortified castles of the Hungarian nobility; from medieval Germanic mining towns to Gothic monuments; from Renaissance and Baroque palaces to sacral monuments of various faiths; from the functionalism of growing post-war cities to current projects reflecting the latest developments.

Cultural heritage is a unique cultural value of the nation, reflecting its social, cultural and civilizational development. As its age is naturally limited, its value is steadily increasing. No walls will last forever even though some of them have been around for thousands of years. Who knows if their builders had hoped to create something to last this long? For example, the Coliseum (Colosseum), an icon of Rome and ancient Roman architecture (completed in 80 AD) – even after nearly 2,000 years, two-thirds

of the original building are still standing and the monument is still considered the featured landmark of Rome.
By cultural heritage, we do not only mean buildings and churches, or material monuments, but also intangible cultural heritage, such as folk songs and traditions, which document the history and the development of society.

We may not even realise it, but cultural heritage is shaping our everyday lives. It surrounds us in big cities and small hamlets, in the natural environment and archaeological sites. We find it in literature, arts and historical monuments, in the crafts, we have learnt from our ancestors, in the bedtime stories we tell our children before bed, in the food we eat, and in the films we watch. Today, cultural heritage is also seen as a source of multiple uses - in education and research as well as in economic strategies. The educational potential of cultural heritage is of particular interest. It is called "heritage learning" or learning through heritage. It aims to provide children with knowledge about the heritage of their own nation and to open their eyes to learning about and remaining open to the heritage of others. (González, 2012)

Natural and cultural monuments of transnational importance are listed in the UNESCO World Heritage List. As of December 2019, the list included 869 cultural sites and 39 mixed sites. But it is not only the listed sites that must be protected and preserved. The same applies to smaller sites and monuments, be it a castle on a hill, a church in the centre of a town, life changes traditions – all these deserve our attention and care. They are important for us to build awareness of our history and to form a relationship to our country, our home.

What about you? Do you know of any remarkable cultural monuments in your area? Do you follow any traditions?

IMPORTANT

Cultural heritage should be a part of every child's life from an early age. Knowing our own history helps us understand who we are. Thus, the role of the teacher should be to teach their students not only about the things that happened or were created in the past and what their importance is today but also how to use the accumulated knowledge and experiences to create the future - a sustainable one, if possible.

ACTIVITY

- Ask the students to find cultural and historical monuments listed as World Heritage Sites in your country. What makes them unique? Why have they been listed in the World Heritage List? Are any of them located in your area? If possible, take your students to the monument site to learn as much as possible about the place - such as why the monument was created; how it has been maintained; what its current condition is; etc.
- Ask the students to have a talk to their parents and write down what traditions they observe to celebrate various events throughout the year - such as Christmas, Easter, childbirth, wedding, etc. Pick one significant event (e.g. Christmas) and ask the students to collect the relevant traditions, then work together to compare them. Do any of the traditions collected by the kids match? Is there any tradition in the list that is unique from all the rest?
- Ask the students to bring an item from their home that has been used for at least three generations (e.g. workshop tools, cutlery, a piece of furniture, a bowl, etc.). Their task will be to present the chosen item engagingly. Work with your students and create a catalogue of these items featuring a photo and a related story. Play the event together with your students applying some of the collected traditions.

DID YOU KNOW?

... Supported by the Council of Europe and the European Union, the European Cultural Heritage Days have been held every September in some 50 European countries since 1991 to remind the general public of the importance and richness of Europe's cultural heritage through a range of activities and projects.
... There are also more than 4000 different museums and near 2000 festivals are held every year to show and celebrate Europe`s cultural heritage.

THROUGH THE EYES OF STUDENTS

"One book, one pen, one child, and one teacher can change the world."

Malala Yousafzai

IMPORTANT

Each country has places which are of significant natural or cultural value to their region. These may not be on the map of protected sites or national parks or the UNESCO World Heritage List but are of great importance to the people living in their vicinity.

These may include a long-extinct local brewery whose building still reminds of the faded glory of the city's beer-brewing tradition, human-made caves in the wood to store the ice (very popular in the mountains regions) or a wetland with rare animal species that are endemic to the region and may be at risk of extinction. Just as some sites are of international importance, these are of regional importance; by giving the region its distinctive uniqueness and making it stand out from other regions, they determine its value.

TAKE ACTION

Certainly, you must know some natural and cultural monuments of local importance in your area. You may have visited these sites a long time ago, or they may still be waiting to be discovered by you. Sometimes you just need to talk to the elderly or the town's chroniclers or local enthusiasts to learn about many other interesting sites. You may not find them in guidebooks but they give your town a unique character. They are part of the country you live in - they are part of your home. Just look around and discover the hidden places of interest in your area. Old walls tell old stories, and you and your students can tell them on. The same applies to natural sites. With the current pace of biodiversity loss, you may be the last to visit or take photos of these sites for future generations. Do not let them disappear from the map and fall into oblivion. You may not be able to decide on their final fate because you lack the necessary funds to save a particular monument, but it is certainly in your power to write their story so they are not forgotten.

INDICATORS

The way we perceive our surroundings is affected by many factors, including our personality, our interests, expectations, and aesthetic perception, but also the distribution of feature landmarks, deteriorating and neglected sites, or the quality of the natural environment. To learn more, check out the student research project "Emotional Map of a Public Space".

www.teachinggreen.eu

DID YOU KNOW?

... The word "museum" originated in ancient Greece. "Múseion" was the temple of nine goddesses - the Muses, each of whom was a goddess of an art or science (and a daughter of Zeus).

ACTIVITY

As information about natural and cultural monuments of local importance is often not available to visitors to a city or region, it is desirable to make it available to people. Ask the students to find interesting natural and cultural sites in your city they would like to include in the local heritage list. Visit the sites together to learn about their history and present. Explore the chosen monument, paying attention to the details and surroundings and the monument's location in the environment, trying to find details you did not notice before. Make a local tour guidebook to the sites you have discovered, including a map, the route for visitors, historical and other data related to the monument, etc. Add a story to each site to make the guidebook unique.

Then the students can organise a tour for their peers, friends, or parents using their guidebook to show them around the heritage site. Alternatively, they can offer their guide services to a local cultural institution or museum.

Ideally, the students can make a signboard or a poster about the heritage sites and put it somewhere around town - in a favourite shop window, for instance, to make it available to potential visitors.

WHAT HAPPENS TO THE HERITAGE FROM OUR ANCESTORS?

Imagine there would be no historical building, church, or castle in your city - only modern buildings, offices, banks, and prefabricated houses. And imagine your town without any mighty trees planted by your ancestors, or without groves by the river, or even without the river whatsoever - with industrial buildings and a regulated water canal only... What would a town or country like this feel like?
Every old house or memorial tree or a castle tell us their unique story from ancient times to the present. Fortunately, there are many minor cultural and historical and natural monuments that have been preserved in Europe.

The world cultural and natural heritage is seriously threatened by natural disasters (floods and earthquakes can be devastating for any monument); environmental problems (acid rain can cause great damage to limestone monuments); rapidly growing urban development; as well as armed conflicts and wars.

Europe is overwhelmed with excessive tourism which is literally flooding some sites with visitors, contributing to their damage and deterioration. To preserve cultural heritage and the environment for future generations, non-mass forms of tourism, such as nature tourism, should be preferred. Ideally, this should be in line with the cultural, historical and economic traditions of a given country and city.

Many countries have been struggling with problems related to caring for cultural and natural monuments, with the lack of funding being one of the most severe. Many sites and buildings were damaged in the past (and are being damaged still) by negligent

and inappropriate treatment, and their rescue or recovery is (not only) financially demanding. But the worst part is that the loss of any monument is ultimate, irreversible, and irreplaceable, which deprives the given country of its history and uniqueness.

IMPORTANT

Among the major negative factors affecting the state of cultural and natural monuments are largely the lack of attention and indifference of people. It is indeed up to us to decide how we will treat our monuments and if we preserve them for future generations. It may not be entirely in our power to affect earthquakes, acid rain, or transportation development, but we can certainly do something to change our negligence, inattentiveness and indifference to our natural and cultural heritage.

FACT BOX

Have you ever heard about the old Argaric Culture (La Almoloya) at the Iberian Peninsula, Spain? An impressive archaeological discovery was made in 1944 but it was only recently in 2013, when an archaeological project named La Bastida Project, shows the real value of this site of Prehistory in Europe. It was inhabited about 4000 years ago in the Bronze Age, and it has great potential to understand our past and the heritage and cultural projection. The Argaric society was a milestone of sedentary life, urbanism, metallurgy and political and economic inequalities (what a coincidence with our present time).

Every cultural and natural monument is a unique entity with its own history that has transformed into a set of various values. Despite all the things that threaten the monuments on the part of man and of nature itself, the monuments are still around – as evidence of the diversity and uniqueness of nature, but also as witnesses to the skills, talents, and diligence of our ancestors.

ACTIVITY

Let the students find out what sites of the past have persisted in your area to this day and which have disappeared forever. Get together and find some old photographs of historical buildings, churches, old trees, or natural habitats of a plant or animal species. If possible, take a picture of the site/building/street/park from the same perspective as taken on the old photo. Compare the two photos with the current condition. In this way, you can make a memory game featuring cultural and historical monuments of your city or area. You can also share the results of your work with the general public - show off your memory game or make a presentation in your local museum.

IMPORTANT

Dear teachers, it is up to you to arouse the interest of your students in monuments and heritage sites, whether located in your nearest surroundings or far away from you. We are aware that arousing someone's interest to the extent that they appreciate and respect what our ancestors have left for us is a long-distance run. But we do hope that before you finish, these unique cultural and natural monuments will not be just a digital memory hidden somewhere in a local museum's archive.

DID YOU KNOW?

... The UNESCO World Heritage List includes the so-called "list of shame" which has so far included two sites in India and two US national parks. The reason for the listings was non-compliance with the World Cultural and Natural Heritage Agreement, lack of discipline, a threat to the site/location, etc. One of the listed US parks - Yellowstone National Park, the first national park in the world - got in the list due to bison brucellosis (a disease), water pollution, visitor indiscipline, mining natural resources in its vicinity, and road construction.

THEME 4: AIR

The Air around Us

Climate Change and Global Issues

Sources of Air Pollution

Transport or there is an Alternative Way

What Can We Do?

THE AIR AROUND US

"There is no plan(et) B."
Mike Berners-Lee

You are walking about the country wandering your eyes over the trees and wavy hillocks until your eyes rest upon the horizon. We all like looking at that line where the land meets the sky. And when you look up a little higher, there it is – a palette of "50 shades" of blue! Did you know that the sky is an amazing play of light on air molecules?

As you are enjoying the view, you are breathing in the air around you. Without air, we would die, and its bad condition cuts our lives short. The air cannot be exhausted, but it certainly can be damaged, polluted, or devalued. We often overlook polluted air just as we do the air itself.

IMPORTANT

The air is an essential component of the environment. Without air, there would be no life on Earth. Besides breathing, we use it in several activities: The air saturated with water vapour can accumulate energy from the Sun to maintain the right temperature in a closed room. The airflow, drag, and temperature fluctuations are used in ballooning, paragliding, and skydiving. The air's ability to be compressed ensures we can enjoy the summer comfort of floating airbeds, inflatable boats, and swimming belts. Compressed air is also used to fill car and bike tyres, for diving, and so forth.

FACT BOX

Despite the statement at the beginning of the chapter, Plan B exists. At least that's what the book by Lester R. Brown is called: Plan B: Rescuing a Planet Under Stress and a Civilization in Trouble (2003)

You must have heard of air pollution - but what is it, exactly? Pollution means that, in the short or long term, the air contains substances that harm the landscape, the environment, and human health. Clean air consists of nitrogen (78% of the total volume), oxygen (21%), and trace gases (<1%). The polluted air may contain particles and gaseous chemicals such as carbon monoxide, carbon dioxide, nitrogen oxides, sulphur oxides, ozone, nitrates, sulphates, organic hydrocarbons, etc. Many are also found in clean air as trace gases, but they only become pollutants if present in unusual high volumes.

Nevertheless, not all air pollution is visible or smelled. Gases such as carbon monoxide and carbon dioxide are invisible and odourless. But beware: carbon monoxide is highly toxic for humans - inhaling large amounts can be fatal! On the other hand, carbon dioxide may not exactly be poisonous in itself (except the case of very high concentration like in natural places with CO_2 emission and low air mass circulation, then you can die by asphyxia), but it is a large contributor to climate change. A no-win situation in either way...

It should not come as a surprise that **air pollution** is considered to be one of the most serious environmental issues of the current world. Even worse, just as industry, transport and other human activities pollute the air by emitting all manner of pollutants, so does the air, in turn, pollute the environment: pollutants bound to water molecules fall back to the ground as acid rain, polluting soil and water, endangering plant and animal species, and damaging buildings. Another problem is the fact that air pollution knows no borders. Air pollutants emitted in one country are transferred by air

currents to another country. Unfortunately, such as “cross-border greetings” from our neighbours are commonplace all over the world and we cannot help them.

There are various sources of air pollution but the major ones include agriculture, households, industry, transport, and municipal waste. These are collectively referred to as anthropogenic, as they originate in human activity. Interestingly, however, nature itself may be the cause of air pollution, such as by volcano eruptions, dust, etc.

FACT BOX

To learn more about the current state of air quality, check the European Air Quality Index.

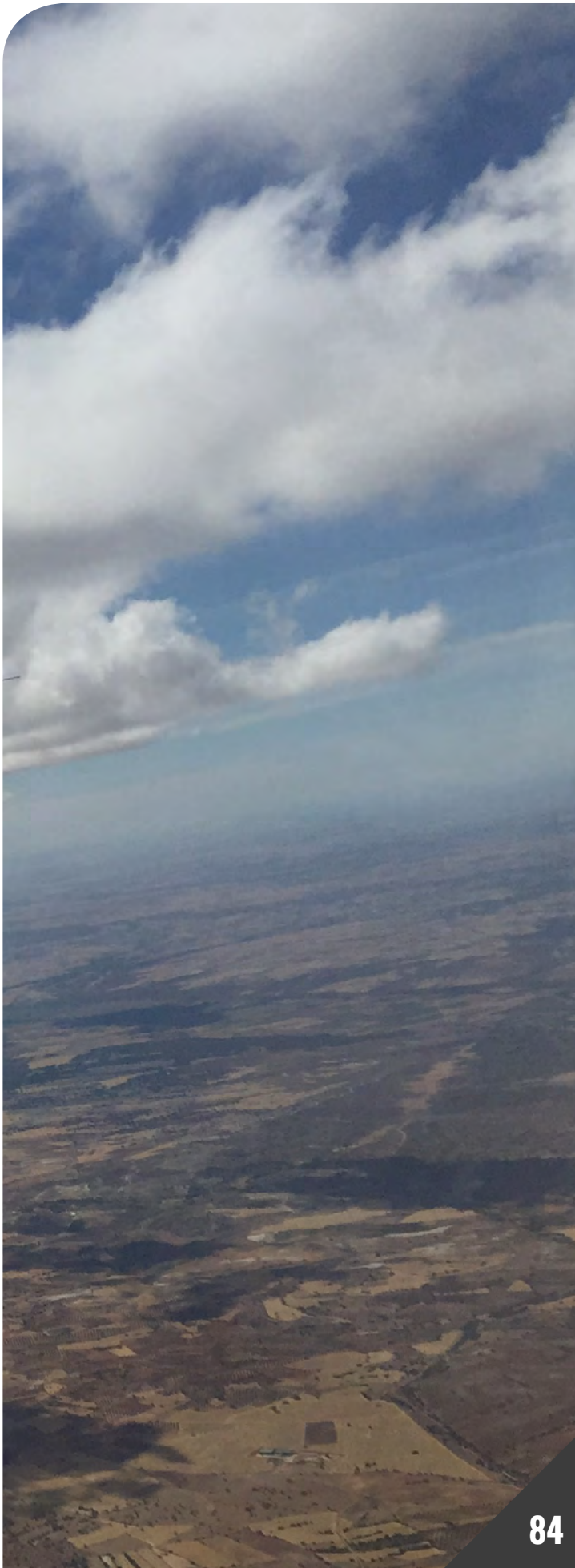
Regarding air pollution, we often use the terms emissions and imissions. Do you know the difference between the two?

Emissions are harmful substances released into the air. These are for example fumes coming out of chimneys, such as nitrogen and sulphur oxides, etc. Once these substances enter the atmosphere, they are chemically and physically changed (but not necessarily) and then transmitted to other places by the wind and water. Once in contact with the environment, we call them **imissions**. Imissions harm the environment, including soil, water, and all living organisms. Imissions represent the local air pollution, i.e. what falls from the air over a certain area.

The need to reduce emissions of air pollutants is often discussed at an international level. While the situation has improved in many countries, concentrations of air pollutants are still too high, and the air quality problems persist. Particulate matter, nitrogen dioxide and ground-level ozone are generally considered as three major pollutants affecting human health today. According to the European Environment Agency (EEA), air pollution is the most common cause of premature death in 41 European countries.

FACT BOX

If you come across an unknown term while reading the text, you can look it up in the Environmental Thesaurus.



ACTIVITY

Find an air quality monitoring station in your area and pay a visit to learn the following:

- What is the quality of your local air?
- Where are the biggest air polluters in your area?
- Which pollutants are monitored at the station and what are their levels compared to other towns/cities in your country or region?

Draw a map of your local area or region (use e.g. Google maps) and add your findings into it.

DID YOU KNOW?

... The sky is blue due to air molecules and sunlight. Sunlight is scattered by air molecules in all directions, with shorter wavelength light (such as blue light) being scattered more than other wavelengths (colours). This is why scattered light contains more shortwave radiation and the sky looks blue.

... We do not always need expensive measuring equipment to easily check if the air is polluted. All we have to do is watch the natural environment and look for bioindicators, i.e. organisms or species that are sensitive to the effects of harmful substances and pollutants in the environment. For example, plant bioindicators include lichens - remarkable organisms consisting of both fungi and algae or cyanobacteria.

... in 2008 was founded the organization 350.org, aimed to build a global climate movement. 350 was named after 350 parts per million - the safe concentration of carbon dioxide in the atmosphere.

CLIMATE CHANGE AND GLOBAL ISSUES

"To be human means more than just to take up space that could otherwise be air."
John Steinbeck

Since the second half of the 20th century, humanity has been facing many environmental issues. As far as the atmosphere is concerned, we talk about climate change, global warming, greenhouse effect, acid rain, the ozone layer, and ground-level ozone. Are you clear on these terms?

Climate Change

By climate change, we mean the change in average atmospheric conditions (temperature and precipitation) due to the change in the chemical composition of the atmosphere, which is attributed to human activity. Droughts and subsequent flash floods increased average temperatures in winter, and fewer days of snow – these are just a few examples of climate change impact. Ski resorts operators or farmers are not happy either, as mild winters with no snow are followed by summers of pest infestations. The only positive thing about climate change seems to be that we use less energy for heating in wintertime – but our summer investments in air conditioning equipment will catch it all up anyway.

IMPORTANT

The landscape is changing. Every year, new temperature records are broken; rains are heavier; many areas that once used to be free from floods are flooded, while others are plagued by droughts. Climate change is the most serious and topical problem in the world today. While climate change is a natural process under normal circumstances, human activity and human impacts have made it much faster and more pronounced.

Climate change has also affected changes in plant and animal distribution. Although we may still have to wait a while until we see tigers in the wild in Europe, botanists and zoologists already register new species of fauna and flora in locations where they have never occurred before.

Even though (human-induced) climate change is the most pressing problem of the 21st century, its root causes can be traced back to much earlier times – particularly, the Industrial Revolution in the 18th century when humans started to burn fossil fuels and emit greenhouse gases into the air, which has led to changes in the chemical composition of the atmosphere.

FACT BOX

How to improve health and well-being in Europe by Tackling pollution and climate change? Read more about it.

The good news is that we can fight climate change. We should prevent burning fossil fuels since the cardinal problem of climate change is the excessive greenhouse gas emissions. To combat the consequences we will have to adopt measures of sustainable use of resources. For example, we should build efficient and sustainable irrigation systems and flood dams to help address the devastating droughts and floods as ones of the worst consequences of climate change.

FACT BOX

Schools, too, can contribute to reducing the impact of climate change through their local activities. A good example is the Maximilian Hell Primary and Secondary School in Štiavnické Bane, Slovakia, with its education process aimed at raising students' awareness of climate change. This is supported by exciting features on the school premises, such as a vertical garden (the first-ever vertical garden in Slovakia) they have built to explain the need of capturing rainwater through plants, with more gardens coming over time. Each garden represents a different ecosystem, e.g. alpine meadows, thermophile succulents etc. to help students learn about plants, the water cycle, the use of rainwater, and the way the entire ecosystems work. They have built a rainwater harvesting system on the school building to irrigate the gardens, which not only saves drinking water but also gives the plants better-quality chlorine-free soft water.

The school ensures all its students are in direct contact with nature, being the only school in the world to offer Falconry (linked to national cultural heritage) as part of its regular curriculum. The school is open to visitors in summer months, with the students showing off their falconry skills and working with the birds of prey.

The school runs several rescue programmes to save endangered bird of prey species, including the Saker Falcon, releasing the birds of prey into the wild as part of the event. It is also involved in some rescue programmes in cooperation with zoos. To learn more about the school, please visit their website.

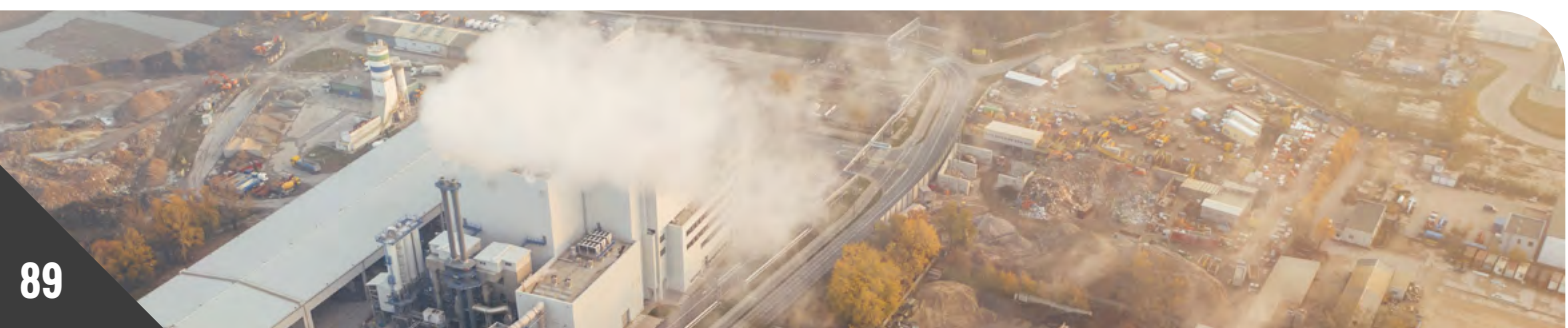
Global Warming

Emissions of greenhouse gases such as carbon dioxide (CO_2) are the cause of yet another environmental problem: global warming as part of climate change. Since the Industrial Revolution, the world's temperature has risen by about 0.8 degrees Celsius and CO_2 concentrations in the air have increased by 31 per cent.

As mentioned more detailed in part Energy (chapter Climate Change in Landscape), humans emit fossil carbon into the air since the Industrial Revolution. Although carbon has been present in the atmosphere long before, the biosphere had been able to cope and live with it for more than 200 million years, capturing it from the air, turning it into biomass and slowly storing it in fossil deposits - our current sources of coal, oil, and natural gas. By burning fossil fuels, however, the carbon from underground reservoirs is rapidly getting back into the atmosphere as carbon dioxide (CO_2) (and accompanied by emissions of methane (CH_4), mainly due to the extraction processes), causing a serious environmental problem.

Now if you think you are finally clear on the global warming terminology, let us make a little twist here and bring to attention some other opinions regarding the causes and effects of global warming. Some research reports indicate not only that CO_2 emissions cause global warming, but also that the widespread rise in temperatures can increase natural CO_2 emissions. This can happen due to the warming of the oceans which are the largest sinks of CO_2 as they contain about 93% of all free CO_2. Therefore, even the smallest increase in ocean water temperature can cause the release of large quantities of CO_2, since dissolved CO_2 in the water decreases its solubility as the water temperature rises and is released into the atmosphere. These hypotheses, however, are difficult to prove as the "ocean exchanger" responds to changes quite slowly - with the response time estimated at 800 years and more.

One way or another, the production and release of CO_2 into the atmosphere in the result of human activity is a huge environmental problem. This is why there are more and more urgent appeals to greener behaviour worldwide.



Greenhouse Effect

The greenhouse effect is often mentioned concerning global warming. It is a process of capturing long-wave radiation emitted by the Earth's surface by greenhouse gases - GHG (such water vapour, ozone [O_3], nitrous oxide [N_2O], carbon dioxide [CO_2], methane [CH_4], and chlorofluorocarbons [CFCs]). While this process is natural to some extent (without it, the temperature on Earth would be around -18°C on average), large amounts of greenhouse gases trap more heat in the atmosphere, increasing the average temperature of the oceans and air.

Acid Rain

The name "acid rain" is a very accurate description of the phenomenon, as the precipitation that falls on the ground is more acidic (i.e. with lower pH value) than it should be. The natural pH level of precipitation in Europe is about 5, sometimes even dropping down to 2.3, which is lower than that of lemon juice.
The main cause of acid rain is compounds of sulphur and nitrogen (especially sulphur dioxide or sulphur oxide [SO_2]) that originate in human activity, such as in transport or burning fossil fuels to produce electricity. These compounds undergo a chemical transformation in the air and, dissolved in water droplets, fall back to the ground in the form of acid rain.
Acid rain can disrupt the chemical balance in lakes and watercourses, increase soil acidity, accelerate corrosion, and damage trees and building façades.

INDICATORS

To learn more about Acid Rain, try the student research project "Acidity of the rain".

www.teachinggreen.eu

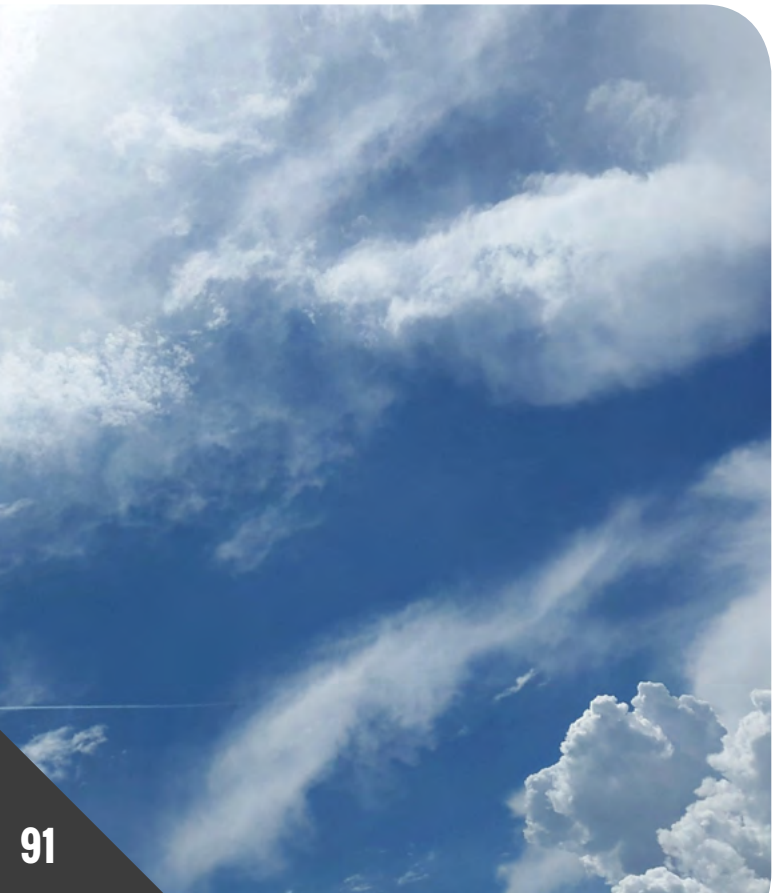
FACT BOX

To learn more about acid rain, its effects and causes, see the video Effects of Acid Rain. What did you learn from it?

Ozone Hole

Put in a simplified way, it is a hole in the ozone layer. To understand why the ozone hole is so dangerous, we need to understand what the ozone layer is in the first place.

To refresh your memory, the atmosphere is divided into five main layers: the troposphere, the stratosphere, the mesosphere, the thermosphere, and the exosphere. All our lives take place in the troposphere that extends to an altitude of about 11km, which is approximately where most of the commercial aircraft fly. The second layer, the stratosphere, extends up to about 50km above the surface - the altitude which is of our interest because it is here, on the top of the stratosphere, where ozone is concentrated to form a layer we call the **ozone layer**.



FACT BOX

To help students to understand how the layers of atmosphere work as barriers, try this funny demonstration from kidsactivitiesblog.com: How to teach your kids about Earth`s atmosphere.

The ozone layer is a region of the stratosphere containing a high concentration of ozone (O3). It acts as an invisible shield to protect us from the Sun's harmful ultraviolet (UV) radiation. At the same time, it allows for the Sun's life-giving light and heat to reach the Earth's surface. If all the ozone contained in this vital shield enveloping our planet could be assembled and concentrated to the maximum extent possible, it would form a tiny layer not more than three millimetres thick. Due to human activity, however, the fragile ozone shield is being damaged, with the CFCs and chlorine, fluorine and bromine compound being the worst culprits. The area where the ozone layer is most depleted (with ozone loss of more than 50%) is referred to as the ozone hole. At present, it mostly occurs at the poles, over the Arctic and Antarctica.

The harmful effects of the ozone depletion may not be evident at first sight. But researchers agree that the ozone hole is one

of the causes of severe health conditions such as skin cancer, cataract, weakened immune system, etc. Even worse, humans are not the only victims; UV radiation is equally harmful to plants and ocean plankton – which in turn affects the entire marine life.

To improve the situation, international talks and efforts are needed to reduce or stop CFC emissions. The good news is that the ozone hole has been shrinking since 2000 thanks to internationally adopted conventions (the 1985 Vienna Convention for the Protection of the Ozone Layer, followed by the Montreal Protocol on Substances that Deplete the Ozone Layer in 1987).

Ground-level Ozone

Ground-level ozone, also called tropospheric ozone, is the opposite of the life-beneficial ozone contained in the stratosphere. Ground-level ozone occurs just above the earth's surface and is dangerous to humans. It causes respiratory tract irritation and diseases, eye irritation, headaches, and increases the risk of asthma. Tropospheric ozone is not the result of direct anthropogenic emissions but is the result of secondary reactions between solar radiation and pollutants or volatile organic compounds present in the atmosphere. Increased ground-level ozone levels are observed on hot summer days in locations of high concentrations of exhaust gases from internal combustion engines, such as at city centre intersections and heavy traffic.

FACT BOX

More information about ozone depletion could be found in the report: NASA Reports Arctic Stratospheric Ozone Depletion Hit Record Low in March

DID YOU KNOW?

... About 20 per cent of all greenhouse gases produced worldwide comes from agriculture, forestry, and other uses of land.
... Climatologists use ice drilling in Antarctica to get data on climate change in the past. Ice drilling allows them to gain information on the state of the climate and the composition of the atmosphere over the past 800,000 years.
... The most acid rain ever recorded had a pH of 1.5 and fell in Wheeling, United States, in 1980. The respective record holder in Europe is the Scottish Highlands which recorded rain with a pH of 2.4 in 1974.
... September 16 was designated by the UN as the International Day for the Preservation of the Ozone Layer, or World Ozone Day for short. It is to commemorate the day when the Montreal Protocol on Substances that Deplete the Ozone Layer was signed in 1987.

ACTIVITY

Task the students to draw a poster on one of the environmental issues you have just read about. The poster should explain why the issue is an issue at all, or what the solution to the problem could be. Use the posters to stage an exhibition on the school premises. If time or space allows, the students can add short explanations to the issues depicted and present them to school students at the opening of the exhibition.

FACT BOX

For some inspirations for Environmental Science Projects, visit the Library on Education.com

SOURCES OF AIR POLLUTION

Air pollution may seem like a complicated issue. One that makes us feel like it may have something to do with us but there is nothing we can do about it. But this is not quite true. Understanding the causes and sources of air pollution and its impact on humans and the landscape can help us take steps to reduce it. Each one of us has a chance to lend a helping hand to improve air quality.

IMPORTANT

Agriculture, households, industry, transport, and municipal waste are considered the major sources of air pollution according to the EEA. None of us is protected from this kind of pollution. The danger of air pollution is that is it transmitted over long distances or even across continents. The pollution sources produce substances such as carbon monoxide, carbon dioxide, sulphur dioxide, nitrogen dioxide, nitrogen oxides, ground-level ozone, particulate matter, hydrocarbons, and lead. But do not worry, you don't need to remember all the oxides; all you need to know is that each one of them is harmful to human health.

FACT BOX

Watch a video about Air pollution in cities. What did you learn?

Agriculture

There are two main sources of air pollution from agriculture: number one, methane and ammonia production in livestock farming; number two, the incineration agricultural waste. Methane contributes to increased ground-level ozone levels and global warming. Do you wonder how you can do something about agriculture in this respect? It is easy: by way of the consumer. For example, you can eat less meat, or reduce food waste at least. Farmers, on the other hand, can reduce the amounts of methane by optimising animal food and improving grazing.

Households

Burning fossil fuels is the source of pollution in our households. Even though it is not you personally who does the burning of these fuels, someone else does for you so you can do your cooking, heat your home, or light your rooms. While the number of households with access to cleaner (and greener) fuels is increasing worldwide, there are still about three billion people to use solid fuels and open fires for cooking and heating. Do you know what exactly you use to heat your home? Hint: heaters are not the right answer...

Industry

Power plants burning fossil fuels, especially coal, are the worst contributors to air pollution. Other polluters include chemical and mining industries with their processes. The only thing that can change this unfavourable situation is national policies and programmes to increase the share of renewable energy resources.

FACT BOX

Watch a video about Air pollution from agriculture. What did you learn?

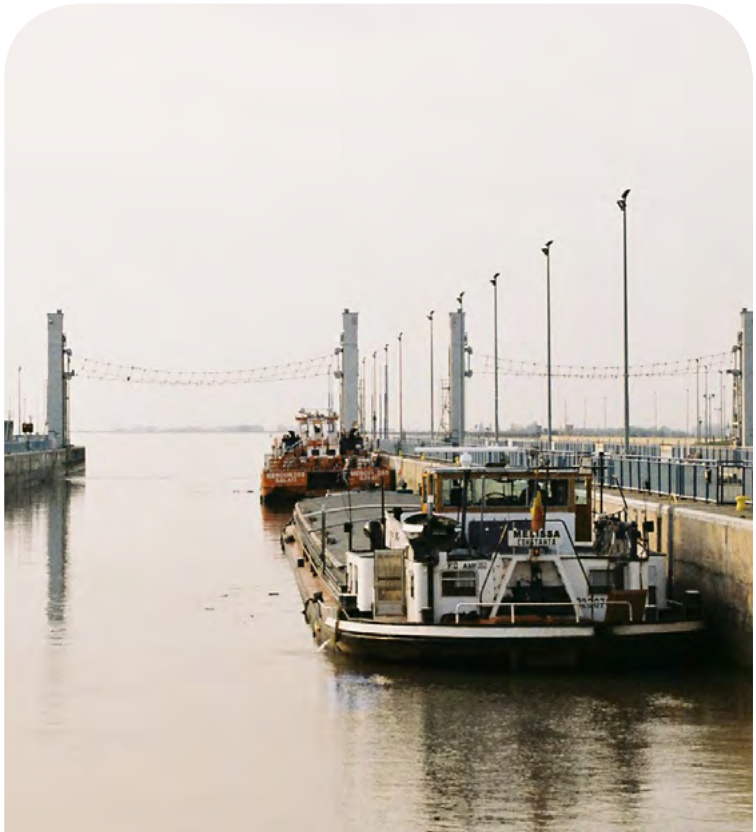
FACT BOX

Watch a video about How to Solve the Housing Crisis. What did you learn?

Transport

Transport is responsible for about one-quarter of the entire volume of carbon dioxide emissions and the figure keeps growing. An estimated 400,000 people die each year due to air pollution from transport emissions. Many experts see a way out of this in the emerging electric mobility and alternative fuels.

Noise is another transport-related issue that may cause serious health problems. One in five people in Europe is currently exposed to damaging levels of noise from transport (according to the European Environmental Agency, the report from 2020). Moreover, the impact of traffic noise is also present in the countryside, where up to 24 million Europeans are exposed to harmful levels of night traffic noise.



Municipal Waste

The incineration of waste in landfills is a source of toxic dioxins and other harmful substances that are released into the air in the process. It is estimated that up to 40 per cent of waste is incinerated worldwide in this way. Improving the waste collection, separating organic waste from municipal waste (and its transformation into compost or biofuels), as well as thorough separation and disposal of waste all reduce the ultimate amounts of waste that is incinerated and landfilled.

Recently, the World Health Organisation (WHO) has warned of health-threatening air pollution levels in large cities around the world. Just days into 2016, several European cities, including London and Paris, were clad in smog. Citizens were encouraged to change their behaviour by using public transport networks or "car-sharing" services to prevent the situation from worsening. Given specific weather conditions linked to climate change (such as extreme heats) coupled with high pollutant emissions, we can expect smog pollution incidents to occur more frequently and to hit multiple locations.

Air pollution damages the surrounding landscape. How?

- **Increased ozone concentrations** cause damage to crops. Southern, Central and Eastern Europe are among the most affected areas.

- Burning fossil fuels causes **acidification of the environment**, which harms all living things. Large amounts of acidic sulphur, nitrogen and carbon compounds are released into the air by burning. These react with water vapour contained in the air and fall back to the ground in the form of acid rain, damaging forests and crops.

- Nitrogen and sulphur in the air cause **eutrophication** in still and running surface waters. Eutrophication occurs when a water source becomes overly enriched with nutrients, which disrupts the natural balance and induces excessive growth of algae, causing the water to turn green. As a consequence, the water is deprived of oxygen which is needed by fish and other aquatic animals to live.

FACT BOX

Want to know how clean the air you breathe is in your town/city? Check the online European Air Quality Index service for more information and see an interactive map of local air quality.

DID YOU KNOW?

... Bioindicators are organisms that can help us detect the effects of harmful substances and pollutants in the environment. For example, excellent air quality bioindicators include lichens - unusual organisms consisting of both fungi and algae/cyanobacteria.

... Some lichens can live up to several thousand years. In Alaska, some lichens may be as much as 9,000 years old.

ACTIVITY

- Divide the students into groups. Read about the Štiavnické Bane school and their unique approach to climate change (see the story in the chapter above). Ask the students to get inspired by the ideas and to think about what could be done at your school to reduce the impact of climate change. Write and discuss their ideas together. Try and present the ideas to your school management to see if any of them could be implemented at your school.

- Do you know who the biggest air polluter in your region is? Visit the environment department at your municipal authority to get a list of the biggest local air polluters and learn of the steps the municipality is taking to protect and improve the air quality.

- Ask students to do internet research about airborne transmission diseases to learn more about healthy atmospheres and pathogens (bacteria, fungi, virus, etc.) affecting humans, animals and plants.. Some tips and prevention measures might inspire them to spread the word.

TRANSPORT OR THERE IS AN ALTERNATIVE WAY

You are driving your car, with your foot on the accelerator, amazed by the beautiful landscape stretching out in front of you. The trees lining the road are flickering outside the windows, and you don't even realise that while you are enjoying your moment of freedom, you are leaving a trail of burnt diesel or petrol behind you "hovering in the air". The price we pay for this freedom is too high – it is called polluted air. Not to mention the environmental damage caused by roads and motorways – when loads of concrete are poured over the fields when trees are cut down and hills are levelled to clear space for road construction.

You may say this tiny little car of yours cannot do that much damage. But hey, you may not believe it but you are not the only one in the world to own a car! About 30 million cars are produced worldwide each year, and there are now an estimated 350 million cars on the roads around the world. This makes transport by far one of the biggest air polluters, with road transport the unconquerable number one compared to air, sea, and rail transports.

FACT BOX

Considering that there are about 350 million cars worldwide and one car produces about 404 grams of CO_2 per kilometre driven (based on Greenhouse Gas Emissions from a Typical Passenger Vehicle), so for every kilometre, all cars in the world produce 141400 tons of CO_2! This is for one minute only (if the average speed is about 60 km / h.). How many millions of tons are produced in a whole day or year?

(Not only but also) Exhaust pollutants from transport are responsible for forest decline, acid rain, ground-level ozone, and the greenhouse effect. Despite introducing unleaded fuel, using catalytic converters and CNG(Compressed Natural Gas)/ LPG (Liquefied Petroleum Gas) power in motor vehicles, and reducing the number of exhaust gases, it is still not enough. Did you know that transport is responsible for nearly one-quarter of carbon dioxide emissions? Harmful levels of nitrogen oxide (NO_X) and particulate matter steadily exceed legal limits, especially near roads. Individual air pollutants can have different adverse effects on our health. Nitrogen oxides, particulate matter (PM), sulphur oxides (SO_X), carbon monoxide (CO) and heavy metals such as cadmium, lead and mercury enter the air with vehicle exhaust gases. Besides, these exhaust substances can react in the air to form ozone. With tires and brakes rubbing against the road surface, particulate matter and heavy metals are released and deposited on the road surface and then, by the action of moving vehicles, released into the air. It should not come as a surprise that all these substances are harmful to human health – with some of them affecting internal organs, some damaging the nervous system and blood, some causing lung diseases and respiratory problems, and some leading to heart attacks or asthma. Air pollution may even cause anxiety and fatigue or worsen the existing condition. Nearly 400,000 people die each year due to air pollution from transport emissions.

FACT BOX

If you are looking for some statistics about car emissions, visit the website of the European Parliament and the article: CO_2 emissions from cars: facts and figures.

Thankfully, burning fossil fuels is not the only way to ensure we can move from place to place to our liking. Today, there is a lot of talk about hybrid and electric cars as part of the alternative ways, widely seen by carmakers as the future of mobility for the years to come, while hydrogen power is hoped for the more distant future. The advantage of hydrogen is that it occurs in water (and in space!) in almost infinite amounts. When hydrogen reacts with oxygen, energy is released and water is formed, which means the only thing emitted by a hydrogen-powered car is water vapour. Despite the great idea, we still face a major challenge in how to obtain hydrogen from water. So far, this is only possible in labs by photolysis (i.e. a process by which molecules are broken down into smaller units through the absorption of light). We can only hope the future will allow for using this method on a large scale as part of mass production.

FACT BOX

If you want to go deeper into hydrogen theme, see the video Hydrogen - the Fuel of the Future?

Renewable fuels and electric mobility may not be the only solutions to reduce air pollution from traffic. Better management of the resources available could be another option. Take a passenger car versus public transport, for example. The car is the winner for many due to its comfort and convenience. Nevertheless, public transport is far more fuel-efficient (in terms of the number of people transported) and less harmful to the environment.

IMPORTANT

The most economical way to travel without adding to air pollution is - guess what - biking. The bike is only powered by the energy we get from our full stomachs (to be read as muscles). Building bike paths and cycling routes, especially in cities where you move in a matter of a few kilometres, is a cheap way of reducing air pollution and also solving the issue of everyday traffic jams.

There is a great concept of public bike share schemes in place in many cities across Europe today. How about your town/city – does it support the use of bikes in place of cars, or a public bike share scheme, or the creation of bike paths and cycling routes?

ACTIVITY

- Think about what would happen to oil companies and diesel/petrol retailers if hydrogen-powered cars were available at affordable prices.
- Task the students to map cycling routes in and around your town/city. Take a trip together to an exciting place taking one of the routes - it will help improve the air quality and your health.

INDICATORS

To learn more about the impact on air pollution of your trip to school by car, bike or public transport, try the research project "Greenhouse Gas (CO_2) Production".

www.teachinggreen.eu

DID YOU KNOW?

... Experimental hydrogen-powered cars have been used in Germany since 1984.
... The beginnings of bike-sharing in Europe go back to the mid-20th century. Amsterdam, the Netherlands, was among the first to introduce bike renting in 1965. However, the system suffered from theft and vandalism back then.

WHAT CAN WE DO?

You don't need to fight for the entire planet if you don't want to. At least fight for yourself.

Air pollution may seem like a complicated issue to solve, but we all can do something to reduce it. Understanding the different sources of pollution and how it affects our health and the environment can help us take steps to improve the air around us.

If you still believe there is nothing we can do about harmful emissions or that the issue has nothing to do with us, you are wrong. Check the table below to see how many grams of CO_2 emissions per hour are released by the following household appliances or pieces of equipment:

IMPORTANT

We all have the right to breathe clean air. What we breathe affects the quality of our lives. Reducing air pollution will reduce the risks of cardiovascular diseases, lung cancer, and chronic respiratory diseases including asthma. Isn't that worth the effort?

FACT BOX

Watch a video for kids on The Causes, Effects and Solutions of Air Pollution. What did you learn?

Appliance / Equipment	Power (in watts)	CO_2 Emissions (in grams per hour)
60W Light Bulb	60	8.52
Energy Saving Light Bulb	11	1.56
TV set	300	43
Tower Stereo	500	325
Computer	360	234
Vacuum Cleaner	2,000	284
Electric Kettle	300	42
Microwave Owen	2,100	290
Washing machine	3,000	426
Dishwasher	3,000	426
AC	5,000	710

Source: www.krotiteliaenergii.sk

TAKE ACTION

Going back to the old-fashioned way of washing your clothes in a stream is certainly not an option. But there are still plenty of options for you to reduce air pollution or at least not add to the existing condition. Get inspired by the following 15 tips:

1. Switch off electrical appliances instead of leaving them on standby when not in use (e.g. TV, computer).
2. For electrical appliances used in 24-7 operation, such as refrigerator, invest in a more economical option. As a rule, your investment will return within a year.
3. Turn off the lights when you don't need them on, especially when using conventional light bulbs.
4. Replace conventional light bulbs with LEDs.
5. If you are planning to buy a stove, prefer an induction-hob type to a ceramic-hob model - it will save you up to 40 per cent of energy.
6. Open the fridge and freezer less frequently than you are used to - it will save you a couple of watts. Moreover, you will please the air and your body.
7. Do not switch on the dishwasher, washing machine or dryer until they are full.
8. Prefer environmentally-friendly cleaners and detergents.
9. Instead of using a car, use public transport or a bike - or just opt to walk. Make at least one day a week your "car-free day", and make that day your family tradition.
10. Keep your car in good condition and follow the regular maintenance schedule.
11. Prefer an alternative-powered car. Electric or hybrid models are a good choice. Even a CNG/LPG power is a better option than the conventional petrol or diesel internal combustion engines.
12. Plant oxygen-producing trees and plants. Support green zones in your area.
13. Prefer local produce to imported one.
14. Engage in local policy-making and raise awareness of the need to breathe clean air.
15. Convince your family and friends to join your efforts for better air quality.

DID YOU KNOW?

... According to the European Environment Agency (EEA), air pollution is the most common cause of premature death in 41 European countries.
... 9 out of 10 people worldwide breathe polluted air.
... On average, one hundred trees can "cope with" 5 tonnes of atmospheric CO_2 and about 500kg pollutants per year, including about 200kg of ozone and 150kg of dust particles.

ACTIVITY

Choose any of the above tips to improve air quality and agree together to strictly follow them for one week (or month, or whatever length of time you choose). Before starting to reduce CO_2 emissions, make a calculation or estimate as to how much CO_2 emissions are released into the air when doing what you intend to stop doing. When finished, calculate how much CO_2 emissions you have reduced compared to the weeks before. Make a joint resolution to adhere to at least one of the emission-reduction tips for a longer period (e.g. one school year). Either each student chooses their own of what they intend to follow, or all of you as a group can make a joint agreement on activities of your choice. Ask the students to write a letter to their future selves on their resolution. Collect when done. After some time, give the letters back for the students to read and judge how they manage to keep their resolutions.

THEME 5: ENERGY

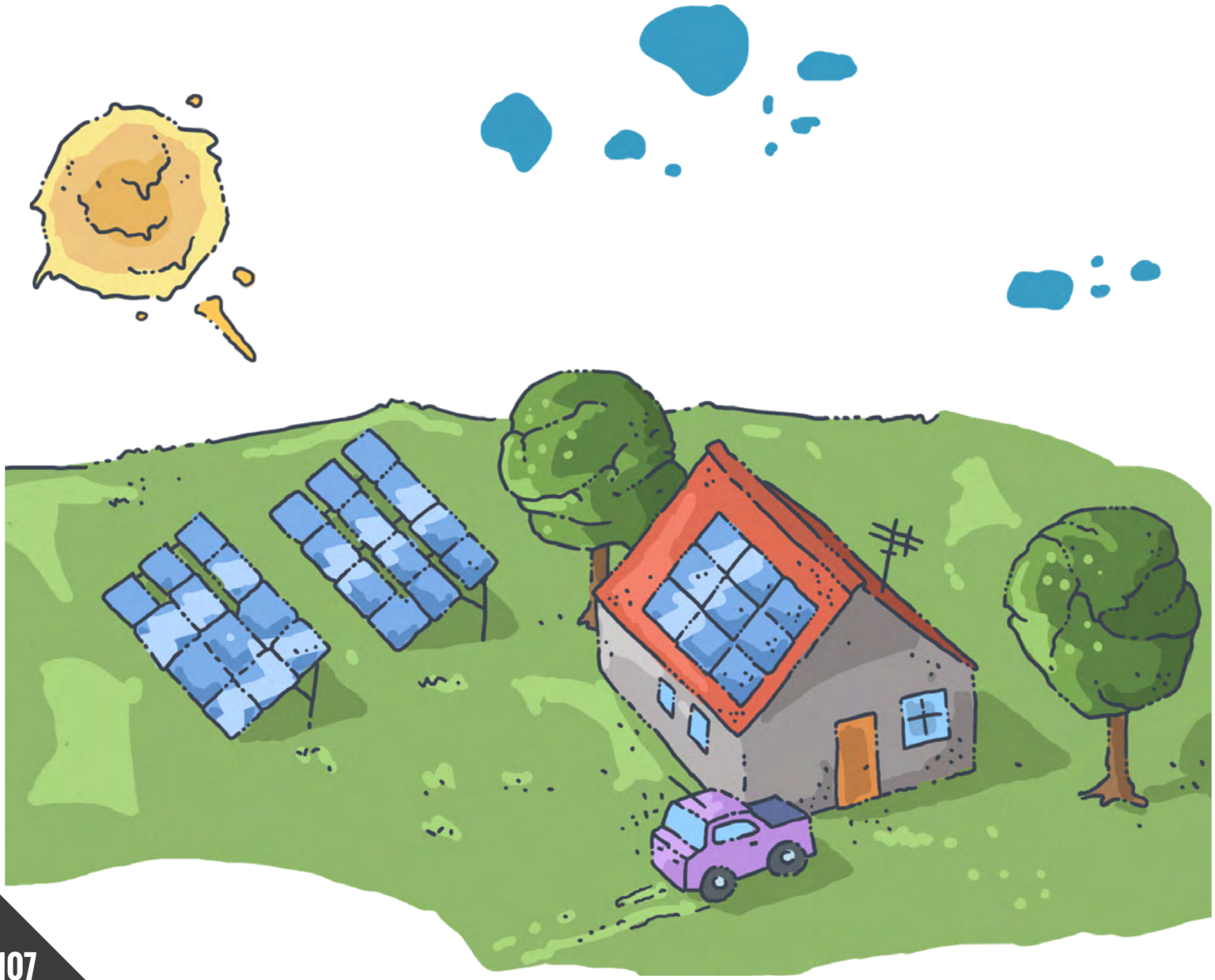
Landscape and Energy

Renewable vs. Non-renewable Energy Resources

Climate Change and Energy

Food as Energy

Household Energy Consumption



LANDSCAPE AND ENERGY

The surrounding landscape provides us with the resources and raw materials we need for our everyday lives. Without them, we would have nothing to eat and no house for shelter; we would be unable to travel and have no way to get warm or turn on the light. We (and all living systems too) need the energy to get and extract and process the resources. But how do we all get it? Again, nature and the landscape are here to help and offer solutions; we find the necessary resources beneath our feet as coal, crude oil, or natural gas, and above our heads in the form of sunlight and the wind. Some of them are naturally renewable, some are not. So many resources at hand – just make your choice and use them wisely and equitably.

IMPORTANT

The landscape provides us with energy or resources to produce it. Energy production and consumption is an immense burden for the environment, entailing emissions of greenhouse gasses and air pollutants, soil degradation and use, waste generation and oil spills. This burden has its share in climate change and global warming, damaging natural ecosystems and affecting human health.

Renewable energy resources are natural resources that can be naturally renewed. They include sunlight, wind, watercourses, sea waves and currents, hydrogen and geothermal heat. Their big advantage is they do not impose a burden on the environment. In the past, people tended to use the natural energy resources – for example, solar energy was used in passive architecture or for heating dark water containers, while biomass had (as with firewood or animal faeces) been used for a very long time. There has been little change in utilising the wind and water power in traditional mills, except that our focus today is more on producing electricity than using mechanical power.

Sadly, most of the energy produced today comes from non-renewable resources such as coal and natural gas. And this is the catch; once they are depleted, we will not be able to use them anymore. The tragic part is that the Earth's non-renewable energy resources are being depleted too fast. If we do not take immediate action to ensure that our energy needs are met through alternative energy resources, civilisation as we know it will collapse. This is why governments, scientists, and environmental organisations from all over the world emphasise sustainable development. This means for us not to deplete all of the available resources for ourselves but to leave sufficient resources for our children and their children's children. Ensuring enough energy for the ever-growing population of the planet while taking into account the diminishing of non-renewable

energy resources and keeping a friendly eye on the environment and the landscape, we must not only reduce energy consumption but also look for alternative ways of producing energy.

Have you ever heard of the "Earth Overshoot Day"? Every year, the Global Footprint Network announces the date when the world and individual countries begin to live on ecological debt. In 1970, the date was the 29th of December. As of that day, we depleted all the natural resources that the biosphere is capable of renewing in one year, meaning we exceeded our ecological footprint and began to live on ecological debt for the rest of the year. If the Earth Overshoot Day was the 29th of December in 1970, now consider this: in 2019, humanity started to live on ecological debt as early as on the 29th of July! The breakpoint comes earlier and earlier every year. And our continued use of fossil fuels has a huge share in this. When do you think the Earth Overshoot Day stops counting?

FACT BOX

If you want to know more about the state of the environment in Europe, visit the website of the European Environmental Agency and their State of the Environment 2020 (SOER 2020).

INDICATORS

One of the methods of measuring the human impact on the planet Earth is measuring the Ecological Footprint. To learn more about your own ecological footprint, check out the student research project entitled "Ecological Footprint".

www.teachinggreen.eu

ACTIVITY

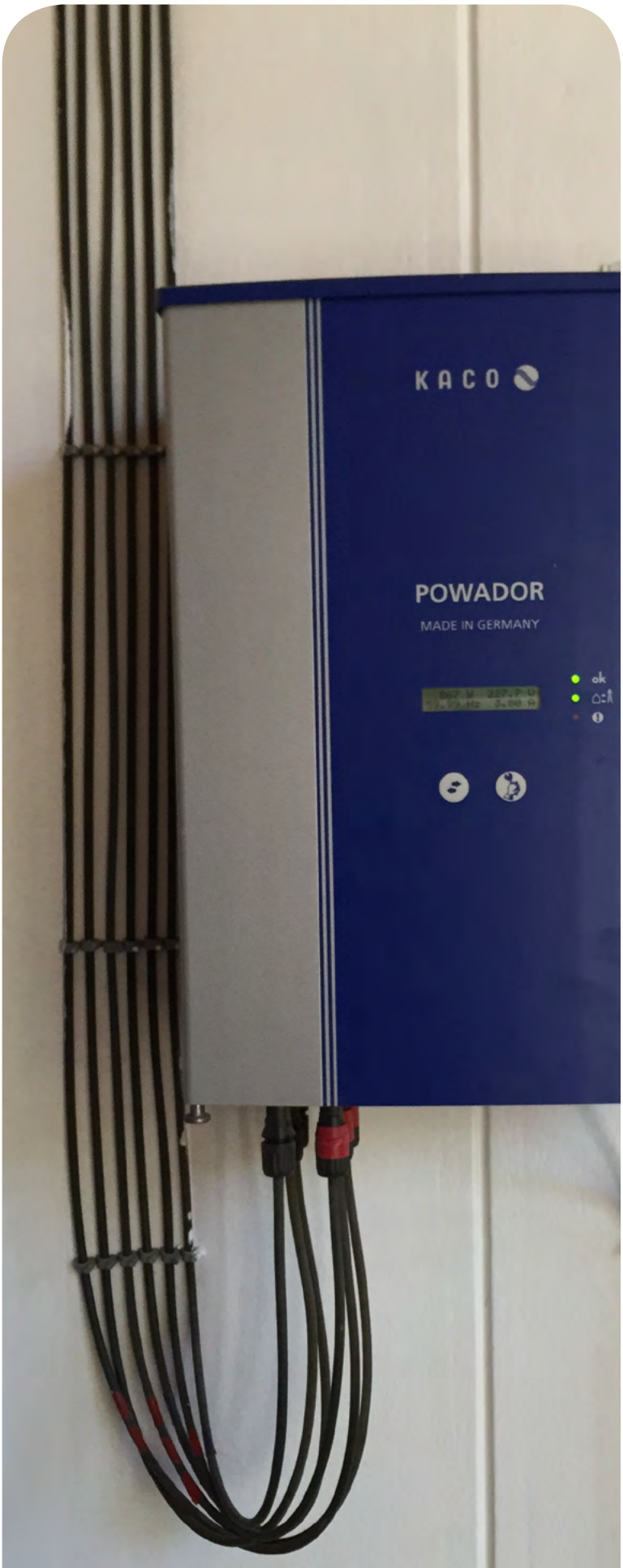
Imagine your ordinary day and write down the activities you do in the course of the day. Then try to imagine what your day would be like if you had no access to electricity. Compare the two days.

Ask your parents or grandparents how they used to spend their evenings when there was no electricity in their homes, let alone the TV or the Internet. Did they play any games? Come together and play some of them. Can you imagine spending one evening a week like this?

Find out if there are any ways in which renewable energy sources are used in your neighbourhood. If possible, make an appointment with the relevant facility manager to see how much energy they produce per week.

DID YOU KNOW?

... Energy is indestructible. As stated in the Law of Conservation of Energy, energy cannot be created or destroyed; it can only be redistributed or transformed in form.



RENEWABLE VS. NON-RENEWABLE ENERGY RESOURCES

Energy resources provided by nature are limited. We do not know their exact amounts but at least we can make a guesstimate.

Today, most of the energy consumed worldwide is produced from fossil fuels, which is not sustainable in the long run. It is a question of time as to how long we will be able to live on fossil fuels. Our dependence on energy drives us to look for other sources. Let us take the Sun for instance; the energy the Sun sends out to Earth every hour equals the amount of energy that fossil fuels produce per year. And the Sun will keep doing this every year, year by year, for as long as it exists - which scientists believe will be for the next five to seven billion years.

FACT BOX

For more data about e.g. fossil fuel consumption, read the article Fossil fuel.

It is estimated that our fossil and nuclear fuel reserves are currently at around the same level as we have already used up. It may seem like a huge amount, but we must realise that energy consumption keeps increasing. There are several estimates of how much fossil and nuclear fuel reserves are there in the world, of which the following are the most cited (Smrž, 2018):

Energy carrier	World reserves available to be used (in years)
Oil	35-45
Natural gas	55-65
Coal	150
Uranium	45

Future generations may no longer be able to benefit from the energy reserves that have accumulated on the planet for over two billion years. If you believe there must be something in there, that there must be some hidden resources found somewhere in the foreseeable future, well, you may be right. Something may be found indeed – but nobody knows how much it will be. We all have this dire gut feeling that the gap between the global fossil fuel supply and demand will only grow bigger and bigger.

FACT BOX

There are several scenarios worldwide for the future of energy. To find out more details, read these 4 most likely scenarios. Which of them are sustainable?

Nevertheless, we are lucky to live on this ever-changing, dynamic planet, at a safe distance of 150 million kilometres away from the Sun – by far the greatest source of energy. Did you know that the Sun provides us with 8,000-times more energy than humanity is capable of consuming right now? And we mean not only sunlight but also other forms of energy derived from it, such as the energy of running water, wind, and heat from the surroundings, etc.

As you must have noticed, we use the concepts of **renewable and non-renewable energy resources**. Let us make a quick recap, and then explore further: if a source of energy is being depleted by being used, we call it non-renewable energy. If the source is essentially not depletable, meaning it is renewed after being used, we call it renewable energy.
Renewable energy resources are all around – the sun, the wind, water and heat from the Earth's crust. People used them long before discovering coal and oil. Nevertheless, it is not the renewable resources that matter to us most today; sadly, it is the non-renewables such as coal, oil, natural gas, oil shale, or tar sands, i.e. the fossil fuels

that are considered the most important raw materials for energy production today. Nuclear fuels are widely used, too.

The nineteenth century saw a breakthrough in energy production when the first coal-fired power plant was launched in New York. Kerosene and oil refining were discovered, triggering the development of the oil industry. Coal gas was increasingly used to illuminate the streets and outdoor areas. Rudolf Diesel invented his diesel engine. Henry Ford introduced production lines, contributing to the motorisation of society. Sunlight, water, and the wind, previously used as energy resources, increasingly receded into the background. Even their long history of successful use did not help - into oblivion went the watermills that had been in use since as back as the third century or the underfloor geothermal heating system known in the baths of ancient Romans. Our dependence on energy, the exhaustibility of fossil fuels, the increasing carbon emissions, and the negative environmental impact of fossil fuel combustion - all these force us look for alternatives.
In 2018, renewable energy accounted for 18.9 per cent of the energy consumed in the EU, with 20 per cent set as the 2020 target. But there are significant differences between the individual EU Member States. The countries leading the way in using renewable energy in Europe include Sweden, Finland, Latvia, Denmark, but also Montenegro and Albania. In Sweden, for example, renewable energy accounts for more than half of the total energy consumed. In Spain and Italy, renewable energy is used in more than 10 per cent, in Slovakia 12 per cent, in the UK 11 per cent, while the Netherlands only use 7.4 per cent. Wind energy is one otf the most important renewable energy resources today. (Source: Eurostat statistics)

IMPORTANT

The use of renewable energy resources not only helps in fighting climate change by reducing greenhouse gas emissions but also leads to increased safety and greater diversity of energy supplies, less air pollution, and new job creation in the departments of the environment and renewable energy resources.

Let us examine selected renewable and non-renewable energy resources and their impacts on the environment and landscape, including their pluses and minuses:

Energy Resource	Pluses	Minuses	Impacts on Environment and Landscape
Coal	The most accessible fossil fuel	Produces 43% of the world's CO_2 emissions, fly ash, and nitrogen oxides (NOx); causes respiratory diseases in densely populated areas; NON-RENEWABLE RESOURCE	Significantly contributes to climate change; causes the greenhouse effect by emitting greenhouse gases; combustion emissions contain toxic mercury
Oil	Extremely high energy density; suitable to produce fuels and electricity; important raw material for the chemical industry	Demanding on transport - construction of oil pipelines is economically demanding and mostly limited to land; NON-RENEWABLE RESOURCE	Combustion of oil and petroleum products is the most significant source of anthropogenic emissions, including greenhouse gases; dependence on oil incites conflicts to control its resources; frequent oil spills lead to environmental disasters
Natural Gas	A high-value fuel; used in the chemical, rubber and printing industries	Gas imports make electricity more expensive; costly pipelines and maintenance: NON-RENEWABLE RESOURCE	Combustion of natural gas creates carbon dioxide which contributes to the greenhouse effect
Solar Energy	The most powerful and safe energy resource available all year round; RENEWABLE RESOURCE	Solar energy is hard to store; the amount of energy made by solar panels depends on the number of sunny and cloudy days; low power density; high acquisition costs	Does not produce emissions or harmful gases; does not consume scarce resources; clean, noiseless, and long-term systems; Silicium sources hoarding by Solar panel manufactures
Wind Energy	Clean energy; does not consume scarce resources; relatively cheap and fast construction and connection to the public grid; RENEWABLE RESOURCE	Low energy content per unit of volume; variability of power depending on wind speed and direction; also depends on the weather and season	Does not produce emissions; source of higher noise levels and visual disturbance of the landscape as a result of tall turbine masts; dangerous to small aircraft and birds; use of marine zones as energy production areas

Hydropower	Hydropower plants have a long service life (over 70 years); RENEWABLE RESOURCE	Change of physical and chemical properties of water; high initial investments in power plant construction; lengthy return on investment (around 15 years)	Disrupts aquatic ecosystems as a result of built-up areas; creates barriers to aquatic animals but does not produce emissions; transforming the whole natural dynamics of the territory
Biomass	Creates jobs in collecting, processing and using biomass; revives local economy; rural economic development; RENEWABLE RESOURCE	Produces greenhouse gases; targeted monoculture planting	Negative impact on the biodiversity of an area due to monoculture cultivation
Geothermal Energy	Clean energy; does not produce emissions; provides enough energy to cover our consumption for up to several thousand years; RENEWABLE RESOURCE	Boreholes deeper than 5km are costly and demanding in terms of geothermal energy technology	The pumped out thermal water has a high content of minerals and cannot be discharged to surface waters
Wave Energy	Clean energy; high power density; RENEWABLE RESOURCE	High transmission costs; missing electrical infrastructure to deliver the energy to end-users	Impact on marine ecosystems, risk of fish and mammals being struck by the turbine; electromagnetic fields` effects
Hydrogen	Hydrogen is versatile; technologies to produce it already available; it can be transported as a gas by pipelines or in liquid form like liquefied natural gas (LNG), can be transformed into electricity and synthetic methane or fuels; RENEWABLE RESOURCE	Producing hydrogen from low-carbon energy is costly at the moment; the development of hydrogen infrastructure is slow and holding back widespread adoption; Hydrogen is almost entirely supplied from natural gas and coal today; Regulations currently limit the development of a clean hydrogen industry.	Build on existing infrastructure, such as millions of kilometres of natural gas pipelines. The IEA's Sustainable Development Scenario estimates that roughly 2,000 CCS facilities are necessary by 2040, up from 18 today, to limit global warming. Currently, four of those 18 CCS facilities produce hydrogen.

Sources: Smrž (2018), The sources of Hydrogen [online], Hydrogen isn't the fuel of the future. It`s already here [online], Wave power [online]

As seen from the table above, using renewable energy resources has many advantages, including reduced greenhouse gas emissions, diversified energy supplies, and reduced dependence on fossil fuel markets (oil and gas in particular). Also, the growing use of renewables has the potential to increase employment by creating new jobs in green technologies. Now, you may be wondering why the share of renewable energy resources in total energy consumption is increasing so slowly. There are many reasons but most of them are economic; they include high investment costs, lengthy return on investment, energy capacity, and the lower purchase price of fossil fuels. It is a paradox considering that most of the renewables are unlimited and free of charge, isn't it?

ACTIVITY

Divide the students into pairs. Invite them to prepare arguments for the energy resource of their choice - one member of the pair takes a renewable resource, the other one takes a non-renewable one. Introduce the following situation: You are at a European Union summit that is to decide on which energy resources to use in the years to come. You have 30 seconds to convince them that the source picked up by you is the best one to be used.

The students present their arguments in front of the class, highlighting the pros of using the given energy source. Then the classmates decide which of the pair offered stronger arguments to convince them about their position.

FACT BOX

In 2020, the coronavirus alerted us not only to how we pollute the environment but also to how dependent we are on energy. Learn more from the article Coronavirus has reminded us how much we depend on electricity.

DID YOU KNOW?

... The 14th century England could see for itself that coal is "depletable". Exhausted open-cast coal mines had to be laboriously drilled and dug deep into the underground. The ensuing serious problems with water drainage and the hard manual work underground were alleviated and facilitated by the steam machine in the 18th century.

... In the UK, the share of electricity produced from hard coal dropped to 5 per cent in 2018 compared to 40 per cent in 2012.

... Hydrogen can be produced from a variety of sources, a fact that confers both security and diversity of supply. Natural gas reforming (SMR) provides half of all hydrogen produced globally. Electrolysis, a process in which excess clean energy produced from renewable or nuclear is used to produce hydrogen, become important as a form of energy storage and will enable greater integration of renewable.

CLIMATE CHANGE AND ENERGY

Over the past decades, nature and landscape had to cope with several climate changes. Extreme rainfall is a harbinger of ensuing floods, with "one-hundred-year flood" events often seen in places unaffected by floods before. Other places are plagued by long-term droughts which are often the herald of devastating fires. The average annual temperature has risen significantly over the past fifty years. Various climate models predict different scenarios of what may come. But there is one thing we all agree on: that the increase in average temperature may trigger devastating phenomena we cannot even imagine right now – not to speak about mass migrations of the population. According to experts, one of the main causes of these changes is attributed to the complex process called global warming which is still not fully understood.

Do you know what the year 1769 and global warming have in common? You may say there is nothing in common at all, as people didn't have a clue about a "global warming" back then. In a way, you may be right. They didn't. But! But something happened in 1769 – and history knows it as the First Industrial Revolution. In 1769, James Watt patented his steam engine. This event is seen as the true start of this Revolution and the ensuing use and combustion of fossil fuels (MacKay, 2012).

IMPORTANT

As seen from the above, man has a significant effect on CO_2 concentrations in the atmosphere. As CO_2 is a greenhouse gas, its increased amounts in the atmosphere enhance the greenhouse effect - by absorbing infrared radiation (heat) emitted from the ground and then trapping it in the atmosphere, preventing the escape of heat from Earth's system, overheating the atmosphere as a result. Most CO_2 emissions come from burning fossil fuels for energy. Therefore, to tackle the issues of the greenhouse effect and global warming, we need to find new ways of getting energy. The climate change problem, above all, is an energy-use problem mainly.

Today, the combustion of fossil fuels (in particular of coal) is the main cause of the global increase in CO_2 concentrations in the environment. In fact, no one knows exactly how much CO_2 has been released into the atmosphere for the past 200 years.

Sceptics say it has been much less than the amount produced by nature itself, i.e. the biosphere and the oceans. Yes, the natural CO_2 flows into the atmosphere may be higher than those produced through fossil fuel combustion by humans. But it is misleading to focus solely on the CO_2 flows into the atmosphere without mentioning about the same amount of CO_2 flowing from the atmosphere back into the biosphere and the oceans. For example, marine phytoplankton is a true expert in consuming atmospheric CO_2. In fact, CO_2 flows out into and back from the atmosphere have been balanced for centuries, meaning it is not important to talk about how much CO_2 the two systems had exchanged - as they were simply balanced. The problem came with new releases of CO_2 into the atmosphere by burning fossil fuels because this caused the balance to be disturbed.

Do you still feel the climate change issue is too far away and has nothing to do with you? Let us take a closer look then.

In recent years, temperatures in Europe have increased due to climate change. Sweden lost its highest peak as a result of global warming; the ice-capped southern peak of the country's tallest Kebnekaise Mountain has shrunk by 24 metres due to ice melting in the past five decades. The rocky northern peak of the same mountain is now Sweden's new highest mountain top. In 2014, Iceland held "funeral" for its first-ever glacier lost to climate change. The once huge Okjökull glacier with an area of 15 km^2 melted completely in the 20th century. Also melting is the snow on the Alps, while Greenland`s ice and snow is disappearing before our very eyes.

Climate change and global warming are responsible for a significant slowdown in the Gulf Stream by 15 per cent (source: The Gulf Stream system is slower for climate change). The Gulf Stream is driven largely by differences in seawater density. Let us refresh the basics of physics and chemistry. Warm, lighter water flows from south to north where it cools off and becomes denser and heavier. It then sinks into deeper layers and flows back to the south. Global warming triggers more rainfall over the North Atlantic and its shores, causing more fresh water to flow into the ocean. Moreover, melting ice in the Arctic dilutes the waters of the North Atlantic, reducing the salt content. The low-salt water has a lower density and is, therefore, less heavy, which means it is not pushed into the depths from the surface so quickly. If we fail to stop global warming, the Atlantic Ocean currents will continue to slow down.

It is hard to estimate the impact on (not only) Europe of a greater slowdown in the Gulf Stream and other climate changes. Climate change experts have worked out various scenarios of what may come. Let us touch on some of them below:

FACT BOX

The connection between melting glaciers and rising sea levels may not be a distant future, it is already happening. For details read the article „Greenland's melting ice raised global sea level by 2.2mm in two months".

- Worldwide, the greenhouse gas concentrations in the atmosphere are estimated to increase dramatically by 2100, with CO_2 likely to increase by 100 per cent by around 2060;
- In addition to global warming of an estimated 2.0 to 2.5 degrees Celsius by 2100, a change in general atmospheric circulation patterns with frontal zone shifts is considered to be the most serious consequence of this development;
- The current climate change rate is ten times higher than all climate change events in history;
- An extreme scenario for 2100 assumes an increase by up to 5.8 degrees Celsius of the global average air temperature in the ground-level atmosphere.

(Source: Climate change and its possible impact on the soil in Slovakia)

While there are many human activities involved in greenhouse gas emissions, energy use is by far the largest contributor. If someone tells you that even methane emitted by belching cows has its share in global warming – believe them, it is not a joke. By comparison: In 2000, agricultural by-products actually accounted for about one-eighth of the world's total greenhouse gas emissions, while energy use accounted for up to three-quarters of the total amount.

FACT BOX

Interested in more scenarios on how will the world`s climate change in the coming century? Read the special report Emissions Scenario from IPCC (The Intergovernmental Panel on Climate Change, 2018).

As we have said above, the problems of climate change, global warming and the greenhouse effect are obviously an energy-use problem.

FACT BOX

More information about releasing the methane into the atmosphere could be found in article Methane, explained.

ACTIVITY

Search the Internet to find more about what kind of activities contribute to global warming in addition to energy use. Have you found an activity in which you are involved as well? How could you reduce your impact on global warming?

DID YOU KNOW?

... The main greenhouse gases include carbon dioxide (CO_2), methane, and nitrous oxide. As each of them has different physical properties, as a rule, total greenhouse gas emissions are stated in CO_2 equivalents.

... Carbon dioxide is the main long-lived greenhouse gas in the atmosphere. Concentrations reached 405.5 ppm in 2017, 146% of the pre-industrial era (before 1750). (Source: Greenhouse gas levels in atmosphere reach new record)

... Between 1750 and late 2003, CO_2 concentrations in the air increased by 34 per cent, while methane concentrations soared by 151 per cent.

... The first systematic meteorological observations were made by network issued by the Granduca of Tuscany and then, from 1657 by the Accademia del Cimento in Florence, Italy, in 1654. Unfortunately, the Accademia didn't last for more than ten years.

FOOD AS ENERGY

Energy is all around, and we need it for everything we do. Food is the most important source of energy for humans (and all living creatures). The human body is highly capable of utilising the energy - transforming it to thermal energy to keep us warm or mechanical energy to keep us moving. Even in moments when we are seemingly doing nothing, such as while sleeping or relaxing, the body still needs energy - for breathing, heart activity, brainwork, or digestion. If you see your neighbour lying motionless by the pool sunbathing, it does not mean they do not have enough energy to do something more active - in this case, the lack of energy is not the culprit.

There is an old proverb saying: "We eat to live." Food is fuel for the body, and what we eat affects the amount of energy we have available during the day (or "We are, what we eat."). It is natural for the body to use fats as a long-term source of energy. Carbohydrates are ok too, but deep down: in this day and age, we really overdo it with carbs and simply eat way too much of them - and from unhealthy sources!

When digesting individual food components (carbohydrates, fats, and proteins), these nutrients are broken down in the digestive system into simpler components (monosaccharides, fatty acids, and amino acids) which the body can make better use of to gain energy and the necessary "building blocks".

IMPORTANT

The amount of energy we get from food is not only dependent on the amount of food taken in. Fat-rich foods, fast foods, added sugars or alcoholic beverages are a great source of energy too - even containing so much energy that it cannot be utilised in one day - but this is not a healthy way of getting energy. If the body takes in more energy than it is capable of using, the excess amount is stored in fat cells as fat. This is why we should not opt for this type of food as our first-choice food and limit its intake.

Vitamins and minerals themselves are not sources of energy. However, nutrient-rich foods help the body to work and utilise as much energy as possible from the food taken in. For example, vitamin B12 plays a major role in transforming food into energy. When our body lacks B12, we cannot fully utilise and extract the energy from the food nutrients, vitamins and minerals we take in. Interestingly, vitamin B12 is found almost exclusively in animal foods.

Group B vitamins are found in relatively high quantities in fruits, legumes, eggs, meat, fish, and vegetables. This means they tend to always be present in a varied and balanced diet in which we rarely come across their deficiency. However, if we have a croissant for breakfast, a hamburger for lunch, and some sausages with mustard and white bread for dinner, the B vitamin deficiency is very likely to occur.

Minerals, including iron and magnesium, play an important role in the body, helping it to function properly, supporting the bodily processes relevant for energy production, and helping in reducing fatigue and exhaustion.
For reference, below are listed some of the top healthy food ingredients that will provide you with energy and keep your blood sugar levels under control - and you can even mix and match them to your liking.
(Source: 20 TOP foods that give you energy)

- Lentils
- Buckwheat
- Quinoa
- Oats
- Beans
- Sesame seeds
- Chia seeds
- Cannabis seeds
- Almonds
- Walnuts
- Cocoa
- Coconut oil
- Blueberries
- Goji
- Avocado
- Winter cabbage
- Beetroot
- Spirulina
- Eggs
- Broccoli
- White yoghurt
- Salmon
- Spinach
- Pumpkin and sunflower seeds
- Fresh seasonal fruits and vegetables

Our daily bread...

Now that we have learned about food ingredients, let us take a closer look at what we actually eat. Let us start with bread.

In the past, people ate whole-grain bread. Bread began to be eaten some 10,000 years ago, in the beginnings of grain cultivation and continued to be eaten on in a more or less the same way for the next 8,000 years. In those times, bread was essentially made of wheat, barley, or rye. Grain was ground in between two stones, which helped nearly all the nutrients contained in the grain get into the bread. Some 150 BC, bakers in ancient Rome changed the bread-making method and started using ground wheat flour sifted through a canvas, virtually removing all the beneficial nutrients except the fine-grained wheat starch. Starch contains most wheat-grain calories but no proteins or essential fatty acids. It only contains one-fifth of copper and hardly any manganese, zinc, magnesium or other trace elements indispensable to our health. And it has no E or B vitamins either. White bread has always been attractive (especially in appearance), just like many processed foods of modern times. Rich ancient Romans got fond of white bread because it looked white and clean. Now compare the whole-grain bread and the white bread - which of the two provides us with more energy and more good stuff for the body?

Most of the (not processed) foods we see in supermarkets are an outstanding source of fibre, vitamins, proteins and minerals when raw. Also, they are low in saturated fatty acids and salts and do not contain refined sugar. Sadly, we live in times of growing popularity of processed foods and can hardly avoid buying any of these whatsoever. But this is the hidden danger: processed foods contain added synthetic colourants, flavours, antioxidants, preservatives and stabilisers to make them last longer on the shelves. Many of the additives are harmful to human health, not to mention that food processing removes nutrients that might otherwise provide the body with energy. For example:

- **Fresh meat** is a good source of proteins, vitamins and minerals, meaning we get food low in saturated fats with heat treatment (by roasting or stewing). On the other hand, meat products, such as sausages, burgers, and pâtés are high in saturated fats and low in nutrients - which means, less energy for the body.
- **Fresh fruits** have a high content of vitamin C, fibre, and mineralTs. They abound with pretty colours and varied tastes and textures. Fruit products, on the other hand, taste poor and their colours are faded. When processed, their natural tastes are replaced by all manner of artificial flavours to make the final product look better on the shelves. Moreover, their fibre and vitamin contents are reduced significantly by processing.
- **Fish** is an excellent source of minerals, vitamins and unsaturated fats when grilled, cooked or roasted. On the other hand, some commercially prepared fish products, such as fish fingers, fish pie, or the cod salad in mayonnaise (a favourite snack in Slovakia and the Czech Republic) are either artificially flavoured or contain added water, bones and skins to increase the product weight, thus increasing the selling price.
- **Vegetables**, such potatoes, are a source of proteins, fibre, and starch, while commercially processed potato products, including the popular potato chips and crisps, contain artificial flavours, colourants, and salts.
- **Fresh milk** is rich in calcium, proteins, and B2 and B12 vitamins, unlike dairy products, such as ice cream, milkshakes, or cream cheese, which are high in fats and salts (cheese) or added sugars (milkshakes and ice cream). Moreover, they often contain artificial flavours and colourants.

FACT BOX

Recent studies suggest milk may have harmful effects on the body. To find out more, read about the Pros and Cons of Drinking Cow`s Milk.

FACT BOX

Are you familiar with food additives? Find out more in Food E Numbers Explained.

The good news today is that there is a lot to choose from. It is solely up to us as to what kind of food we decide to eat and if we get any energy from it. Food businesses producing processed foods usually do not care about our healthy diet. Their only focus is to mix and blend the cheapest ingredients only to sell the end product at a considerably higher price than individual ingredients if sold separately. Nowadays there is also a high-end market that does care about health foods, but it charges a premium.

FACT BOX

If you are vegetarian, or vegan, or just try to reduce your use of animal products, you should plan your meals to ensure you will get enough of protein. Top 15 sources of plant-based protein might help you.

The journey of food to our plates

To ensure food for their populations, many regions around the world had to resort to growing crops that had originally not been grown in their geographical area. Today there is much talk about growing home crops, preferring local products, and using new technologies that make it possible. Do you know the benefits of local products? Preferably, we should eat regional fruits and vegetables when they are in season. Our ancestors easily adapted their diet to the changing seasons and the readily available resources, and it should be no problem for us to do the same. Knowing our local growing seasons is important to understanding where we live and have a sense of place, which is important to our mental wellbeing.

Local produce is not only fresh and appealing; they also mean closer connections to where food comes from and support awareness of seasonality and the realities of food production. It also supports the local economy or traditional culture. Imported produce is mostly treated with preservatives, which are only adding to the chemical burden.

Food from small retailers and local producers is beneficial to the environment and wildlife. Well-managed farms provide ecosystem services: they preserve fertile soil, protect water resources, support biodiversity, and provide habitats for wildlife in local communities. Besides, farming is an investment for the future. By supporting local farmers today, we are helping to ensure that there are farms in our community tomorrow. This is an important issue for food safety.

ACTIVITY

- Try to recall how much raw, cooked, and non-processed fruits, meat, fish, and vegetables you have eaten or how much fresh milk you have drunk in the course of a week. Compare these to the processed meat and fish products, fruit and vegetable products, or dairy products you normally eat. What is the proportion of each, and which type of food is prevailing in your diet? Talk about what fast food and slow food mean. Discuss which diet gives your body more energy and why. Which of the foods you have in your home are imported? Do you think they could be replaced by local alternatives? For one week, could you eat local foods only? Try to do it. After one week, talk about what kind of diet you had, if it was varied enough, or if there were any imported foods you just could not give up on.

- What do you think about these food Myths? Read the article Healthy Eating: 21 Food Myths You Still Think Are True and discuss these myths with your students.

DID YOU KNOW?

... Not only what you eat but also how often you eat is important. If you eat every three to five hours, the levels of your blood sugar (i.e. your source of energy) rise slightly, with no sharp fluctuations.

... There are some 40,000 burger shops around the world, of which 9,000 are part of the McDonald's chain.

... Food energy is measured in calories, also known as kilocalories (kcals) or kilojoules (kJ). Both are units of energy, with kJ being a metric equivalent to kcal (1 kcal equals approx. 4.2 kJ).

... in Spain, the whole-grain bread is called "war bread" since during the Spanish Civil War (1936-1939) since white bread was not easily available.

HOUSEHOLD ENERGY CONSUMPTION

You are sitting on your sofa watching your favourite TV show. All of a sudden, there it goes a commercial! What do you do? You may switch channels, or you may use the time to make a cup of tea or grab some titbits. If the latter is the case, you will probably go and turn on the light in the kitchen and the kettle for hot water. But for all this, you need electricity! You need electricity to watch the TV, to turn on the lights, and to boil water for your tea. And what about heaters, where do you think they take the heat from? They too need electricity. But, did you ever think where all the electricity comes from? We tend to take energy supplies for granted today. But they do not come to our door out of anywhere. All the electricity we use needs to be produced somewhere. Just look around and you will find a power plant, a heating station, or a municipally owned utility that powers your house. See that tall chimney that is fuming smoke day and night, all year round, to ensure enough energy for our homes, industrial businesses, and offices.

IMPORTANT

Much has been said and written about energy consumption in households, but it will not hurt to give some facts on why homes appear to be so insatiable for energy.

Most energy in households is consumed as heat for heating homes (64 % of final energy consumption in the residential sector in the UK in 2017) and making hot water. A lot of money is also spent on electricity to run a household itself for:

- cooking,
- washing,
- lighting,
- dish washing,
- vacuum cleaning,
- freezing the food,
- or running consumer electronics devices.

It may be of interest to note here that an hour of watching TV costs 3 cents, while an hour of vacuuming costs up to 20 cents. Nonetheless, this reasoning may not be the smartest in trying to convince someone that watching TV is actually better than vacuuming in terms of saving on energy and your family budget. Refrigerator and freezer are the biggest electricity eaters anyway. Although their consumption as such is not too high, they are on 24-7, which is why their overall consumption is one of the highest.

In the past, mostly energy was used for heating and making hot water in homes while the operation of electrical appliances was much lower in energy. In recent years, however, the gap between the consumption of energy used for heating and making hot water and for appliance operation has been partially reduced. The reasons are several. Although new or newly insulated buildings display much lower heat losses, the consumption of original household appliances remains unchanged. Also, homes and households are increasingly equipped with new or more efficient appliances. While families were well off with a TV set, washing machine, iron, fridge or vacuum cleaner in the past, we cannot seem to imagine living our current lives without plenty of technology and electronic devices at hand, including a personal computer (for each family member in many cases), printer, scanner, DVD player, dryer, or AC.

INDICATORS

Even electrical appliances in standby mode consume some power before you turn them back on. To learn what is happening to them while you are not at home, check out a student research project on "Power Consumption in Standby Mode".

www.teachinggreen.eu

FACT BOX

On Eurostat website, you may find more statistics about Energy consumption in households.

FACT BOX

Interested to start monitoring your household consumption? Try Energy monitors.

Our kitchens are "packed" with all manner of appliances – from an electrical kettle to a coffee machine, food processor, toaster, home baker, juicer, dishwasher, and microwave or hot-air oven.

For reference, the annual consumption of some of the household electrical appliances is as follows:

- Fridge with freezer compartment: 26%
- Lighting: 20%
- TV set: 13%
- Washing machine: 11%
- Iron: 8%
- Electric kettle: 8%
- Vacuum cleaner: 8%
- Microwave: 6%

(Source: Smrž, 2017)

Carbon dioxide (CO_2) is one of the best-known gases produced by burning fossil fuels. Its amounts in the atmosphere are steadily increasing as a result of increasing energy consumption worldwide. Assuming that around 142 g of CO_2 emissions are produced per 1 kWh of produced electricity, a household with annual consumption of 15,500 kWh produces nearly 2.2 tonnes of CO_2 emissions. This means that energy saving does not only bring financial savings but also reduces the emissions resulting from their production.

FACT BOX

To find the electricity consumption of your devices you can use free Energy Use Calculator.

DID YOU KNOW?

... By not letting your laundry dry out completely but leaving moderate humidity in, you will be able to do without the steaming function when ironing, which is energy demanding.
... The right hot-water boiler size can save you energy. All you need to do is consult an expert who will calculate the right hot-water boiler size to suit the number of your household members.
... You should check the energy label data for your appliance. The energy labels usually have seven energy classes (A+++ to D).
... Appliances labelled with green arrows on the energy labels are easier to operate and offer lower energy consumption than those marked with red arrows standing in the D class.
... By replacing a conventional 100W bulb with a compact fluorescent lamp or a light-emitting diode (LED), you can save from EUR 12 per year for fluorescent lamp and twice as much for a LED.
... The A+++ refrigerator should be placed in a dark place and defrosted regularly.
... Pressure cookers save about 50-70% of electricity.
... Reducing temperature in your flat by 1°C will save you 5-10% of energy costs.
... A fully loaded washing machine (or dishwasher) has an equal consumption than a half-loaded one. So, it is reasonable to start running one when fully loaded.
... We can also save energy by turning on the computer only when we really need it to work. Even more, energy can be saved by not putting the computer or TV set in the standby mode but turning it off completely.
... Leaving your phone charger plugged in when not in use will use up about 0.5 watts per day. This may not seem much for one phone - but, just imagine all the phone owners and their chargers...

(Source: Suggestions and tips for your household, Central Slovak Energy)

ACTIVITY

Find out how much energy is used in your home in the course of a regular week (check the heat and electricity metres). What it means: keep doing things you normally do in the same way you are used to doing them for one week. Next week, change your routine and follow as many home energy saving tips as possible. Then do the comparison. Did you succeed in saving any energy? Could you imagine living like this in the long run?

THEME 6: WASTE

Waste in Landscape

Where to Put It?

A House Full of Waste

Organic Waste and Composting

A Life without Waste

WASTE IN LANDSCAPE

"Anyone who thinks that you can have infinite growth on a planet with finite resources is either a madman or an economist."

David Attenborough

We live in a disposable society – from plastic bags offered in supermarkets to single-use coffee cups and disposable plastic water bottles. We use these for no longer than 15 minutes but after we dispose of them, they remain in the environment for hundreds of years. Looking at this paradox from any point of view, it simply doesn't make sense – even if we tried to make a mathematical calculation to explain it. Fortunately, there is a way to avoid this kind of waste. First, say "NO" to single-use products; second, replace them with something more sustainable. A plastic bag can be replaced with a cloth bag. Coffee can well be carried in a stylish reusable thermo mug which will even keep it hot for a longer time. A plastic bottle can be easily replaced with a glass one and filled with, say, tap water.

Nevertheless, things are not easy with all types of waste. The thing is waste is generated as part of most human activities. Consider this: a product bought in a shop or supermarket is usually packed. While we are free to refuse to use a disposable plastic bag offered to carry our stuff home (instead, we've got our cloth bag to use, right?), we are not free to decide on the original factory packaging in which the products come anyway – we have no other choice but take the packaging with the purchase, like it or not. As a result, waste is generated after unpacking the item bought. What's more, the new product will only be used by us for a limited period of time and then thrown out once broken or worn out. Even worse, sometimes we decide to throw it away before its lifetime expires because we simply want

a “new model”. The material result of this behaviour is what we call **waste**. Oddly enough, what is “waste” to some may be a valuable item or reusable resource to others.

Now take a closer look at what kind of and how much waste we generate. According to Eurostat, the EU generated five tonnes of waste per capita in 2016. Rest assured though; you have not thrown five tonnes of food leftovers, cans or plastic packaging out in your litter bins in one year. Rather, the statistic also includes industrial waste, the largest waste producer whatsoever (accounting for up to 65% of all waste). One way or another, it is still a huge pile of waste we all generate every year; of this amount, only 38% is recycled and up to 46% ends up in landfills - which is another burden for the environment and the landscape...

FACT BOX

To get more statistics, please visit the Eurostat website.

In general, there are two major categories of waste: “other waste” and “hazardous waste”. Regarding households, as a rule, we use the term **municipal waste**. The average European produces nearly 500 kg of municipal waste per year - and this can fit either in the “other waste” category or the “hazardous waste” one (e.g. bacteria, i.e. waste with a hazardous property - radioactive, or medical).

In recent decades, we have been throwing out increasingly more waste that is even more harmful than before – and this is not only about hazardous waste. Anyway, why is waste a problem?

- Waste can have **adverse effects on human health**, with even seemingly ordinary things to be a source of a problem. Plastics contain various additives – including stabilisers (which may contain heavy metals such as mercury and cadmium); emollients for flexibility (often phthalates); and chlorine, which is part of PVC. Chemical compounds with carcinogenic effects are used in paper production. Chlorine is still used to bleach paper. And the list goes on.
- The incineration of waste generates gases that contain heavy metals or toxic chlorine derivatives, mostly dioxins. These can have **adverse effects** on the immune or nervous systems and even have carcinogenic effects.
- Landfill waste **deteriorates the environment**, i.e. by emitting landfill gases whose main components are methane and carbon dioxide, the gases that contribute to global warming.
- Rainwater flowing through legal and illegal landfills is "enriched" with harmful substances which then cause **pollution to the surrounding land and water environment**.
- Landfills created in construction and the subsequent waste disposal **take up land** that could otherwise be used more efficiently, such as for growing crops, or as pastures, with one tonne of municipal waste taking up about 1m3 of space.
- In many cases, our actions are uneconomical; we often see landfills getting filled with the kinds of **waste** we could still **reuse as part of the recycling process** to spare the relevant raw materials, natural materials, energy, water, etc.

Obviously, waste causes damage not only to the landscape but also to humans. In addition to the environmental damage and impaired health, there is also economic damage. Waste in a landfill or incinerator loses its potential to become a resource material for another product – which, as a consequence, requires more raw materials to be mined, often from non-renewable sources. Moreover, we lose precious land by building landfills and incinerators. Municipalities pay considerable amounts of money for landfilling or waste incineration. Last but not least, waste-related health issues are another burden to the economy as treatment of waste-caused diseases costs a lot of money.

IMPORTANT

We live in a society who thinks that Earth is a single-use planet, and treats the landscape as if it was a waste bin. If you think that what you do does not matter, you are wrong. To reduce municipal waste by nearly 0.5 tonnes per year is certainly worth the try. No matter how small, all actions of individuals can add up and eventually result in a big change. And who knows, you may be the one to help avert the most catastrophic climate change scenarios.

DID YOU KNOW?

... On average, a European citizen produces 481 kg of communal waste per year.
... Up to 90% of raw materials used to produce a commodity turn to waste before the end product leaves the factory, while up to 80% of all products are thrown out within the first six months of their purchase.
... Littering is a socially undesirable behaviour which includes discarding carelessly or dropping on the ground in a public place all sorts of rubbish, such as plastic bottles, food wrappers, used cans, old toys etc. - simply, anything and everything that should normally be discarded in waste bins. In essence, littering is a term to denote any freely discarded solid waste anywhere in the landscape, city or countryside.

ACTIVITY

- Ask the students to try on their next trip out of town to collect pieces of waste lying scattered on the ground, beside the roads, on the lawns, or along the river/stream. Remind them not to forget to take litter bags and waste collection gloves with them. Once completed, talk about the task in your class, asking students where they found most of the waste, what kind of waste it was and how much they collected.

- Work with your students to make a waste-free kit consisting of frequently used multiple-use items. You can carry the kit around with you in a cloth bag wherever you go. You will be surprised to see how significant your reduction of plastic consumption will be.

Your kit can include the following items:
- A multiple-use cloth bag in place of plastic bags;
- A drinking bottle made of stainless steel or glass (feel free to invest in a bottle that will last for years);
- A reusable coffee or tea mug with a well-sealed cap (also suitable for a snack or a handful of nuts to munch on);
- A stainless-steel straw;
- An easy-to-wash cloth napkin in place of paper tissues;
- Cutlery made of stainless steel or wood in place of disposable plastic forks and knives;
- Fruit and vegetable net bags.

Let the students decide what they would like to carry around with them to have “at hand”.

WHERE TO PUT IT?

There is a neatly wrapped box of chocolates lying on the table, with a nice ribbon on it. There must be a special occasion or a birthday celebration around here, congratulations! Now take a closer look at the sweet gift. The chocolate itself is nice, but go count the layers in which the few sweet pieces are wrapped and packed: a gift wrapping, a cellophane wrapping, coloured cardboard underneath, then the box of chocolates itself with a corrugated board on them – and, to top it all, each piece of chocolate wrapped in coloured tinsel, seated separately in a plastic tray. Seven wrappings! In fact, there are very few products that need more than two layers of packaging. And yet, the less essential the product, the more pieces of packaging it has.

Humans produce huge amounts of waste every year: waste from foodstuffs, construction and mining; industrial and agricultural waste; old electrical appliances, cars, batteries, clothes and furniture; disposable plastic bags, and paper waste, to name but a few. The amount of waste and its types are closely related to our consumption and production. We tend to throw out anything we find to be out of vogue or no longer fitting. Did you know that demographic change affects the packaging of products? This trend can be seen in an increasing number of products packed in small packages as a result of an increasing number of single-person households.

Anyway, what happens to the waste we throw out? While a portion of it ends up in separated-waste containers to be reused, most of the waste ends up in large landfills. Should you visit one, what you would find would certainly include a lot of wrappings, rotting organic material, broken glass, cans, pieces of old furniture and broken home

appliances, as well as hazardous material, such as half-empty detergent bottles, pesticides, paints, adhesives, solvents and other chemicals. All of this makes up a stinky and poisonous mass. Moreover, such landfills take up vast areas of lands that need to be taken care of somehow by hiding them away once filled – for us not to see how much waste we produce.

Did you ever think that waste disposal companies might play a role in waste production? It is a paradox, but true. If they take the waste away from your home fast enough, you may not become aware of just how much waste you have produced, and will not mind keep producing even more. In this way, the regular waste collection may indirectly encourage further shopping, consumption, and waste disposal.

The way our ancestors did it

Our grandparents managed waste (or any material that we now consider waste) differently than we do today. They were able to use things for longer periods of time. They would not throw out a sugar paper bag; instead, they would reuse it to wrap other foodstuffs - such as nuts, beans, or poppy seeds. Goosewing tips trimmed off in feather plucking were used to sweep the ovens or to use for butter in cooking and baking. A piece of a broken jar with ears would be used to scoop feed for livestock. Our ancestors were wise enough to use every little piece of food from their kitchen and eat up everything with no scraps left over: there was no discarding or wasting in their times.

Incineration is another way to dispose of waste. Until recently, incinerators were seen as a solution to the problem of "where to put it [waste]?" By burning waste, we not only get rid of the waste itself but also generate energy - to heat local homes, for instance. Sounds great, huh? There is a catch, though. While solving the problem of waste alone, we created another one: waste incineration releases poisonous gases. The temperatures in incinerators often go below 900 °C, which is the level at which dangerous dioxins - ones of the most toxic compounds - are released into the air from burning plastics. And dioxins are just one of the hundreds of components contained in the fumes and smoke from the incinerators.

Moreover, waste incineration leads to irreversible loss of raw materials that could otherwise be reused to make new products. As a result, we need to re-mine them, thus wasting the precious resources we only have in limited reserves.

The humankind is inventive enough to find other ways of getting rid of waste. Unfortunately, those are often to the detriment of the environment, or even illegal. Sadly, we still live in times when a lot of waste ends up in illegal landfills or just scattered around the landscape or possibly burned in home stoves.
Now, what exactly is the problem? To begin with, it must be noted that illegal landfills have no insulating barriers to prevent harmful substances from penetrating the subsoil. As there is no monitoring, illegal landfills can spring up anywhere, even near the rivers where they pose a direct threat to the waters as well as species living there.
As a result of household waste incineration, the air is even more contaminated with pollutants, being mostly the products of incomplete low-temperature incineration. The smoke contains harmful gases, mostly the carbon monoxide which is toxic to humans and can cause suffocation.
Household waste incineration can also produce the above mentioned hazardous dioxins as by-products.

INDICATORS

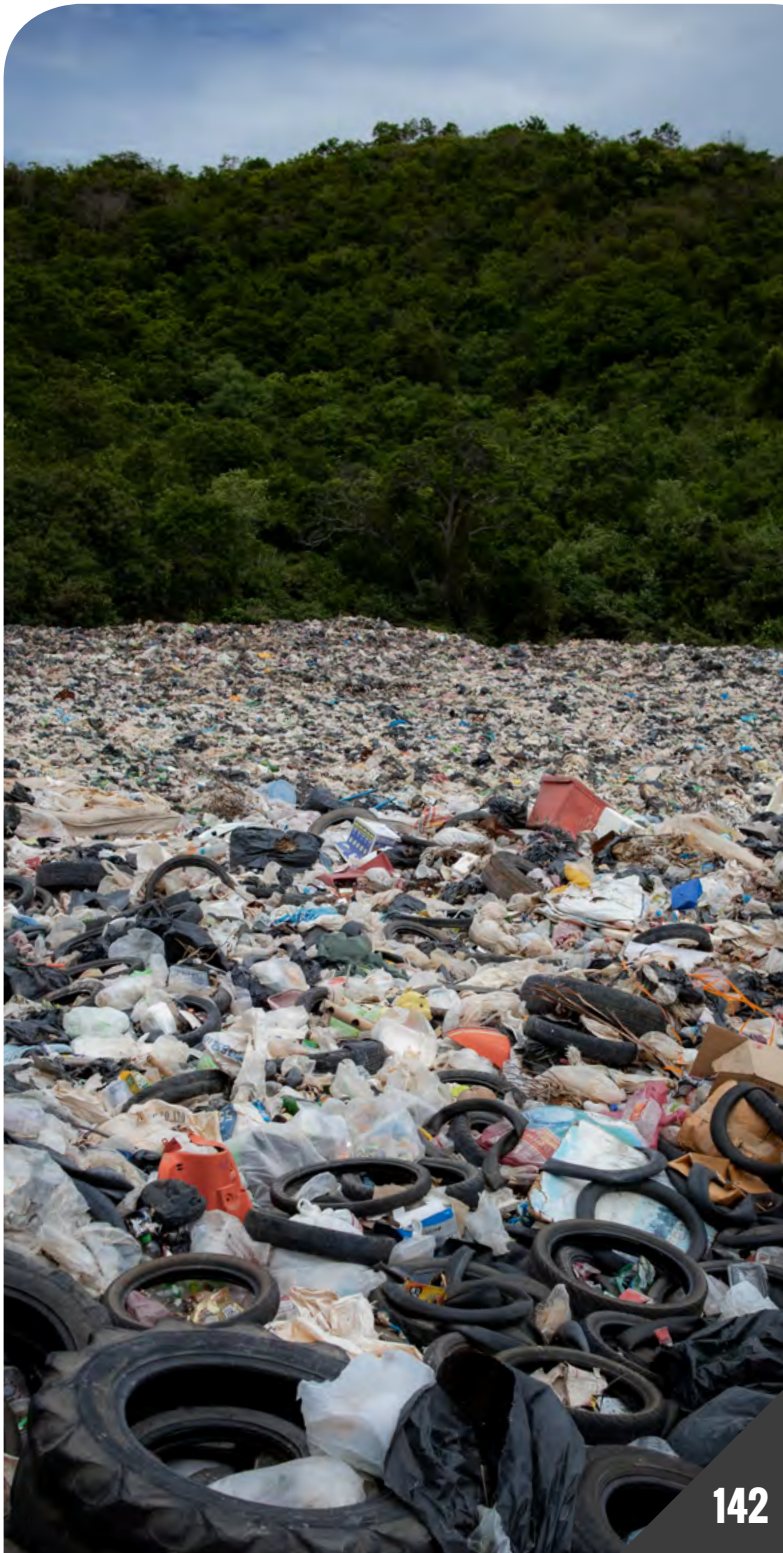
To learn if waste ends up in an illegal landfill in your area, check out the student research project titled "Illegal Waste Landfill Mapping".

www.teachinggreen.eu

FACT BOX

To learn more about the Great Pacific Garbage Patch, read the National Geographic article.

The waste that has not been landfilled or incinerated may eventually end up in the sea. The world's ocean beds are full of waste and even more waste is floating on their surface. The seas inadvertently become the final resting place for our waste. Take plastic, for example. Plastics break down into microplastics over time but never disappear completely, destroying marine life or even entering the food chain – by getting ingested by innocent fish swimming in the sea that ultimately ends up on our dinner plates. One of the good examples of such a "marine wasteland" is the Great Pacific Garbage Patch (aka the Pacific Trash Vortex), a vast area of marine waste accumulating in the open North Pacific Ocean. Sadly, this is not the only place in the world's seas where waste accumulates in enormous amounts; it may "only" be the largest.



The current European Union's waste policy is based on a five-level waste hierarchy to be applied in waste management, namely:

1. Minimising Waste;
2. Reusing Waste;
3. Recycling and Composting Waste;
4. Incinerating Waste Using Energy;
5. Landfilling and Other Ways of Waste Disposal.

What exactly does this mean in practice?

Do you find any of the above-used terms unclear? Waste management is associated with many more, including waste separation, upcycling, and zero waste. Do you know how to use them? Check out the definitions below.

Minimising waste aims at reducing the amount of waste we produce. It involves thinking ahead as to how much waste we would produce as a result of what we are about to do (e.g. shopping).

IMPORTANT

In the first place, waste generation should be prevented. If waste cannot be prevented from being generated, it should be used as a secondary raw material for recycling. If waste cannot be recycled, it should at least be recovered for energy. Dumping waste in landfills should be minimised.

Recycling waste is a process of reusing used materials. Recyclable waste includes materials such as paper, metal, glass, plastic, etc.

Composting waste is a process of recycling biological (organic) waste. All you have to do is have a place where your organic waste can be disposed of. The rest of the job will be taken care of by microorganisms and oxygen whose joint work will help turn the waste into a quality fertiliser.

Waste separating is a process of waste sorting, where the waste is separated (sorted) is not considered unnecessary; rather, it is taken as a secondary raw material to be recycled and reused.

Upcycling waste is a process of reusing waste, often creatively, to turn the unwanted material or product into something more useful or of greater quality.

If you still have old clothes in your closet that you have not thrown away simply because you thought they could still be used someday, you did well. Every shirt or dress can be upcycled to get a new life and become a new valuable piece. The difference between recycling and upcycling is that recycling results in a product of lower-quality compared to the original item, while the process of upcycling adds to the quality and value of the original piece.

IMPORTANT

Are you still lost in the sea of the waste terminology? Do not worry. All you really need to remember is this:

"The best waste is the one that is not generated."

ACTIVITY

- Ask the students to think about what they really need in life. Their task will be to look around their own room at home and think about what they really need to live and what is redundant. They can focus on their personal belongings, clothing, or footwear - anything they choose to. At the same time, ask them to think about what they would be willing to give up on. When done, write down on the blackboard a list of items the students consider "extra" in their lives and believe they could do without. Are any of the items recurring? Which ones and why?

- The current trend in the world of clothing which has gone global is to do a "clothing swap". It involves an exchange of valued but no longer used clothing amongst friends, neighbours, or in a clothing-swap bazaar. You can try and organise a clothing swap session in your classroom or school. Invite the students to check out their wardrobes (preferably with their parents) to see if they have any clothing they no longer use but is still "wearable". This can also include accessories, such as bags. Let the kids bring their pieces to school and then swap among one another to their liking. In this way, they give the clothing they no longer use a second chance while their classmates obtain a fresh piece for their own wardrobes or simply something nice to keep from a friend.

DID YOU KNOW?

... One tonne of incinerated municipal waste generates about 6,000 m3 of gases. Among other things, the mixture might contain hazardous heavy metals such as lead and mercury and highly toxic compounds, especially dioxins. These are among the most toxic substances on Earth, right after radioactive waste.

... 2.41 million tonnes of plastic enter the ocean every year. It is estimated that 150 million tonnes of plastic debris float on the surface of the world's oceans today (source: Recent reports and initiatives on plastic and micro-plastic waste at sea)

... About 4.2 tonnes of plastic waste enters the Black Sea through the Danube River each day. (Lechner et al., 2014)

... We now have over 500 locations in the ocean recorded as dead zones where marine life cannot exist. To find out how did this happen, visit Marine & Ocean Pollution Statistics & Facts 2020.

A HOUSE FULL OF WASTE

Look at what household (or municipal) waste is composed of and if it can be recycled:

Material	Percentage	Recyclability
Organic Waste	45%	Excellent recyclability; compostable
Paper	14%	Easily recyclable
Plastic	11%	Easily recyclable
Glass	10%	Easily recyclable
Textiles	4%	Minimum recyclability
Metal	4%	Easily recyclable
Inorganic Waste	4%	Easily recyclable
Tetra Pak Packaging	3%	Easily recyclable, not fully
Hazardous Waste	1%	Limited recyclability
Mixed Waste	4%	Non-recyclable

(Source: Waste, Friends of Earth, Slovakia)

IMPORTANT

The average household produces about two tonnes of waste per year. Imagine what would happen if all this waste was not collected and taken away. Houses would be surrounded by waste bins full of rotting food leftovers, corroding metals, plastic wrappings, and broken glass. All this mixed together is completely unusable. But once the pile of waste is sorted and separated by types, we discover that a large portion can be reused. It can make up to 80 per cent of the total waste mass, while the remaining 20 per cent is made up of materials which are hard to recycle, such as composite materials or chemicals.

Organic Waste

Also known as biodegradable waste, it includes leftover fruits and vegetables, peels, food leftovers, as well as garden waste (e.g. foliage, grass, etc.). This type of waste can be turned into fertiliser by composting.

Paper

Paper waste collection usually applies to newsprint paper, cardboard, office paper, and even old books with the hardcover ripped off. By recycling, paper waste can be reused to produce any of the products of the paper industry, including toilet paper, books, or wrapping paper.

Plastic

Some plastics are easily recyclable, such as polyethylene terephthalate (don't be puzzled, it is the well-known "PET" material), or polyethylene. On the other hand, polyvinyl chloride (aka PVC) or polystyrene are very difficult to recycle. And what can be made of used recycled plastic? If you have some fluffy fleece clothing in your closet, know that you actually wear PET bottles! It takes about 30 mineral water bottles to make one fleece jacket.

Glass

What is outstanding about glass is that it can be recycled to infinity. Separated waste glass can be recycled to produce full-valued bottles or glasses.

Textiles

Textile recycling is difficult because it requires relevant equipment. But the good thing about this type of waste is that a large part of well-preserved clothing can get back to people through charities and public collections to make it available to use and wear again. Damaged textiles can be reused to weave carpets or make home accessories. Textiles can also be recycled as

insulating material. Have you ever heard of a "SimplyTex"? It is textile wallpaper made of recycled leftover textiles.

Metal

Many metals used to make cans, lids, and foils (e.g. iron, aluminium, copper, etc.) are reused in the metallurgical, engineering and construction industries.

Inorganic Waste

Inorganic waste includes gravel, sand, or bricks. This type of waste is easily recyclable to be reused mostly in the construction industry (where most of it comes from).

Tetra Pak packaging

This type of packaging is known as box packaging branded Tetra Pak, Elopak, etc. They are easily recyclable multi-layered composite materials, consisting of three to six layers of different materials, including cardboard, plastic, and aluminium foil. They are recycled to produce building boards and insulation materials.

Hazardous Waste

Even though this type of waste is not significantly present in household waste bins, it needs to be given high attention. Recycling hazardous waste involves the separation of its individual constituents in the first place. Batteries, fluorescent lamps and old oils are among hazardous waste to be recycled.

Mixed Waste

This includes, but is not limited to, heavily polluted waste (which makes recycling impossible), but also single-use diapers (also heavily polluted). As a rule, this type of waste ends up in landfills or incinerators.

TAKE ACTION

GOOD IDEAS:

How to easily reduce household waste?

- Do not mix different types of waste. Ideally, keep several waste collection containers - for paper, glass, plastic, metal, and other mixed waste each. All you have to do is check if your area supports separated waste collection.
- When buying things, avoid packaging wherever possible; you don't need plastic bags to carry your vegetables from the supermarket - those have long been out of vogue now while reusable net bags are very trendy!
- Prefer large-packs for products you regularly use; for example, rice or pasta can be bought in large packs and will not expire on you that soon.
- When shopping, look for drinks in returnable bottles or another returnable packaging instead of single-use cans.
- Make sure you prefer recyclable packaging - for example, prefer paper or glass to plastic.
- Consider in composting your own organics.
- Try to buy directly from the local producers.
- Reduce pesticides and aerosols.
- Bring your own (textile) bags to the market and avoid using the plastic bags.

Do you know how long it takes for different types of waste to decompose?

Type of Waste	Decomposition Time	Other Waste Management Options
Apple Core	A few weeks	Composting
Newspapers and Magazines	A few weeks	Separation and production of wrapping paper, cardboard, toilet paper
Chewing Gum	50 years	
Aluminium Cans	20 to 100 years	Separation and reuse of raw materials – aluminium, steel
Disposable Batteries	200 to 500 years	Separation and reuse of raw materials, e.g. lead
Car Tyres	200 to 300 years	Separation and production of rubber mats; reuse for sports surfaces or as an admixture for asphalt
PET Bottles and Plastic Bags	500 years	Separation and production of fabrics, furniture, and various items
Polystyrene	1,000 years	Separation and production of insulating materials
Glass	4,000 years	Separation and production of glass products

(Source: Separate the Waste)

FACT BOX

Are you searching for some practical ideas to use recycled materials for your school ground? Try some of these ideas, recommended by project partner Learning through Landscapes from the UK:

- Design and create your own recycled plant from plastic containers, plant it up, watch it flourish and take it home for the summer (Source: Recycled planters)
- Investigate how effectively you can harness solar energy to heat water with your own DIY plastic bottle solar kettle (Source: Solar Kettle)
- Learn how energy can be harnessed by the flow of water over your own DIY recycled plastic water wheel (Source: Water Wheel Investigation)

ACTIVITY

Find a packaging-free shop in your area and take your students to pay for a visit. Identify what kinds of products can be bought packaging-free, or what could be used without packaging in your household.

After your shop visit, ask the students to think about which of the kinds of packaging they normally use they could do without. Task them to write a letter to themselves listing specific commitments to minimise waste or to support packaging-free shopping (e.g. use their own cloth bags or reusable vegetable net bags instead of plastic ones). When done, take up their letters and put them aside for six months. Six months later, let the students read their commitments and say if they have managed to keep them.

DID YOU KNOW?

... Production of plastics dates back to 1907 when Bakelite was first produced. Plastics gained popularity in the 1930s when polyvinyl chloride (PVC) was made.

... Food cans can be recycled to make house keys, among other things. A pan can be made of 150 used cans - think about it when you do your next cooking.

... PET bottles first appeared in 1978 when they came filled with Coca-Cola drinks. Today, the company makes over 100 billion single-use plastic bottles a year, which is about 3,400 bottles per second. How many have you down for the past few weeks?

... Plastics are made from a natural material, such as cellulose, coal gas and oil. Therefore not only their disposal but the making of plastics is also a problem. (Source: plasticseurope.org)

ORGANIC WASTE AND COMPOSTING

Basically, composting is a natural process of converting waste into quality fertiliser called humus which can be used in replace of artificially-made industrial fertilisers. Compost is a great asset to the country, as it is rich in nutrients; it is a sort of a soil "conditioner".

Compost is used mainly in small growers' gardens and horticulture as well as organic farming. In essence, we can compost anywhere – as the saying goes, where there's a will, there's a way. Many cities have joined the green trends by realising it was better to handle organic waste in a useful way than to just keep piling it up. As a result, they resolved to create municipal composting plants to recover biodegradable municipal waste. For instance, the Fairfield Composting Plant in Manchester, UK, was established as an alternative to a planned local waste incinerator (which wasn't built in the end). Thanks to the composting plant, some 3,500 tonnes of waste are spared from ending up in landfills or incinerators every year. The composting plant is a good example of how reducing waste or even heading for zero waste are no myths and how environmentally-friendly alternatives in waste management can work compared to conventional methods.

IMPORTANT

There is no doubt the problem of waste keeps getting worse. Sadly, up to 45 per cent of total household waste is organic waste. If we do not separate it from the rest, it will end up in a landfill left rotting, smelling, and decomposing as useless mass. The good news is there is a way of averting this fate, and it is called composting. The great advantage of composting is that we do not actually dispose of organic waste; instead, we produce organic fertiliser, i.e. compost, which is perfect for growing plants. Moreover, the composting process is a phenomenon that Nature knows for ages, so why not to learn from the best and get inspired?

TAKE ACTION

Organic waste can also be composted at home or school (or in your school ground). You don't need large areas of land; all it takes is just a corner somewhere in the backyard. You don't even have to invest in costly containers; a simple pile of waste will break down into humus equally well as waste in composting containers will. In addition to practicality, composting organic waste at school is of educational significance - it teaches children how to properly handle waste and how to use it as a raw material to increase soil fertility. In addition to paper, glass and plastic waste separation that are in place in the classroom environment, you can introduce a separated collection of organic waste to then be composted in the school ground. By getting involved in the process of composting, the students will try for themselves how to recycle waste.

FACT

Compostable items:

- Garden waste: flowers, mown grass, foliage, plucked weeds, tree branches, hay, cones, tree bark, sawdust, wood shavings, etc.
- Household waste: leftover fruits and vegetables, coffee grounds, tea liquor, ash, flowers, eggshells, egg cartons, paper teabags, etc.
- In minimal amounts: citrus and banana peels, pet droppings, etc.

Non-compostable items:

- Bones, meat, dairy products
- Oils
- Drugs
- Vacuum dust, weeds with seeds, disease-infested plants, etc.

DID YOU KNOW?

... When organic waste decomposes in a landfill, landfill gas is formed, with methane (CH_4) - one of the greenhouse gases - being its main component.

... Earthworms can break down biological waste, including bread and pastries. This ability of earthworms is used in vermicomposting. It is composting in special containers where the major role is played by these little helpers.

ACTIVITY

- Look for a composting plant in your area. Try to learn more about its working principle and what kind of stuff they compost. If possible, take a school trip to the plant. If the composting plant is too far away, ask the students to find some information about it on the Internet.

- How does your school manage organic waste? Does it use composting? If not, talk to the school management to make a common compost pile and then use the humus you get. Alternatively, you may join forces to make a vermicomposter. Instructions on how to make a compost pile or a vermicomposter can be found on the Internet. And do not forget to place mini bins into each classroom to collect organic waste!

A LIFE WITHOUT WASTE

TAKE ACTION

Even a simple "no" can trigger a change. You are standing at the cash desk, ready to pay for your purchase. The lady at the cash desk asks you a question: "Would you like a plastic bag?" What is your answer? If your answer is "No, thank you", congratulations! You have just reduced the amount of waste in a landfill somewhere out there by one plastic bag. You have become an everyday activist. It may not seem much to you, but even small steps like this can eventually lead to a big change. Just imagine every shopper saying "no" to this plastic bag. .Such small actions of ours can trigger a domino effect of positive outcomes that will eventually result in a huge change reducing the overall amount of waste in the world.

Zero waste has been a hot topic in Europe in recent years. Packaging-free shops can be found in many cities across the continent. In these shops, you can pour a drugstore product of your choice right into your own bottle or weigh your desired amount of flour into your own cloth bag. Retail chains do not want to be left out of this trend either and adopt their strategies accordingly - which is evidenced in their returnable packaging options, deposit plastic bottles or packaging-free goods. Sadly, many countries remain unaffected by the green trends and keep producing the same large amounts of waste, with some even larger than ever before.

In response (not only) to this, but activities are also taking place around the globe towards the circular economy. The current economy is based on the linear principle of the "take-make-throw away" pattern.

You don't need to be a rocket scientist to understand that a model like this is not sustainable; natural resources are limited, the extraction costs are increasing, the world's consumption keeps growing, and the landscape continues to be devastated. This is why experts around the world are seeking environmentally and economically sustainable ways of using resources. They have come up with an approach called the circular economy which is in contrast to the traditional linear economy model. The circular model is based on the efficient use and regeneration of natural resources, which results in minimising waste and reducing the cost of input materials and the amounts of energy required in production. As a priority, the circular system prefers long-life products and the separation of non-usable waste from that which can still be reused. In this way, all that is left to be disposed of is waste that can no longer be reused or recycled. The circular model promotes eco-innovation and environmentally-friendly approach, preferring the use of renewable energy sources to non-renewables, rentals and sharing to purchasing, and local trade and production to imports.

FACT BOX

To learn more about the circular economy, please visit the Circular European Economy Stakeholder Platform.

INDICATORS

Do you think that excessive waste production has nothing to do with you or that the zero-waste target is not the real thing for you? Check out the student research project "There is an alternative" to learn more.

www.teachinggreen.eu

FACT BOX

To learn more about zero waste lifestyle, please visit the Zero Waste International Alliance website

TAKE ACTION

Any effort aimed at reducing waste is important. You too can contribute to this change - by leading by example, spreading ideas, or sharing ideas with your students and at home. A simple "no" to a plastic bag in a grocery store can be the beginning of your long journey to minimise waste. And maybe eventually, you will end up producing zero waste altogether. To live a life without waste, or with **zero waste**, seems hard, if not impossible, but it doesn't have to be this way. Above all, to live a waste-free life means to leave a smaller environmental footprint on the planet.

IMPORTANT

Zero-waste lifestyle does not mean self-sacrifice or life in need. Rather, it is more about bringing creative solutions into your everyday moments that will let you live a more environmentally-conscious life. It is crucial to realise that we all can make our contribution to nature conservation and environmental protection regardless of our age or religious beliefs. We all should care about the planet we live on together. And we all should reduce our environmental footprint. If not out of mercy, then at least for selfish reasons - because Earth is the only home we have.

TAKE ACTION

GOOD IDEAS:

How to easily reduce waste when shopping?

- Avoid buying fruits or vegetables packed in plastic; you really don't need to bring apples from the shop on a film-wrapped tray.
- Prefer local retailers who do not need to pack their products for transportation.
- Prefer clothing made of natural materials which are also more comfortable to wear.
- Avoid using disposable plastic packaging. Use cloth net bags instead of plastic ones or food packaging films to carry your fruits and vegetables from the shop.
- Find a packaging-free shop in your area. When you go shopping, take your own shopping bags, net bags or glass jars with you to have the goods weighed and placed in them.
- Prefer large packs to small ones; concentrates to ready-made products (for example, you can save up to ten packs by diluting concentrated detergents); glass or metal packaging to a plastic one; returnable packaging to non-returnable.
- Prefer tap water to bottled water.
- Do you know that paper tissues can be replaced by cloth ones?
- Before buying yet another piece of something, think twice if you really need it. There is usually a lot of clothing in your wardrobe that you do not use or have never used before.

ACTIVITY

- Make a deal with your students: for at least one month (ideally even longer), your daily task will be to pick and collect waste you find in the street, in the park, in the woods, around your school, or in the school ground. Armed with the slogan "Three are better than nothing", try and pick at least three pieces of waste and put them in the waste bin every day. At the end of the collection period, play mathematicians and estimate as to how much waste you have collected to spare your town/city and improve your local environment. What do you think would happen if everyone in your town, city, country, Europe and the world did the same thing?
- Ask the students to make a review of their plastic waste bins to see what kind of plastic waste they produce the most - is it plastic bottles, yoghurt cups, disposable tea/coffee cups, plastic bags, or anything else? Now join forces to focus on how to minimise your plastic waste or replace it with something recyclable (for example, replace plastic bottles with glass ones). Alternatively, you can think about how to upcycle this waste. Just be creative! One week later, let the students review their plastic waste bins again to see if they managed to minimise their waste or replace it with something more sustainable. Make an agreement that each one of you will stick to one of the options of minimising waste for a period of one month. After one month of reducing plastic waste, get back together to assess if the students managed to minimise their waste and if they could live like this for a long time.

DID YOU KNOW?

... Buyers around the world use 500 billion single-use plastic bags per year.

... You can also minimise waste by eating up your ordered food and drinks in the restaurant or café instead of taking it away with you in plastic packaging and with single-use cutlery. Use your meal/coffee time to have a chat with friends or to just enjoy the view from the terrace while having your lunch.

... The average annual consumption of disposable plastic bags in the EU is 198 pieces per capita.

THEME 7: HUMAN ENVIRONMENT

The Human in the Landscape

Urbanisation and Its Impact on the Environment

Consumerism and Its Alternatives

Human Activities in the Environment

It Is Up to Us!

THE HUMAN IN THE LANDSCAPE

Stop for a moment and look around. What do you see? A landscape of houses and ever-higher buildings, vast shopping, malls, and sprawling parking lots, crawling asphalt roads, highways, metal and plastic barriers, bricks, polished stones and concrete, but also fields, parks... Almost every place, every little corner of our landscape is related to man and his human nature and needs. In 2020, there have only been a few truly wild places left on this planet that have not been transformed by human action.

One of the human features is the need to own something – but its something one really needs, or something one just thinks one needs. Today, it is unthinkable for a common person to pack their property into a chest as they would do before World War II.

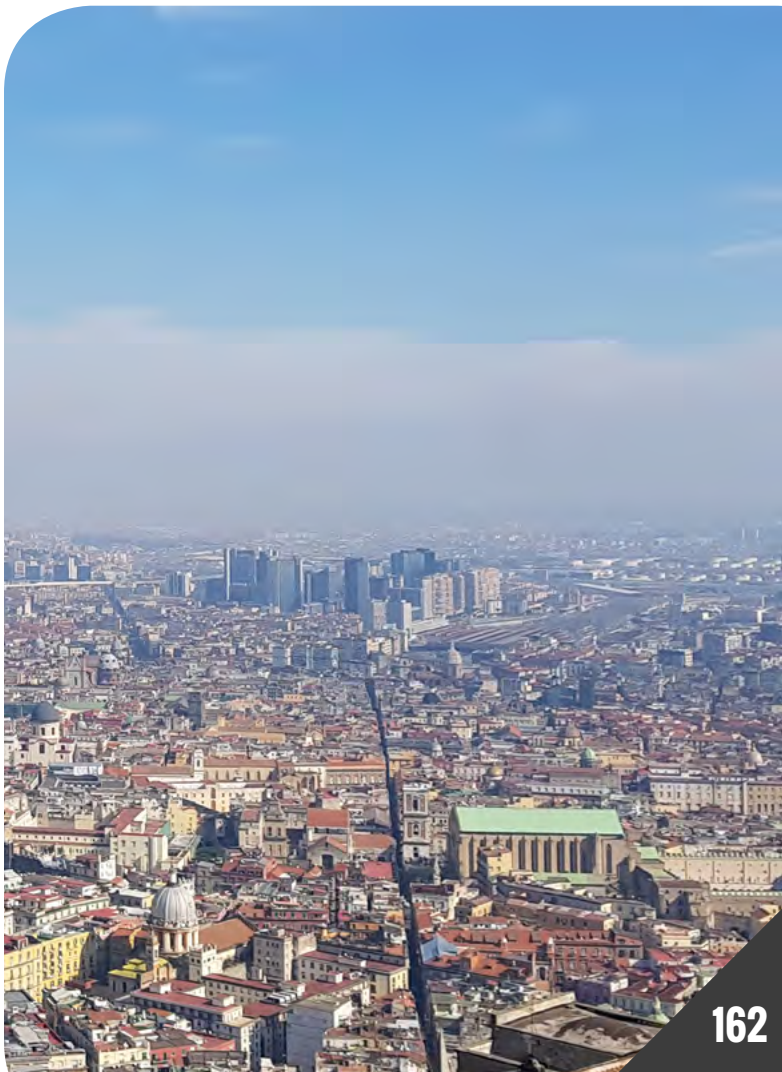
IMPORTANT

Human impacts on the landscape and the environment could be judged as positive, and negative. Sadly, the negatives - including air, soil and water pollution, overpopulation, fossil fuel burning, waste accumulation, and deforestation - significantly overweigh the positives. While the environment is capable of coping with some of the adverse human interventions, the more severe ones are much harder for it to handle. The negative environmental impact of human activity is much more pronounced today than it was in the past. The scale of human interference brings about climate change, soil erosion, floods, dams, vast deforestation, or poor air and water quality. Moreover, they threaten and change dramatically biodiversity in many locations. Nonetheless, the interaction with the environment is a human necessity, as it gives us food, water, fuels, energy, medicines, building materials, and much more. While advances in science and technology have helped us use of the environment to our benefit, they have also brought about environmental damage, disregarding the fragility of natural ecosystems and its relevance for any living system including humans.

Just as our homes got filled up with furniture and stuff, the landscape got filled up with warehouses, parking lots, cars, buildings and their extensions, which all just take up space and stand in the way to trees, greenery, animals and humans.

The environment created, inhabited, and transformed by man to his needs is called the **human environment**. Humans are in constant interaction with their environment. This, however, is not a new phenomenon; it has been happening from the moment man first used the landscape to his advantage – such as by cutting trees to clear land to grow crops. This was how man began to change his environment.

Not only do humans affect the environment, but the environment also affects humanity. The way we change our clothes in response to the changing weather and seasons is a good example of this interaction. While most of us can easily cope with this kind of outer influence, the impact of environmental issues on humans is much more severe, as they affect all human activities, including our health and economic development. Due to the loss of biodiversity, we suffer from losing many plant and animal species. Additionally, we are more vulnerable to uncommon diseases. By uncontrolled deforestation of rainforests, we are destroying the "lungs of the planet" that produce oxygen for us. Accumulation of waste in the environment is much more than a mere aesthetic problem. What about the pollution of the air and water that we essentially need to live?



FACT BOX

What about the permafrost melting due to climate change and the increase of methane and unfrozen microbes? Read more about fast thawing of Arctic permafrost.

Think about when things began to change. When did humans stop living in harmony with nature and his environment? We do not even need to go too far back in time to see. Our relationship with the landscape changed with industrialisation which began in the 18th century in the United Kingdom, followed by other parts of Europe and North America until it spread all around the world. Before industrialisation, the technologies used were not capable of significantly changing the environment on a large scale. At that time, people lived in agricultural societies, earning a living from the land using hand tools and simple work techniques. Industrialisation allowed for larger and faster use of resources. Take logging, for example: in the past, people used hand axes to cut down trees, while we use powerful chainsaws today. Another example is increasing yields from crop production by applying industrial fertilisers and pesticides. It is these kinds of changes that have rapidly increased the human impact on the environment.

FACT BOX

Read more about Overconsumption of natural resources and its impact on the landscape.

IMPORTANT

With all the negative aspects, we should not forget about the positive human impact on the environment, including protection of unique and wild areas and endangered species, reforestation, erosion control, irrigation, and measures to improve living conditions for other living creatures. But deep down: much too often do these interventions only eliminate or lessen the environmental damage already caused by humans. If there was no deforestation, there would be no need to mend it by reforestation. And protection of other species is only important for human himself - they must be protected from him.

DID YOU KNOW?

... In 2000, the European Landscape Convention was adopted in Florence, Italy, by the Council of Europe member states to highlight the importance of the landscape and its protection, management and planning at a Pan-European level to promote a balanced and harmonious relationship between human needs, economic activities, and the environment.

... From 1980 to 2005, the world population and global resource exploitation increased by nearly 50 per cent. The world population increased from 4.44 billion in 1980 to 6.49 billion in 2005. From 1980 to 2005, the exploitation of natural resources increased from 40 billion tonnes to 58 billion tonnes. (SERI et al., 2009)

... Geographers use the term the ecumene, which basically means inhabited land. In 1973, there were already some societies that the ecumene per person is as low as an acre (0.4 hectares, or 4046 m^2) for all users (Greenwood, N. - Edwards, J. M. B., 1973).

FACT BOX

Have you ever heard about augmented reality? Get inspired by application Becoming Biodiversity.

ACTIVITY

Involve the students in a sci-fi game aimed at explaining to alien visitors (i.e. extra-terrestrials who genuinely cherish their own planet) how we treat our own environment and why. Divide the students into groups of 3 to 4. One of the groups will play the alien visitors while the rest will prepare arguments to explain the way humans treat their own planet. Ask the students to focus on the following questions:

- What are the positive impacts of humans on the environment?
- What are the negative impacts?
- Why do humans need the environment? Why do they care not to destroy it completely?
- If humans need the environment to live but, at the same time, destroy it with their activities, what are their reasons or what is the explanation of this behaviour?

For older students, you can define the characteristics of the groups they will represent - such as world powers representatives; conservationists; people from the poorest parts of the world; economists; armaments industry representatives; kindergarten children etc. For each case, the students will present the likely views of the given group. Additionally, you can start considering how environmental values can be taught through social sciences, ethics and philosophy.

The "space visitors" can prepare questions for the individual groups by themselves. In conclusion, get together to say who gave the best explanation to aliens of the human's behaviour to his environment. Wrap up your session by saying what you would like to take from the debate for the future.

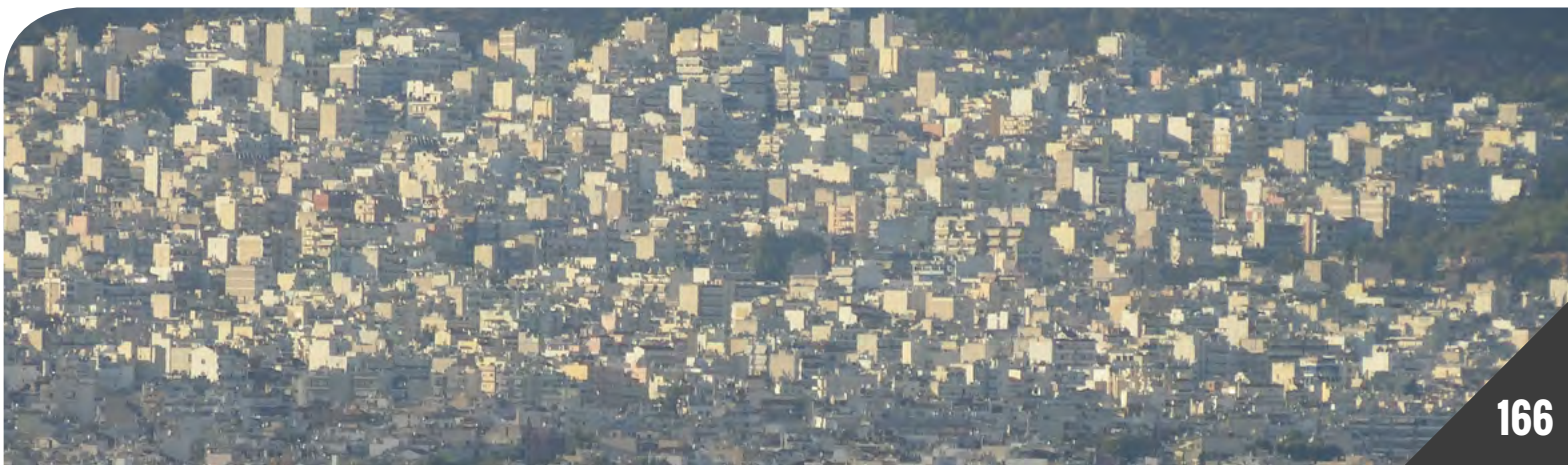
URBANISATION AND ITS IMPACT ON THE ENVIRONMENT

When humans settle in rural or non-urban areas and create themselves somewhere to live. The history of the human settlement goes as far back as to the Neolithic (aka New Stone Age, dating back to around 6000–2300 BC in Europe). Staying in one place for a long time required food supplies and animal husbandry or grain growing. Initially, humans found refuge in caves. Later, they began to build simple buildings from natural materials (permaculture is evidently rooted deeply in the past). Such permanent places to live are called settlements.

Being with settlements growing in width and height, their function and the way of life of their inhabitants were changing too. Over time, rural settlements turned into first towns. While they saw a significant development in the Middle Ages, the first towns emerged much earlier than that. In Europe, the first towns were established by the Phoenicians in the Mediterranean for trade purposes as early as in 2500 BC. Even though the development of towns and cities differed from country to country, there were some common features to distinguish them from the rural environment – such as regular

IMPORTANT

Urbanisation has its pros and cons in any given country. Its positive aspects include new job creation, trade, technological advancement, improved transportation and communications, better education and health care, and an overall improvement in living standards (such as water and energy supply, energy grid, sewage disposal, fire control, hospitals, etc.). On the other hand, however, large-scale urbanisation has adverse effects on the landscape and the environment.



markets; the free status of the town's residents, schools and church institutions; brick houses; city walls, i.e. fortifications to protect the town/city from outer enemies. Industrialisation, which continued to spread around the world in the 19th century, was another aspect to affect urban development. As a result, towns and cities saw the fastest development in countries with dynamically developing industries.

Sometime in the 1930s, for the first time, the increase in the number or proportion of people living in towns and cities was termed **urbanisation**. To many, the term "becoming urban" is the most apt phrase to define urbanisation (Johnston, et al. 2000).

Let us take a closer look.

Excessive Use of Natural Resources

The increasing urban population and its expensive lifestyle require increased consumption of natural resources (water, energy, wood, and fossil fuels) compared to rural areas.

Air Pollution

The air is usually more polluted in cities than in rural areas. The reasons include industrial production, which is concentrated in cities, and car and rail transport, as all the crowds of people, need to have a way of getting to work every day (with their workplaces often miles away from where they live). Besides, the bad air in cities is due to less greenery generally found in urban areas compared to the countryside. The problem is that large parks and lawns are often lost to give way to the multi-story apartment and office buildings. As a consequence, urban air pollution is at the root cause of many health issues for city dwellers.

Higher Noise Levels

The quality of life of urban people is strongly affected by the ubiquitous noise. Noise is most often generated by transport and industrial production. Long-term exposure to the noise levels of over 85dB can lead to impaired hearing or even loss of hearing in humans. For comparison, the noise of this or similar intensity is generated by a garbage

truck or a helicopter. Strange as it seems, some opt to be exposed to such noise deliberately – by listening to music through earphones. But we are not the only ones who suffer from high noise levels; noise also adversely affects wild animals. Luckily, noise can be effectively dealt with; a very good natural barrier is vegetation which can reduce noise levels by up to several per cents.

Rising Temperatures in Urban Built Environment

Urbanisation is fundamentally changing the character and function of the landscape. Concrete structures and roads are now built where lawns and grassy areas once used to be. Materials used in building construction are impermeable and capable of retaining heat more heat than natural surfaces.. On the one hand, this is a good thing because none of us likes to live in a cold and damp house. The insulation of the walls, for example, allows us to retain heat inside our homes on cold days and to prevent it from entering from the outside on hot days. Instead, the heat accumulated by buildings heated by the sun during the day is then mot of it transferred to the environment even after sunset. This causes the temperature inside the cities to be higher than the temperature in the surrounding rural areas (this effect is called UHI, Urban Heat Island).

Nevertheless, another cause of urban overheating is the lack of greenery with its ability to cool the air through water evapotranspiration and shading.

INDICATORS

To learn more about the noise levels in your environment and immediate surroundings, try the student research project "Exposure of the Population to Noise".

www.teachinggreen.eu

FACT BOX

Watch the video to find out more details about Façade Gardens in Rotterdam. If you are interested in green roofs, and the whole green infrastructure planning in the cities, we recommend the document Building a Green Infrastructure for Europe.

While many cities cut trees and pour concrete all-around at the expense of parks and lawns, other cities know the value of urban greenery and try to inspire their inhabitants to lend a hand. For example, the Dutch city of Rotterdam encourages its residents to create façade gardens. All they have to do is remove a few tiles from the pavement and plant some plants in there. The city management even put together a set of instructions for the residents on how to create such gardens and what to grow in them. Thanks to the façade gardens, the residential streets are not only more beautiful and pleasing to the eye, but also cooling down the houses in summer heats. In this way, the residents themselves can help make their city more resilient to climate change. Click the link below to see the way they do it:

Soil sealing and soil quality

Soil impermeabilization reduces soil quality. Soil is rich in biodiversity and micro-organisms living in the soil contribute to the decomposition of organic matter and carbon sequestration and storage. Moreover, soil hosts several species that are fundamental for the surviving of other terrestrial species. These functions are reduced or lost by the so-called soil sealing (impermeabilization) and can be recovered by de-sealing it and regenerate by properly greening it.

Landscape fragmentation

Impermeable surfaces like highway and road networks might constitute impassable barriers for the movement of some species. They cause a fragmentation of the landscape that might impede migration of some wild species or even inhibit the access to the important part of their habitat (e.g. area of food or water source). Other side effects are due to traffic pollution and noise which can cause the displacement of some species to other areas, thus reducing local biodiversity.

Urban Water Runoff

Cities are largely clad in concrete and other artificially made reinforcing materials which are impermeable and easy to overheat. What happens if rainwater falls on such a surface? Rainwater runoff and leakage through the above impermeable artificial materials (which are omnipresent in cities) is another problem. If rainwater flows over the ground without soaking into it, it results in lower groundwater levels and volumes, an increase in the runoff volume that might increase the risk of flooding and lower surface water quality. Besides, the runoff water carries with it all manner of pollutants into the river.

INDICATORS

To learn more about the availability of green areas in your area, check out the student project "Real Availability of Green Areas".

www.teachinggreen.eu

Reducing Green Areas and Biodiversity

With our ever-growing cities, the area of green spaces is shrinking, the number of trees is dwindling, the city biodiversity is declining, and arable land is being lost. Buildings, railway and automotive infrastructures, parking lots, dumping sites – all of these are taking up more and more land. Industrial production is another cause of the deteriorating urban environment. Environmental changes due to urbanisation can cause some species to either move to another location which provides them with better living conditions or just disappear from the ecosystem for good.

All of the above influences are part of everyday urban life. In the years to come, experts say, we can expect severe droughts and heats to hit as a result of the climate crisis – which will make living in cities close to unbearable in summer months. This is why it is necessary for (not only) cities to start making preparations and taking measures to at least mitigate the impacts. Concreting, asphalting and paving coupled with the wide roads and narrow foot walks are a sad legacy of the past, and we need to consider including more greenery and water-infiltration areas in our further urban planning and development letting the soil breathe.

The importance of the fresh air and greenery was also evident during the 2020 coronavirus crisis – the global COVID-19 pandemic whose outbreak was first identified in December 2019 in Wuhan, China. People locked up at their homes simply lacked nature walks. And this is the potential of urban green spaces – the areas of relaxation where you can walk, sit on a bench under a tree, read a book in the shade, or just get some rest enjoying the place.

At last, many cities are coming up with initiatives aimed at improving the environment, future and health of their inhabitants. Sometimes it doesn't take much – all you have to do is the following:

- Reduce the number of car lanes on roads;
- Replace a car lane with a cyclist one or lanes dedicated to public transport;
- Restore pavements and footways;
- Build cycle paths;
- Plant trees, shrubs, and grass; Install a fountain or floor hydro jets in the city centre to cool the air in summer heats, etc.

High-quality public spaces with plenty of greenery can mitigate the impacts of climate change, and some cities have inspiring projects underway. The city of Copenhagen, Denmark, wants to improve the space in front of the gates of Tivoli Gardens by creating a recreational space of 10,400 m^2 for pedestrians and cyclists only. They are also planning to plant trees, lawns and flowers to make the place a new green park. As back as in the 1990s in Tel Aviv, Israel, a four-lane road was turned into a two-lane car road and a tree corridor with foot and cycle paths and sports fields. The Dutch city of Utrecht is planning to build a new district only one kilometre away from the city centre that will have 12,000 residents but none to own a car. It may sound utopian to some, but the Netherlands is accustomed to having car-free streets since the 1960s.

Public spaces worth mentioning are also emerging in Slovakia; for example, Comenius Square in Bratislava was created by turning a parking lot into a public space full of greenery, sitting options, street food and entertainment – all for free.

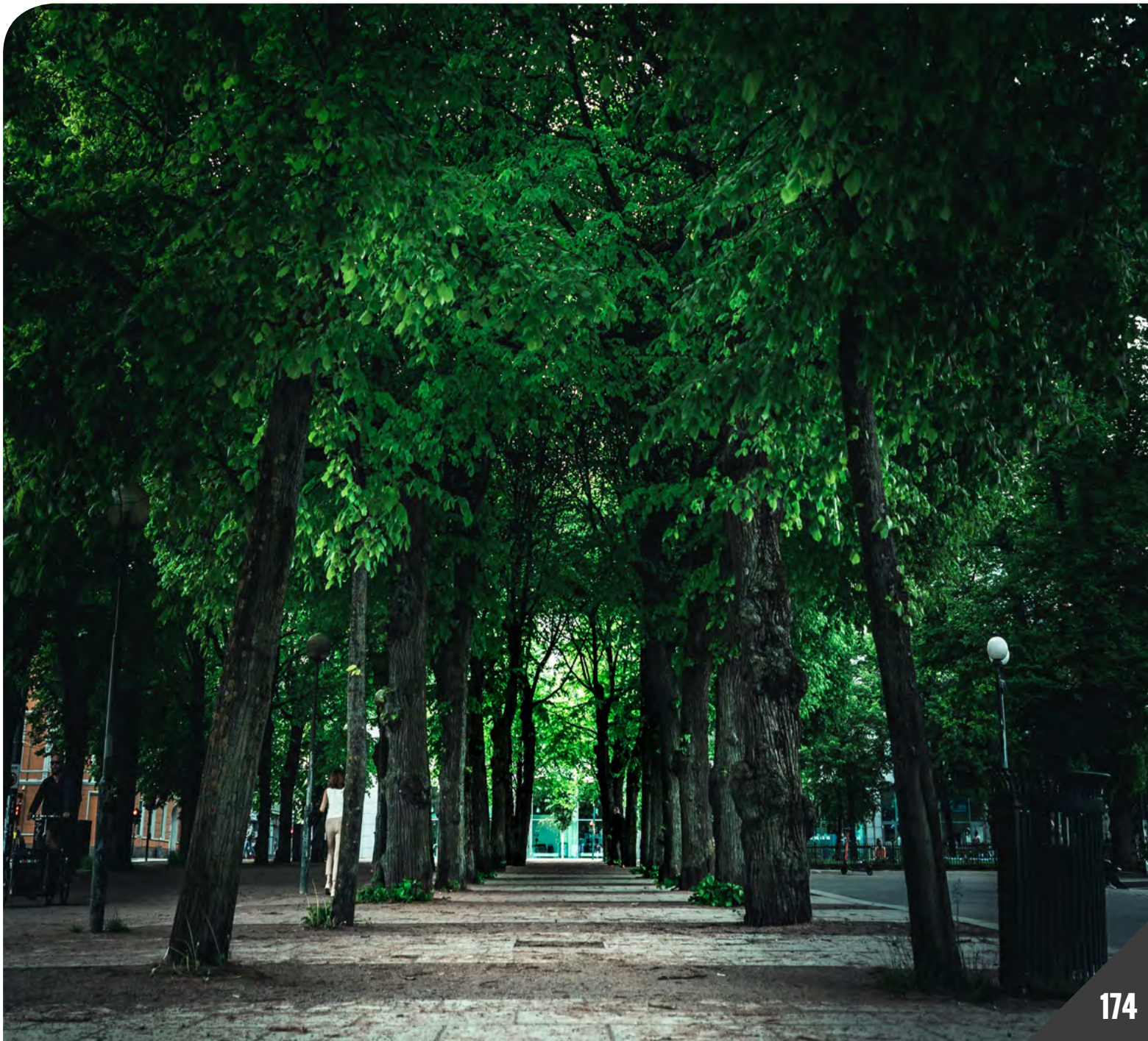
ACTIVITY

Take your students for a trip to the city centre. If you live in the countryside, take a trip to a nearby town familiar to the kids. Divide them into pairs, with each pair to have at least one camera-equipped smartphone. Their task will be to search for the town/city for green areas suitable for relaxation. Ask the students to look around the town/city centre to find where there are green spaces, where there are sitting areas, or where there is too much concrete or asphalt in one place. Ask them to take pictures of the sites and think about which of them make them feel nice and comfortable; which invite them to rest on a hot summer day, or if at all they would visit a place like that on a hot summer day; and how these spaces are used by the public. When back at school, look at the pictures together and write your notes of the places including descriptions in the table below. As an illustration, check out the description of a sample public space. Feel free to customise the table to your needs.

Public Space	Description	How it makes me feel and why	What it is like in summer	How it is used
St Anne's Square; rest area	The grassy area of approx. 10x10m; tall trees casting shadows; benches in place; asphalt all around	It is OK, you can sit around here; a good view of people walking through the square while I am sitting aside; a shade in the summer	People are sitting on benches, enjoying the shade and the quiet here	A sitting space for people to rest and relax after shopping; an ice cream shop nearby in the summer
St Anne's Square; benches in front of the local shop	Concrete/asphalt; benches in place; no trees	I don't like sitting here because shoppers walking in and out of the shop are passing both in front of and behind me	Too hot; no shade; the bench is not used too much as it is too hot to sit	The only people sitting around here are the elderly, tired after a long walk

ACTIVITY

Before leaving for the town/city centre, hand out the table sheets to the students so they can take notes right on the spot. At the end of the activity, make a list of spaces to relax in your town/city, and pick your favourite ones. Alternatively, you can suggest how to promote these spaces to the residents to use.



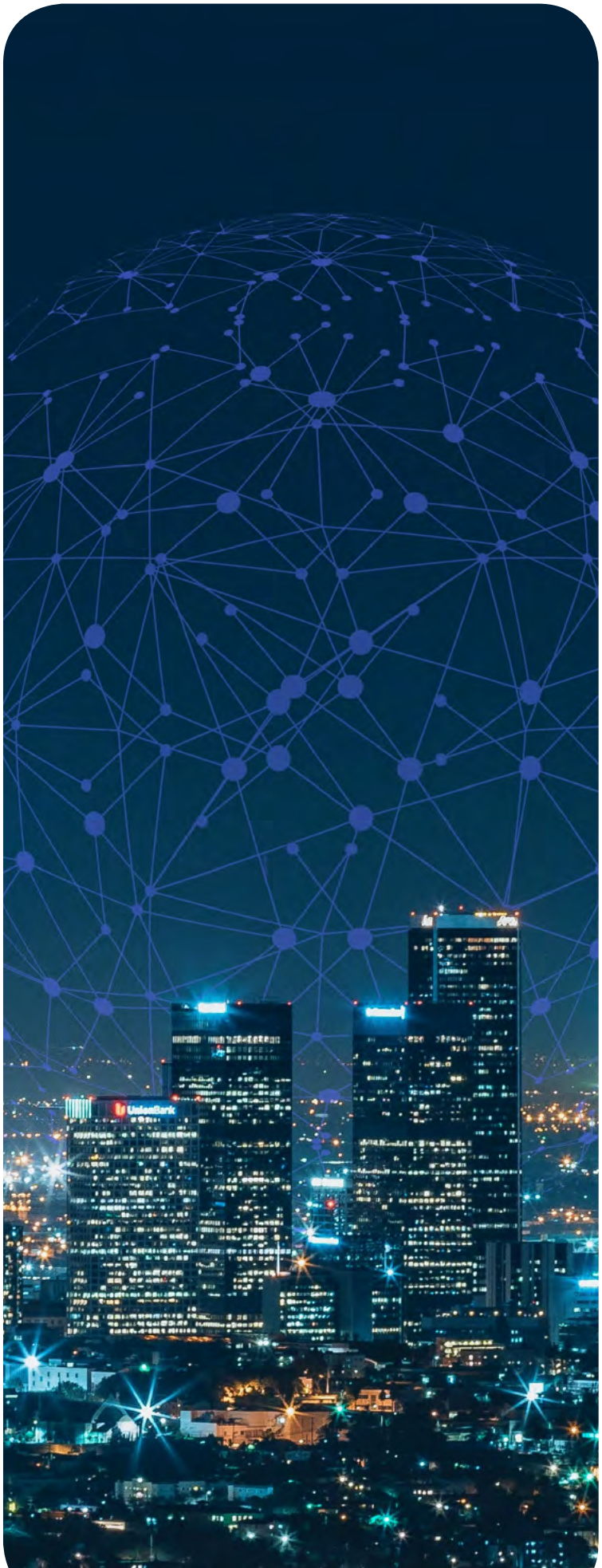
DID YOU KNOW?

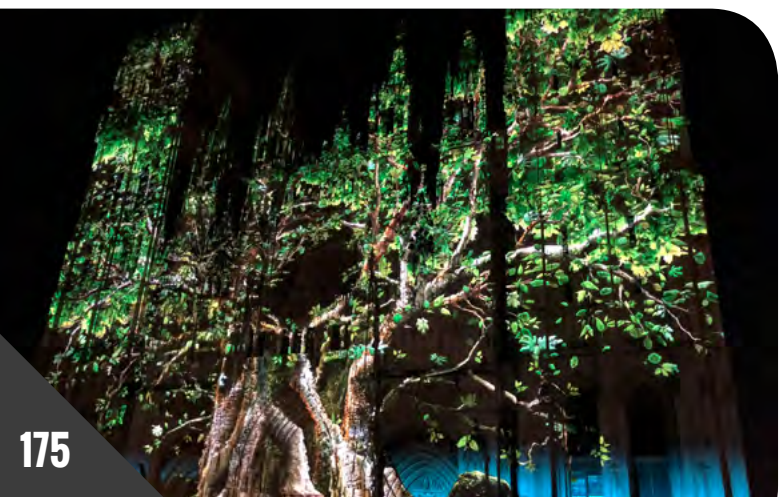
... Experts estimate that one in ten people throughout the world will live in a megacity by 2030. A megacity is a very large city, typically with a population of more than 10 million people. At present, the total number of megacities in the world is 29, with more than half of them in Asia.

... Tokyo is considered the most populous city in the world, with a population of around 38 million.

...If you are wondering about the future of human environment and urbanization, you might be interested in Virtual reality in construction.

... Spending time in the natural environment has a soothing effect, bringing about stress relief and relaxation and a sense of refreshment. To find out more information about the benefits, check the Europe-wide programme Healthy Parks Healthy People.





CONSUMERISM AND ITS ALTERNATIVES

"Future generations to live fifty thousand years later [...] will likely call us a fossil-fuel civilization, and our era will be termed the Carbon Age, just as we refer to the ancient times as the Bronze Age or the Iron Age."

Jeremy Rifkin, Founder and President of the Foundation on Economic Trends, and Advisor to the European Union
(From his book The Third Industrial Revolution)

Decades of stable growth in Europe and the world have changed the way of life known for centuries. People did not experience anything like abundance or even surplus in the past. Nowadays, we produce and consume way more goods and services, travel more frequently and over longer distances. The impact of our activities on the environment is increasingly greater and more obvious. This world and way of life have been created by us, and we keep struggling not to lose it. People do not shop because they need the goods they buy. Instead, they often shop to get spiritual or emotional satisfaction, trying to drive away from the bad mood with a new smartphone or a trendy piece of clothing. Overconsumption, wasting, and increasing supply and demand are among the features of the **consumerist way of life** you must have heard of.

The consumerist society is a material thing-oriented society. Sadly, a person's value is measured not by what he/she is, but by what he/she has. Besides, compression of services from multiple sites into an area as smallest as possible

in size is also characteristic of this type of society. This is why hypermarkets and supermarkets have been being built; they aim to satisfy the customer whatever his needs, to keep him on the spot for as long as possible, and to make it clear to him that he has the right to demand almost anything. And so there is a multiplex cinema along with a hairdresser's, international fast food shops, a pharmacy with a children's corner, a gym with a fashion boutique all in one place. A typical feature of consumerism is advertising, a powerful tool to stimulate demand. Advertising is often sophisticated, sometimes even aggressive, with the only goal: to play on our emotions for profit. Advertising creates false needs and artificial desires in society, effectively encouraging a culture of waste.

Alternatives to the consumerist lifestyle almost always include strategies to reduce consumption, resort to voluntary modesty and simple living, and use or own as few things as possible. The Zero Waste, Minimalism, or Simple Living initiatives as examples of this trend also help reduce the ecological footprint. Let us take a closer look.

IMPORTANT

Consumerism is a huge burden on the environment. The ozone layer, the loss of biodiversity, or climate change - these are just a tiny portion of the problems we face due to consumerism. In a sign of the light at the end of the tunnel, increasingly more people of today realise that change is inevitable. What once made them happy does not make them happy anymore, and they are seeking alternatives.

Zero Waste is a lifestyle that encourages the reuse of resources while generating no waste. It may sound a bit scary and unrealistic, but the fact is it doesn't have to be that hard at all. The Zero Waste philosophy comes down to five "5R" principles (by Bea Johnson, Zero Waste Home):

- REFUSE what you do not need;
- REDUCE what you really need;
- REUSE and repair;
- RECYCLE what you cannot refuse, reduce, or reuse;
- ROT the rest.

The subject of Zero Waste is covered more in detail in the WASTE section. In fact, Zero Waste does not have to be a total "zero" in terms of waste production, but it can get very close. Just as Bea Johnson, a zero-waste promoter did. Johnson, a US blogger and author of the book Zero Waste Home has managed to reduce her four-member family's annual waste to a jar. Deep down, how many jars do you fill with your household annual waste?

Minimalism (or minimalist lifestyle) is a lifestyle that prefers owning a usable minimum of things to gathering them. In fact, minimalism has no clear-cut rules or definitions. According to theminimalists.com: "Minimalism is the thing that gets us past the things so we can make room for life's most important things – health, relationships, passions, growth, and contribution." In other words, minimalism prioritises what is important in our lives and removes what is unnecessary.

FACT BOX

For more information on Zero Waste, please visit the Zero Waste International Alliance website at http://zwia.org/

Still, sounds too general? Let us explain with an example. Imagine you long to have a new smartphone even though your current model is still working – it is not broken nor have you lost it. When you buy the one you yearned for, you are excited – for a while. Your initial enthusiasm fades away over time because getting new stuff only brings fleeting joy. After a while, you long for another new something. By buying new things, we only gather stuff around us but never

improve our lives. But if we give our time to minimising such distractions and focus on the things that really matter instead, the quality of our lives will improve accordingly. In fact, we are not required to resist the joy of new stuff when pursuing minimalism; rather, by giving up on the unnecessary, we create space to enjoy the few remaining things to the fullest and then invest our energy in something more meaningful. After all, isn't the well-known slogan "less is more" about minimalism?

Simple Living is a response of the present day to overconsumption. Simply put, simple living involves a voluntary renunciation of one's own unnecessary consumerist desires. This lifestyle has a different meaning for different people. To some, it means to voluntarily give up on their TV set or car; to others, it means to simplify their diet habits or housing needs. The idea of simple living is thousands of years old. Just remember Diogenes of Sinope, the ancient Greek philosopher who decided to live in a barrel.

FACT BOX

The Minimalists is one of the most popular websites on minimalism.

Simple living is voluntarily chosen by those who are aware of their shared responsibility for the state of our world. And it is not so much about saving the world. Rather, it is about leading by example and living a more responsible life instead of just talking about it. One of the definitions of simple living says: simple living is a way of life that is simpler on the outside and richer on the inside. Sometimes it does not even take much to start: How about reading bedtime stories to kids instead of watching TV, or opting to walk or take a bus or train instead of using a car at least once a week?

FACT BOX

More information about simple living could be found in the book Voluntary Simplicity, 1981

FACT BOX

You can calculate your own ecological footprint on Footprint calculator.

The Ecological Footprint is a useful tool to determine our impact on the environment. It is determined by the number of planet Earths we need to support and sustain the way we live now. There are plenty of websites to calculate your own ecological footprint.

This century, humanity is going to face several global crises (including ones related to disease epidemics or pandemics, such as the COVID-19 pandemic in 2020) – which will require the governments around the world to spend billions of Euros, dollars, or pounds. Maybe it is time to think about how to use this money to change the current unsustainable model or the consumerist way of life to make it sustainable. Or is it not a question of money? Is it possible to start with yourself?

IMPORTANT

Take a moment to think about what exactly you want to pass on to your students. What can we do for them daily? Among other things, the least we can do is teach them how to live a more responsible life, e.g. using the above-mentioned alternatives to consumerism. If they know how to take care of themselves, they will know how to take care of the planet. Let us leave them with something better than just bleak prospects and obesity they would fight if they were left surrounded by piles of waste.

ACTIVITY

- Ask the students to choose one of the alternatives and explain the concept in their own words within 30 seconds. Called the "elevator pitch", the method teaches how to formulate your ideas clearly and concisely within a limited period of time. To illustrate, imagine you are travelling in an elevator with an important person, and you want to use the short amount of time you have on the elevator ride to explain to them your idea or position - knowing you will have no more chance to do so again.

- Ask the students to try for one week to give up on something that takes a considerable amount of their free time, such as watching TV, playing computer games, etc. Every student writes down on a piece of paper their own resolution on what they intend to give up on and then hands it over to you. In the next session, talk about how it turned out - if they succeeded in giving up on what they intended and how hard it was for them to persevere. Then encourage the students to team up and agree to one thing they will give up on as a group for one week. Assess their achievements in the next lesson.

DID YOU KNOW?

... Can you live a happy life with no more than 50 personal belongings? Colin Wright, labelled by many as an extreme minimalist, knows the answer. He is the author of several books for young adults. In his blog Exilelifestyle.com, he encourages his readers to vote on what country he would move to next every four months.

... A Slovak photographer walked a path of 3,000km across New Zealand with a backpack weighing just 12.2kg. That is what we call minimalism! The path he took is known as Te Araroa Trail (The Long Pathway) and is one of the most beautiful in the world. Just see the video about this trail for yourself.

... We could live on as little as 40 per cent of the energy we use today without having to give up on a single valuable thing. All it takes is to make small changes locally, such as in our homes, dwellings and settlements; this would make a huge global difference.

... There is a Global Ecovillage Network, which is an interesting alternative to explore human environments and settlements. See more info in their website ecovillage.org.

HUMAN ACTIVITIES IN THE ENVIRONMENT

Looking deeper into the past, we see that man used to be an integral part of the natural environment, using what he found for living, such as picking forest fruits and hunting animals for food. Initially, man adapted to the conditions of his surrounding environment just like other animals did. Unlike them, however, he began to actively change his environment and adapt it to his needs over time. Extensive deforestation associated with the development of agriculture, the incoming industrial revolution, the development of production, unilateral tillage and drying of land, the ruthless hunting of some animals and the accidental spread of plant and animal species – all this has significantly altered the natural ecosystems and disrupted the original ecological balance of the landscape, bringing about more environmental problems. Today, the severe human impact on the environment has made scientists believe that intact nature or ecosystems untouched by human intervention do not exist anymore.

IMPORTANT

There is no doubt that the growth of human population and its needs puts high demands on the environment. Our civilisation and technologies have affected the environment and changed it forever in an unprecedented way. While these changes are mostly negative, however, humans also have the power and the ability to mend the wrong and correct their mistakes. So, we do believe they still have a chance to change the environment for the better... That maybe, just maybe, it is not too late...

Below, take a look at some of the selected human influences on the environment which we consider to be the most serious on a global scale.

Overpopulation

Environmental degradation is one of the most serious impacts of continuing population growth. People need space to live, just as they need it for their agriculture and industry. To create space, forests are being cut down and fertile land being taken (with more and more people to be fed, paradoxically). With less and fewer trees to filter the air, the CO_2 levels are increasing, which may cause damage to all living things on the planet. Our dependence on fossil fuels for energy is another problem: the larger the human population, the more fossil fuels it needs. The use of fossil fuels, again, leads to release huge amounts of CO_2 emissions into the air... and the cycle goes on and on and on... It looks like we will keep on destroying the Earth until it destroys us.

FACT BOX

Do you wonder what would happen if every human suddenly disappeared? If so, watch an exciting video called: What would happen if every human suddenly disappeared? A similar subject is covered in the book "The World Without Us" by Alan Weisman (2007), in which the author offers an original vision of the world without humans and presents the reader with expert views on how Earth would cope with our creations should they be left to their own fate. If you want to know what the demise of the human environment would look like and which of the human creations would last the longest, this book is a must for you.

Agriculture and Genetically Modified Plants

Agriculture could have significant adverse effects on the environment, such as the loss of biodiversity, water and air pollution, climate change, soil erosion, and the use of large amounts of water for irrigation.

Non-native species have been brought to new locations, and grazing animals have contributed to many environmental changes, e.g. they have depleted native grasses thus contributing to soil erosion. Today we know that the rapid expansion of beef cattle has had its share in the changes in the composition of gases in the atmosphere. Recent advancements in the field of plant genetic modification raise concerns about the impact of newly developed crops on the environment and human health.

Adverse human impacts on the environment have even worsened with the industrialisation of agriculture. People are increasingly more aware of the impact of huge production farms on the environment and try to return to smaller farms or even urban or community gardens.
Moreover, agricultural activities are a major source of water pollution, like pesticides and fertilisers applied to crops can leak into rivers and leach into soil and groundwater, ending on the sea and coastal areas.

Deforestation

Deforestation has many adverse effects on the environment, including lowering oxygen levels (and increasing levels of greenhouse gases), increased risks of soil erosion, and the destruction of animal habitats. Estimates from a 2020 report by FAO say that up to 10 million hectares of trees are cut down each year to clear land for industrial and agricultural developments and to gain wood as a raw material to use to make products.

Air, Water and Soil Pollution

Human activities in industry and transport contribute to air pollution and increasing emissions of harmful substances released into the air. While it is difficult to identify as to which specific substances are harmful to humans, plants, and animals, it is widely acknowledged that air pollution can indeed

cause public health problems and also harm plants and animals. Pollution, however, is not limited to the air only. It can also affect soil as well as surface or groundwater sources. Toxins coming from industrial chemicals and municipal waste have a huge impact on the natural environment, which leads to environmental degradation and issues such as acid rain and the spread of algae in the marine environment amongst a great diverse of negative impact.

Climate Change and Global Warming

The most serious ways in which humans affect our planet includes the extraction and consumption of fossil fuels and the associated CO_2 emissions and greenhouse gases released into the air. Recent studies indicate that "CO_2 emissions contribute to the deterioration of the ozone layer, which may, in turn, contribute to global climate change" (Source: How do humans affect the environment?). This is especially true considering the current air pollution coupled with the reduced ability of forests to capture carbon (as a result of deforestation).

ACTIVITY

Divide the students into five groups and assign each group with one of the above human influences on the environment. Their task will be to think about whether this type of influence has any personal impact on them or the town/city where they live (for example, whether their region is affected by deforestation). If yes, what is the specific influence? To add more, ask them to think about the impact of this influence on the country where live.

DID YOU KNOW?

... In the 19th century, up to 80 per cent of Europe's population worked in agriculture compared to only about 20 per cent today. The declining trend is very likely to continue, as shown by the situation in Sweden where only three per cent of the population currently work in agriculture.

... The Anthropocene is already defined as Earth's most recent geologic time period as being human-influenced, or anthropogenic, based on overwhelming global evidence that atmospheric, geologic, hydrologic, biospheric and other Earth system processes are now altered by humans.

IT IS UP TO US!

"We are the first generation to feel the impact of climate change and the last generation that can do something about it."

Barack Obama, former President of the United States

Running tap water while you are cleaning your teeth, bottled water standing right next to the water tap, discarded chewing gum on the ground... These and other habits show clearly how unaware we are of our polluting the environment. And since we may be the last generation that can do something about it, we should get started – right off.

The best thing is to start with ourselves. If you don't know how, here are a few hacks for you. Maybe you are one of those who use or do things that pollute the environment without even knowing it.

Citizen science

Every person can make a difference, and collectively, as a member of a civil society organization can make a big difference. When one person, one family, one community, one town understand the reasons for making responsible environmental choices, there is a greater chance, the whole group will take those reasons to heart and incorporate transformative actions into their daily lives. Then the change is starting.

Many of us do not know fully the consequences of our own actions but it is through education, awareness building, self-control and participation in community organizations that we can ensure that the members of the community learn more about actions and significances on healthy quality of life, fair governance and environmental collaborative actions for a better global common future.

Here is the right moment when **citizen science**, as public participation in scientific research, can play a key role in the participatory process. The school group can easily collect and provide reliable information from different sources about community needs:

- the best and solid evidence about community's requests or thoughts,
- to improve a green park area,
- to enhance potable water access,
- to replace old electrical grids,
- to re-build a hospital,
- to build wastewater plants,
- to build a controlled community composting site,
- to change a legal procedure for community services,
- about any plans affecting the community,
- about the lack of teachers,
- about the reconstruction of roads, etc.

Actions for inspiration: In Spain, Divino Maestro School, located in Las Torres de Cotillas, in Murcia Region, was one of piloting school testing Bioprofiles indicators. Several primary and secondary classes worked with some indicators during the school year 2019-2020. After their school work, teachers and students decided to write an official letter to the local Mayor due to their findings. After monitoring the green area available to the town, they were surprised to find out that the collected data was showing their town doesn't have enough green areas for inhabitants (less than 10 m^2 per inhabitant). So they decided to ask the Municipal government to do something about it. An official written request, written and signed by the students, was submitted to the Townhall. On this document teachers and students were requesting the Town Mayor for a public land plot in town to be planted with trees and green coverage to enhance the area per person in this town. As a complement for this, the school offered to plant the trees, water them and care about this new green plot as a school project. As a response, the town hall started to look for the proper tree species for planting in drylands, the right access for watering, and some basic tools plus other educational materials for this school request. They all were started working together to improve the local environment and enhancing green coverage per person in town (on the picture you can see students presenting their findings to the Environmental Department Representatives from Las Torres the Cotillas Townhall).

TAKE ACTION

7 x DON'TS:

- **Do you use deodorants and hair sprays?** If you do, you unknowingly release aerosols into the air, which are among the worst air pollutants. Moreover, they damage the human and animal lungs and get into their bloodstream.

- **Avoid bottled water**. There are too many plastics around us anyway. Tap water is treated for drinking and sometimes even tastes better than the bottled water that has been plastic-packed for weeks or even months.

- **Chewing gum has no place on the ground**. Besides the fact that it sticks to your shoes and is almost impossible to remove from clothing, it causes problems or even death by suffocation to small animals, such as birds that confuse it with food.

- **Do not dispose of used batteries in municipal waste**, as they contain hazardous toxic substances. Even one small battery can contaminate up to 3,000 litres of water.

- **Do not release helium-filled balloons into the air**. They are dangerous for birds, fish and marine animals that confuse them with food.

- **Do not use single-use plastics**, such as disposable bags, coffee cups or straws. This only increases the already enormous amounts of waste.

- **Avoid products containing palm oil**. Not only do they contain saturated fatty acids which may cause cardiovascular diseases, but also huge areas of tropical forests, especially in India and Malaysia, are burned each year to clear space to grow oil palms.

TAKE ACTION

7 x DOS:

- **Separate your waste**. This will allow it to be further processed and reused.

- **Recycle and reuse your waste** whenever possible. Think twice before throwing anything away and consider whether it can be reused or used differently.

- **Save energy**. Turn off the light if you don't need one, and use energy-saving LED lights. Check your home electricity contract and reduce your incoming power according to your own needs.

- **Eat healthy foods and prefer local produce**. Fruits and vegetables from local retailers did not need to travel long distances to get to your plate, meaning they did not leave behind a big ecological footprint. If you eat bananas and drink coffee every morning, how big do you think your ecological footprint is?

- **Stop the water tap if you do not need running water at the moment**. Even an innocent dripping tap can make a few litres before you notice and have it fixed. More than 8,000 litres of water flows up through a dripping faucet, which may cost you more than €40 for cold water and even four times more in case of hot water.

- **Walk more**. Or ride an environmentally-friendly bike. You will please the environment and your health.

- **Grow flowers and medicinal plants at home**. Just like trees, flowers produce oxygen - and make your home more beautiful and cosy.

It is very important nowadays to learn how we can gather together with others using networks or groups, or associations since to transform and influence social structures in the human environment, we must be more than ONE, remember that one butterfly does not make the springtime.
So, GO, gather with others, look how you, your community can influence and participate actively to rule, to govern your territory improving the surroundings for all, looking for the common good. It will take time but remember that a trip of thousand miles starts with just one step.

There are many things we can do to improve our environment. And some of them cannot be done by anyone else but us. Maybe there will be someone to pick that chewing gum you dropped the other day, but who will be there waiting in your bathroom to stop the running tap every time you are cleaning your teeth?

Go out. Look around and think about the environment you would like to live in. What do you dislike about the current one? What do you miss and what would you like to keep for the future? In another step, think about what you can do to make it happen.

IMPORTANT

We must protect and cultivate the planet Earth, our only home. It is in our existential interest. Earth will survive regardless of whether we make it or not. But our own existence is uncertain...

Mother Nature is relentless; she can forgive but will not do it indefinitely. So, the best thing is to treat her well - and maybe, just maybe we can make up for the damage that has been done already.

Humans affect the environment in many ways and each one of us must be aware of our own personal environmental impact.

The best time to act was yesterday.
The best we can do today is to get started.
If we wait until tomorrow, it may be too late.
We all as individuals and the entire society need to help ourselves survive.

DID YOU KNOW?

... Within a century, we will have lost around 67 per cent of the fauna currently endangered, while 99.9 per cent of species will be at grave risk of extinction, says the International Union for Conservation of Nature and Natural Resources (IUCN).

... The sea level has risen by 20 cm since 1880. By 2100, it is expected to have risen by another 30 to 122 cm.

... There is a term "Smart City" to describe the introduction of advanced technologies in urban environments to improve the quality of life. Smart Cities include Luxemburg, Amsterdam, Zürich, and Ljubljana.

... There is a term "Smart Environment", where care is taken to preserve the natural and human environments in their mutual interaction. It would be nice to live in such an environment, don't you think?

ACTIVITY

- Work with your students and find local fruits and vegetable retailers or local community gardens in your area. Make an appointment with one of the products retailers or community garden organisers. Suggest the students play journalists to ask the retailers questions about their experiences and reasons why they launched their business, what kind of problems they are facing, etc. The students then draft a newspaper article promoting the local retailer or community garden. Select articles that have appealed to you the most and offer them to your local newspaper to publish.

- Take a walk around your town/city with your students. Task them to think about what kind of environment they would like to live in, what they dislike about the current one and what they miss - or what they like about it and would not change at all. Write your ideas on the blackboard. Think about them together or in groups and say what needs to be done to make each particular idea come true.

CONCLUSION

Have you ever thought that our lack of interest in the environment may be rooted in the fact that we have somewhat "cut ourselves off" from the natural environment over time? Sometimes we don't even know what there is on the other side of the door - outside. Humans are adapted to walk and run. Exercising in fresh air has a more soothing effect than sedatives before sleep. If we sit in front of our TVs at home, we will never know what the world outside looks like or that the air we breathe is polluted. We can never know the taste of fresh spring water or what the river looks like, as the only water we get in touch with is tap water (not to mention its being chemically treated or even bottled in plastic!). With the benefits of virtualization, we can now view the natural and cultural heritage sites on the Internet, so why bother travelling and sightseeing? All waste we produce ends up in waste bins in the streets right in front of our homes, but we do not care about where it goes from there. If we need energy, we just turn on the switch - and there is light! But where does it come from? Well, from the switch, of course! If we need to get warm, very few of us need to walk out to the woods to bring some wood for the stove to heat our home; instead, all we have to do is turn on the heater (or if it is too hot, we turn on the air conditioner, one way or other).

But where exactly does the heat come from?
Who makes it for us and from what?
How can we notice the loss of biodiversity if we do not go out?
Plants that once used to grow on pastures are very hard to find today... or no longer to be found at all.

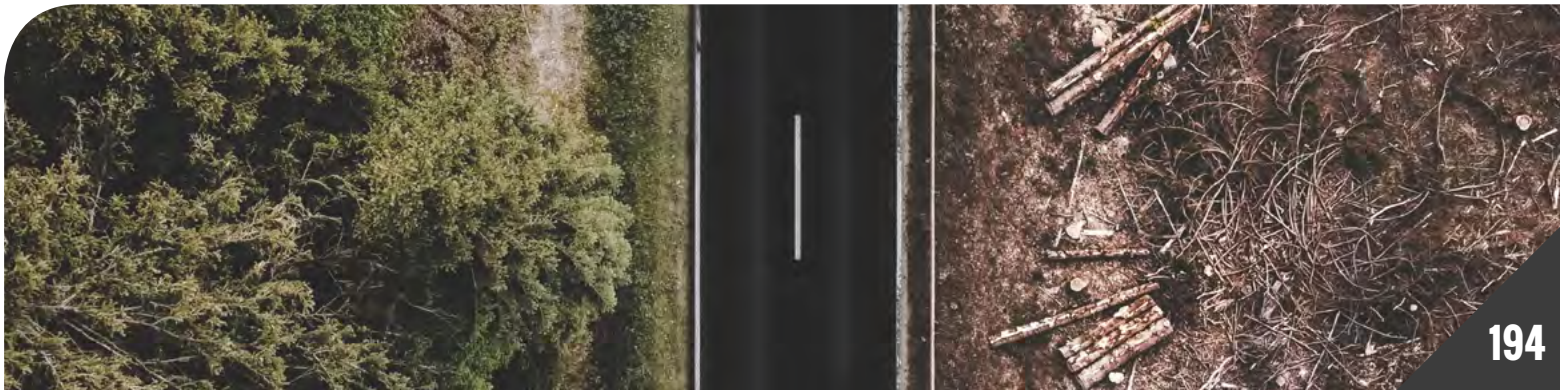
Even without us turning on the computer, the world today resembles virtual reality more than it does the real world. The most real world is out there, outside our windows. **So, go outside!** And take your students with you. If you want them to cherish and protect the country they live in, the first thing they need to do it get to know and experience it first-hand.
We hope to meet you out there one day!

BIOPPROFILES project partners

AFTERWORD

The climate, water, soils, flora and fauna all over the Earth are currently undergoing huge changes. So far, unfortunately, for the worse. Rising average temperatures on Earth are one of the many impacts of climate change over the past decades. Due to the heating of our planet, land and alpine glaciers are melting, the level of the world's ocean is rising, the weather is fluctuating, and temperature extremes are frequent. Every day, we witness reports of devastating floods, forest fires, or hurricanes in areas where they did not occur before. High concentrations of greenhouse gases in the atmosphere are leading to the acidification of the seas, coral reefs are dying out, fish migration routes are changing and all underwater life is also changing. And so the question is, "Is humanity able to reverse this trend?" In response, there is another question: "Is environmental education still relevant?" YES, definitely.

Although people's thinking is gradually changing and there are concrete results, there is still room for improvement. The constant dissemination of environmental knowledge and information undoubtedly plays an important role in solving global problems, sustainable development and protection of the environment and biodiversity. Certainly, no one doubts that environmental education is an important element in the strategy of environmental care. It resonates at different levels of schools in different subjects. Most subjects from biology, geography and civic education, through the languages, mathematics and physics to art education can participate in the implementation of the cross-curriculum theme of environmental education for students aged 10 - 15 years. It is only up to the teachers how they can use the topics of their subjects to stimulate students` interest in current environmental problems and inspire them to know the problems and especially to understand them. It is the knowledge and understanding of environmental issues that are a priority condition for students' access to effective and active protection and sustainable development of the environment. The new concept of school teaching based on educational cycles and digitization, which is being recently discussed in the context of current and future pandemics, may open the door to better implementation of current environmental issues. The handbook



"TEACHING GREEN. Teach Locally, Think Globally." can also be an excellent tool not only for the teaching process itself but also for extracurricular activities. It represents a suitable information source for teachers, with several inspirations for practical environmental education and its implementation in daily life. It can be used not only in the educational process but also in the subsequent implementation of educational activities, workshops and other information events.

It does not matter in which part of the world we live, the climate crisis and its consequences, but also inappropriate human activities in the landscape, can manifest themselves practically anywhere and at any time. And finally, perhaps, the most important thing. Humans still have a chance to prevent the much worse and lasting consequences that could have apocalyptic proportions.

Mária Bizubová, the University Teacher at Comenius University in Bratislava, Slovakia, the author and co-author of several textbooks in ecology, biology and geography for primary and secondary schools

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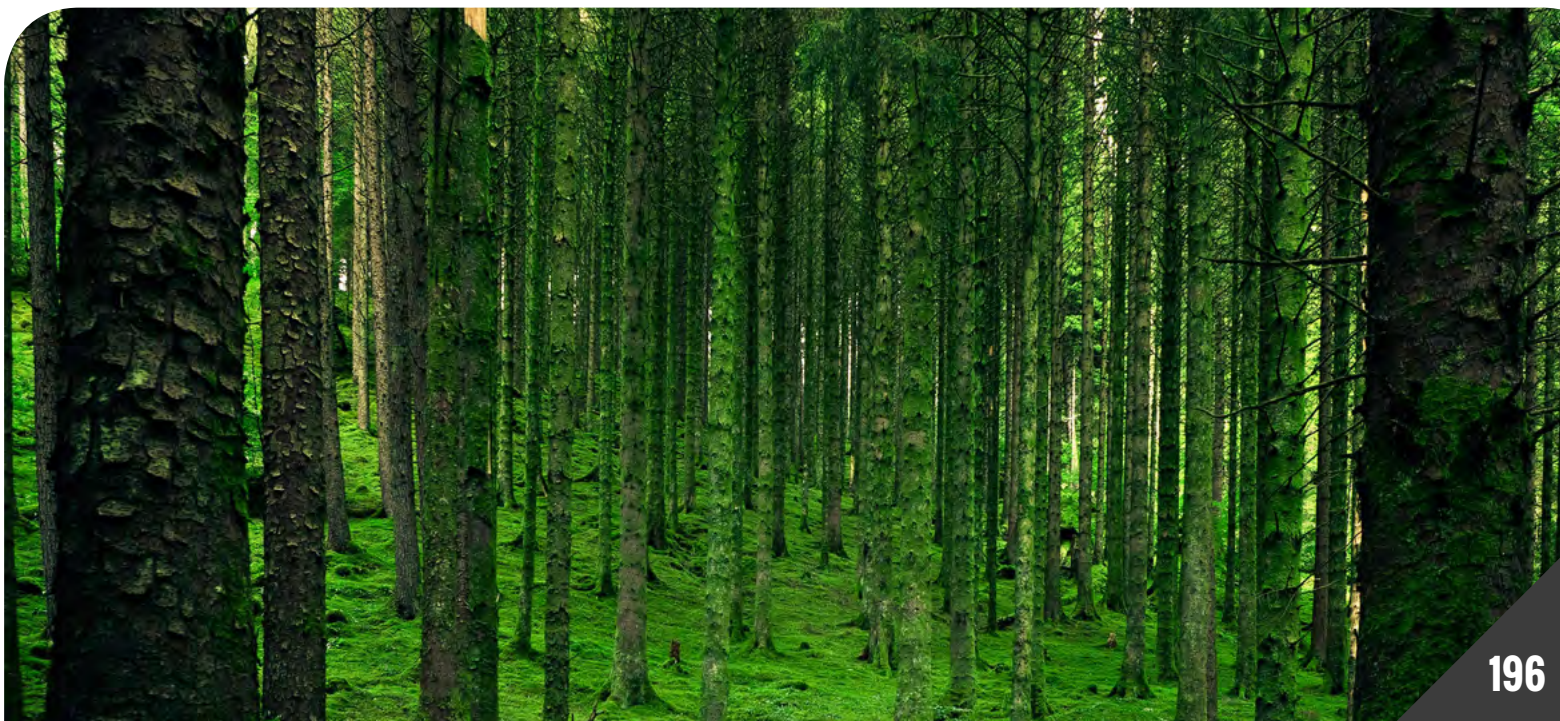

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Authors: Adriana Kováčová, Mária Bizubová, Juan Diego López Giraldo, Mary Jackson, Imrich Jakab, Jozef Kahan, Luciano Massetti, Iveta Palúchová, Peter Petluš, Viera Petlušová, Zuzana Pucherová, Ruth Staples-Rolfe, Janka Sýkorová, Francesca Ugolini, Katarína Veselovská, Martin Zemko

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