LEVEL	1
LEARNING OUTCOME	LO2 Students can follow the principles of sustainable development and environmental system management
SPECIFIC LEARNING OUTCOME	Students can identify major sustainability challenges
KEYWORDS	Sustainability challenges: waste, energy, climate, food, biodiversity, social inequalities
INTRODUCTION	All the major sustainability challenges we are facing nowadays are human impact-related. In this learning unit you will discover which are these challenges and why we should all take them into account.
HOW TO WORK WITH THIS MATERIAL	Read the text and follow the instructions
TIMING	approx. 4 hours

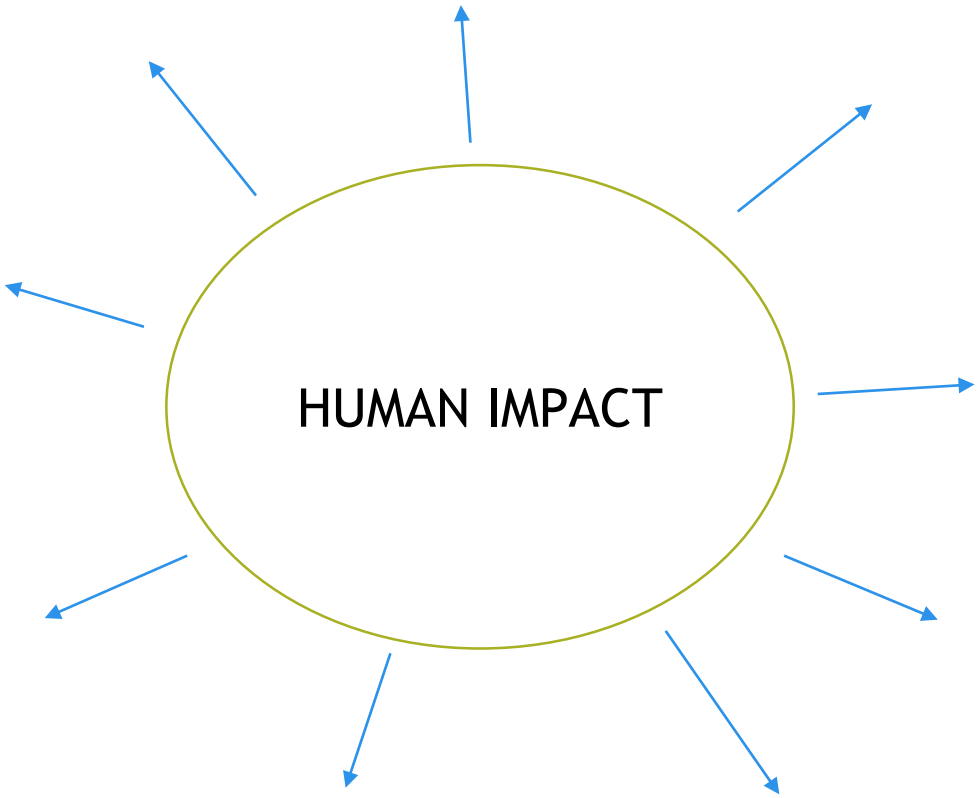
Co-funded by the Erasmus+ Programme of the European Union

1. First activity: What do you know?

Let's start with a simple and useful activity!

When you think of human impact on Earth, what come to your mind?

Try to write in the diagram below, at the end of the arrows, all the keywords that come to your mind. Take your time!



Co-funded by the
Erasmus+ Programme
of the European Union

Are you done? Talk to your classmates and teacher to reflect together on the results of this first activity.

2. Human impact: a definition for us

Human impact on planet Earth is an important topic that we have to bear in mind every time we make choices. **All human actions involve impact**. We must learn to foresee all the possible consequences of our actions and, above all, promote positive actions that respect the natural balance of the planet as much as possible. Since ancient times, our species learnt to exploit everything that the environment offered, improving their living conditions, multiplying and colonizing gradually every liveable area. Thanks to the ability to use tools, transform raw materials into resources, create more and more efficient machines, human beings have finally become the most adaptable species of our planet.

Unfortunately, also the only one creature capable of bringing very deep changes linked to its presence.

This is environmental impact: **an alteration from a qualitative and quantitative point of view of the environment linked to human activity**. In other words, we can speak of environmental impact every time someone carries out an action that has a direct or indirect consequence on the Planet and its resources.

Unfortunately, these changes negatively effect the delicate natural balance and often return as enormous problems to us. Finally, the unfair use of resources and the related consequences triggered by the human impact on the environment have

Co-funded by the Erasmus+ Programme of the European Union

led to the emergence of social and economic inequalities.

Waste, Pollution, loss of biodiversity, climate change and social inequalities are current issues that constitute threats to be overcome for a sustainable future. All the forms of environmental impact are interconnected and feed on each other. We have to find right solutions as soon as possible: this is our challenge!

Let's talk about these topics one by one.

3. Waste

3.1 Activity: look at the pictures and answer the questions

How many kg of waste is produced by a person, on average, in your country? _____

Is this value higher or lower than the European average? _____

How many of yourself does it take to weigh as much as the amount of kg of waste produced by a person in your country? _____

What type of waste can you recognise in the photo?

Co-funded by the Erasmus+ Programme of the European Union

_____

_____ _____

How do you think these types of objects reached the sea? _____

_____

_____

Try writing your own definition of waste here: _____

_____

_____

_____

3.2 Waste: the most visible effect of human presence

In all the places reached by human beings, but also in those where they have never arrived, it is always possible to find some signs of their passage through waste.

Referring to the law we can define them as "**Any substance or object that the holder discards or has decided or is obliged to discard**". Waste is the symbol of industrialisation and consumerism. Everything we use, consume or transform will become waste!

In Nature there is no concept of waste: in biological cycles, in fact, what is discarded by an organism becomes one resource for other living beings. **Nothing is wasted but everything is transformed**.

Until the last century, human beings behaved very similarly to nature. The advent of the industrial revolution and the increase in goods placed in companies also led to an increase in consumption and therefore, an increase in waste. In the current social and productive models, matter and energy are taken from the environment to produce consumer goods and that process is followed by a production of waste. These are not just organic like those of pre-industrial society, but they are also inorganic (such as **plastics, metals, fibres, parts of electronic devices**) and often remain in the environment for a long time because they do not represent a source of nourishment for any organism. This implies two things: first of all, that waste is generated both by us during our daily activities and by industries that produce the things we consume to live; second point, there are no scavengers who

Co-funded by the Erasmus+ Programme of the European Union

FROM GARBAGE TO DIRT: The Decomposing Time line

can reuse a large part of our waste and therefore these accumulate in large quantities. In the picture below you can see how long it takes some waste to decompose in nature.

3.3 Why is waste a problem?

The accumulation of waste or its inadequate management alters our entire planet by promoting cause-and-effect reactions that are beyond our ability to remedy them. **Pollution** of water and the atmosphere, **loss of biodiversity**, **climate change**, etc. are just some of the consequences of waste accumulation. Directly or indirectly, everything we leave in the environment returns to us as a threat.

A very current example is plastic pollution in marine and coastal ecosystems (see in-depth material below).

Co-funded by the Erasmus+ Programme of the European Union

Landfills, considered as a last resort in waste management, can contaminate soil and water and release methane, a very powerful greenhouse gas linked to climate change. Illegal activities, such as illegal dumping, burning or exporting, also play a role, but it is difficult to estimate the true extent of these activities or their impacts.

Finally, waste also represents an economic loss and in some areas of the World many people live close to mountains made of garbage accumulated year after year.

Make this quiz about plastic waste in oceans and test your knowledge!

https://www.earthday.org/oceans-and-plastic-pollution-quiz/

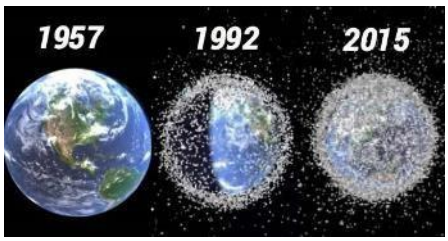
3.4 Learn more about waste!

If you want to learn more, we will suggest you the following material:

Waste in space:

Do you know that human beings have not limited themselves to create waste exclusively on Earth but have also created it in space? Look at this poster!

https://assets.rbl.ms/19822258/origin.jpg



Albatross and plastics: sometimes our waste in ocean may be regarded as food by albatrosses, a sea bird. Look at this short video and pay attention: the images can be very strong.

https://www.youtube.com/watch?v=yySqrKaDrRk&feature=youtu.be

Plastic islands in Oceans: do you know that all the waste that arrived in the sea year after year led to the formation of huge floating islands of plastic in the oceans? You could find more information on this website and on this video.

https://stories.visualeyed.com/garbage-island/

https://www.youtube.com/watch?v=MnCbTTTi7ic

Co-funded by the Erasmus+ Programme of the European Union

Indian landfills: India is famous for the largest landfills on the planet. The waste forms real hills on the outskirts of the cities with which human beings have to live. See this video to understand how can be difficult live there.
https://www.youtube.com/watch?v=iMgNpafyvFI

4. Fossil fuels: let's talk about it!

4.1 What are fossil fuels?

In the recent history of humankind, the discovery, transformation and use in many sectors of fossil fuels, such as **coal, oil and natural gas**, certainly plays a fundamental role. **We can say that we have reached total dependence on fossil fuels for most human activities**. Transportation, energy and plastics are some clear examples of the importance of fossil fuels around us.

Fossil fuels are those fuels that derive from the transformation of organic matter into more stable and carbon-rich forms.

Why are they so important? Basically, because they have **a high energy / volume ratio**, they are **easily transportable and storable** and **still cost relatively little**, even if it must be emphasized that the price per barrel of oil has increased, from 11 dollars in 1998 to 60 dollars today, by almost 600%. On the other hand, they have **several disadvantages**:

- They are very polluting
- Cause an increase in CO_2 in the atmosphere, a greenhouse gas that is not polluting but crucial for global warming.
- They are not renewable, since the fossilization process of organic matter is very long (millions of years) and the quantity that fossilizes is minimal compared to man's energy needs.

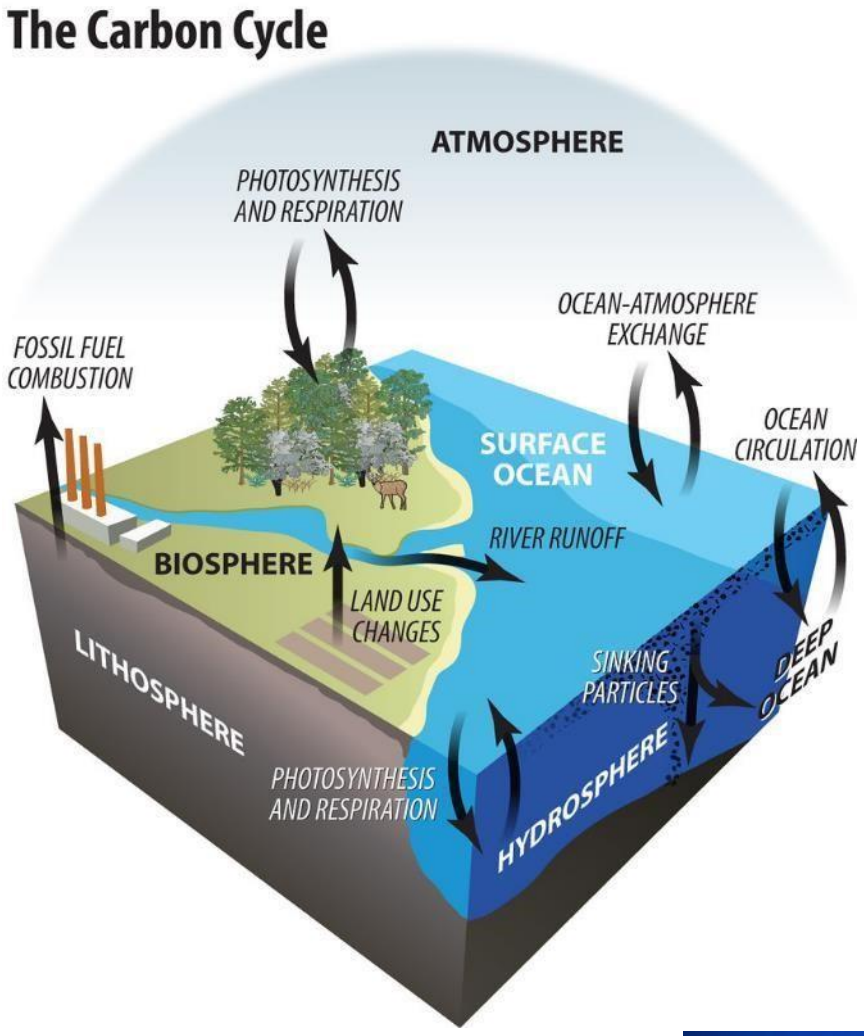
Co-funded by the Erasmus+ Programme of the European Union

If you want to know how fossil fuels are formed, see this short video:
https://www.youtube.com/watch?v=zaXBVYr9Ij0&t=137s

4.2 Fossil fuels and the carbon cycle: let's play!

To understand the complexity of the environmental impact associated with fuels, we must remember that these substances are formed by molecules rich in carbon. The energy is stored in the chemical bonds of these molecules, defined hydrocarbons, and it is released through combustion. The amount of total carbon on our planet is constant and is stored in

Co-funded by the
Erasmus+ Programme
of the European Union



systems called **reservoirs** in the form of different molecules. Carbon is not stationary but can move from one tank to another through specific paths defined **processes**.

The biosphere, fossil fuel deposits, the atmosphere, carbonate rocks are carbon reservoirs, are processes combustion, photosynthesis and precipitation of carbonates. The use of fossil fuels leads to the displacement of the carbon contained in the deposits directly into the atmosphere in the form of CO2, one of the main greenhouse gases, the primary cause of the ongoing climate change.

If you want to learn about carbon tanks and processes, play this online game:

https://www.brainpop.com/games/carboncyclegame/

You will win if you are the fastest to move more carbon into the right **reservoir** using the right transfer **process**!

Co-funded by the Erasmus+ Programme of the European Union

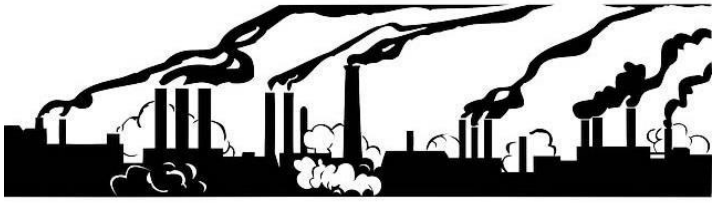
4.3 Fossil fuels influence Earth

The impact of fossil fuels on terrestrial balances is articulated and complex. Let's deepen some impacting mechanisms.

If we consider the process of extraction and transport of oil, we often witness accidental spills both at sea and on land. In this case we are talking about **environmental contamination** (of soil, air and above all water) caused by all kinds of liquid hydrocarbons, or by crude oil or its derivatives. In land-based oil fields the harmful spills are due to poor design, management and maintenance of the plants. In these way entire ecosystems are destroyed: habitats undergo radical transformations and all living organisms die.

The most significant impact, however, remains that linked to the use of fossil fuels. **Burning coal, petroleum derivatives or methane, produce air pollution**. Fine dust and many toxic substances are released into the atmosphere, giving rise to acid rain, smog and finally everything is then carried into our body through breathing and our health suffers the worst damage.

Why do human beings have so much need to burn fossil fuels? The answers is simple**: we live in a period characterized by mass transport and very high consumption of electricity**. All types of transport used by us, both on and off the road, consume great quantities of petroleum derivatives every day. On the other hand, all production activities and our everyday life is linked to **electricity**.



Unfortunately, more than 90% of the world's electricity is still produced through thermal power plants where coal or methane is burned.

Have a look at this site if you want know more:
https://energyeducation.ca/encyclopedia/Energy_production

Last but not the least is the relationship between fossil fuels use and the Climate Change. We will deal this last topic in detail in the next paragraph.

Co-funded by the Erasmus+ Programme of the European Union

4.4 Activity on Smog

If you want to know all the curiosities about smog, click on this link and you will find nice job for you in two steps: watch short video first and after answer to the questions in THINK section. Compare with your classmates or with the teacher your answers.

This is the link for you: https://ed.ted.com/on/gp8AOaSJ#watch

5. Climate change: a complex phenomenon

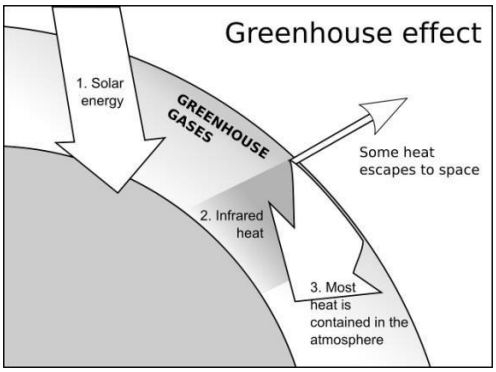
Another important example of man-made environmental impact on a global scale is climate change. We could define it as **global phenomenon of climate transformation characterized by the changes in the usual climate of the planet**. Include the increased temperature trends described by global warming, but also encompass changes such as sea level rise; ice mass loss in Greenland, Antarctica, the Arctic and mountain glaciers worldwide; shifts in flower/plant blooming; and extreme weather events and many others phenomena.

Do you know the difference between Clime and Weather? If you are not sure of your knowledge, discover the differences through this video:

https://youtu.be/vH298zSCQzY

Let us see one by one the main topics of climate change: greenhouse gases, global warming and final visible effects on our planet.

5.1 Greenhouse gases



Greenhouse gases are normally present in the atmosphere that act by increasing the temperature of the planet and ensuring the conditions for life on the earth's surface. These gases allow themselves to be crossed by the solar radiation entering towards the earth's surface but are able to retain, in a consistent manner, the infrared radiations emitted by the earth's surface, the atmosphere and the clouds. In this way the heat connected to the infrared radiation does not return to the space and is retained.

Co-funded by the Erasmus+ Programme of the European Union

This process is called the **greenhouse effect** since it is the same mechanism that we can observe in a glass greenhouse: the sun's rays pass through all transparent materials while infrared rays do not.

These gases, usually present in nature in small quantities, are increasing more and more because they are produced by human activity.

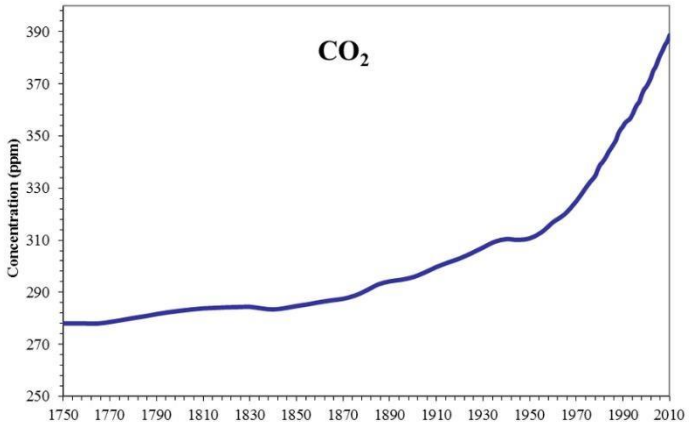
Natural greenhouse gases include carbon dioxide (CO_2), water vapor (H_2O), nitrous oxide (N2O), methane (CH_4) and ozone (O_3). Some human activities, in addition to increasing the level of all these gases, also release other greenhouse gases into the air such as sulphur hexafluoride (SF_6), hydro-fluoro-carbides (HFCs) and per-fluorocarbons (PFC).

It is important to remember that the percentages of these gases in the atmosphere are of the order of parts per million (ppm) and that very small variations can trigger significant changes.

Water vapor is the only greenhouse gas that doesn't undergo substantial variations in concentration in the atmosphere linked to human activity. The water cycle works by restoring the right percentages in the main water tanks very quickly.

The **CO_2** emissions are a direct consequence of industrial activity typical of developed countries linked to the use of fossil fuels fossil fuels. We all also produce carbon dioxide, both through our breathing but above all through our daily consumption:

-Keeping a light bulb on for 4 hours produces 0.2 kg of CO_2.



-Taking a shower means expelling 1 kg of CO_2 into the air

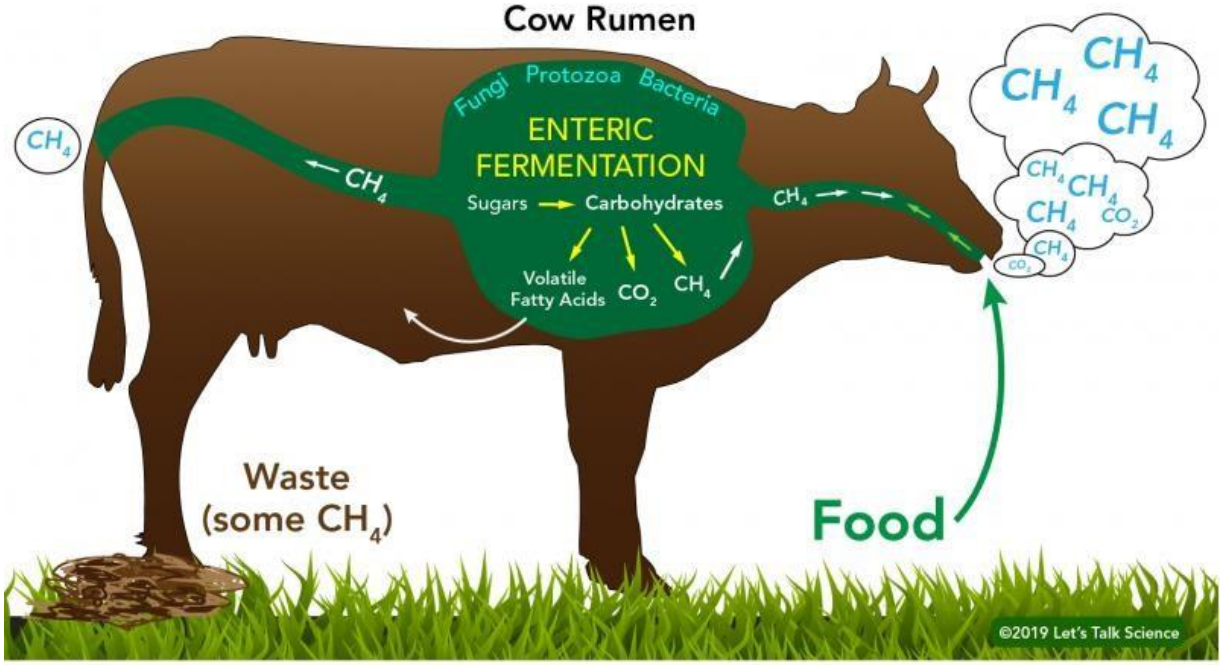
-Washing in the dishwasher is equivalent to taking a shower, 1 kg of CO2 in the air

-Keeping a freezer running means generating 40g of CO2 per hour.

The amount of carbon dioxide is increasing year by year as you can see from the diagram. If we consider **methane** (CH4), in addition to one that escapes from human extraction of hydrocarbons, this gas reaches the atmosphere also for activities related to agriculture. In fact, important quantities of

Co-funded by the Erasmus+ Programme of the European Union

methane are a consequence of the fermentation of organic materials in the marshes and of biomasses (organic residues of different origins), which



develop biogas. High methane emissions occur in cattle and sheep farms, which produce methane in the digestive processes by bacteria present in the stomach.

Methane persists in the atmosphere for far less time than carbon dioxide (about a decade) but it is much more powerful in terms of the greenhouse effect. In fact, pound for pound, its global warming impact is 25 times greater than that of carbon dioxide over a 100-year period. Globally it accounts for approximately 16 percent of human-generated greenhouse gas emissions.

Since the first industrial revolution, man has been causing a progressive and dizzying increase in carbon dioxide and methane and their constant growth is the main cause of **global warming**.

5.2 Activity: Make a solar oven!

Do you know you can use the same principle of greenhouse effect to build a simple solar oven to heat your sandwich? If you want to build one with the help of your teacher, here you will find all the information:

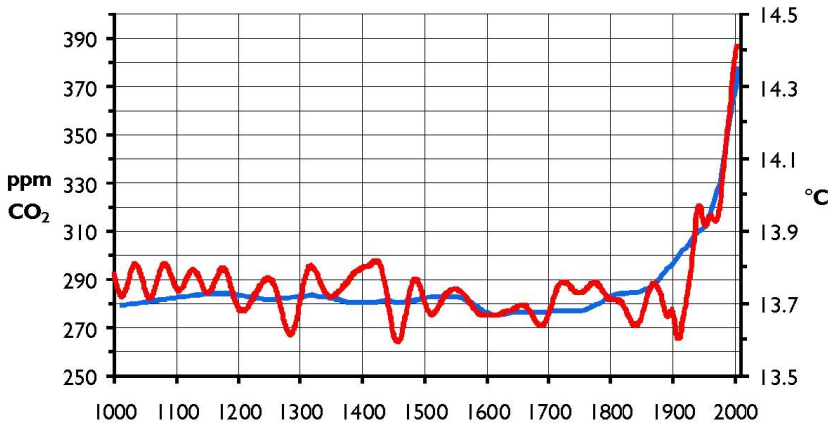
https://climatekids.nasa.gov/smores/

Co-funded by the Erasmus+ Programme of the European Union

5.3 Global Worming and Climate Change

Global warming is the most important but not the only one aspect of climate change. It refers to the rise in global temperatures due mainly to the **increasing concentrations of greenhouse gases** in the atmosphere. The increase of temperature of our planet in the last century was only 0.6 Celsius degrees but led to enormous alterations in the parameters and characteristics of the climate of many areas of the globe. Starting from global warming, what follows is a complex succession of cause and effect reactions that lead to changes that are not always predictable and increasingly complex in the climatic characteristics of the Earth.

During its geological history, our planet has already had periods characterized by global warming exclusively due to natural phenomena. **The speed with the current global warming occurred, however, is justifiable exclusively as a consequence of the human impact on the atmosphere.**



There is a direct correlation between an increase in CO2 in the atmosphere and an increase in the average temperature of the planet. Human activities are estimated to have caused about 1.0° C of global warming above pre-industrial levels, with a possible range of 0.8° C to 1.2° C. If it continues to increase at the current rate, global warming will likely reach 1.5° C between 2030 and 2052 ".

The terms *global warming* and *climate change* are often used interchangeably, but they have distinct meanings. In addition to the rise in air temperatures, climate change encompasses changes in other elements of climate such as precipitation patterns, winds, and ocean currents. Global warming is a single aspect of the more complex phenomenon of climate change.

Climate Change is a significant change in climate that is directly or indirectly attributable to human activities. We can therefore define that the main cause of climate change is

Co-funded by the Erasmus+ Programme of the European Union

human activity and the increase in the greenhouse effect linked to the alteration of the gaseous composition of the atmosphere. What we actually see are the effects of climate change. These effects are closely interrelated and feed on each other. We can call it **Feedback mechanisms**; in this way the more we go forward in time, the less chance we have of controlling and re-dimensioning the phenomenon. Let's see the visible aspects of climate change!

- The **global warming** represents the first observable and scientifically monitored element: In this video you can see how the average temperatures of the earth have changed since 1884: https://youtu.be/gqBCzWTs3r4

- A direct consequence of global warming is the continuous **melting of ice** associated with the two polar caps and high altitude glaciers. Every day huge amounts of water pass from solid to liquid, drastically reducing the habitats connected to the delicate polar ecosystems. Have a look at two photos of the same Italian Alps glaciers after 30 years.

• If the ice melts, huge quantities of water flow everyday into the sea and another phenomenon symbolic of climate change makes its way: **the raising of the sea level.** Slowly the emerged lands shrink the coasts retreat due to regressive erosion and many coastal cities have to deal more and more often with the advance of the sea.

- **Extreme weather events,** such as cyclones, typhoons, exceptional rains and heat, are phenomena that are increasing widespread. This trend will continue to be more and more frequent and disastrous for both the environment and humankind. Such phenomena that were previously typical of the tropical belt are increasingly found also in temperate zones, far from the equator. We can remember that

Co-funded by the Erasmus+ Programme of the European Union

the temperature is a measure of energy of a system. The rise in the planet's average temperature by nearly two degrees implies greater energy associated with the dynamics of the atmosphere. All atmospheric processes will be intensified in quantity and power. Floods and landslides are secondary phenomena directly linked to extreme weather events.

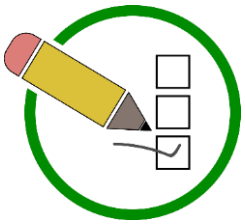
- All the desert areas of the planet increase their extension year by year. They occupy areas previously covered by the savannah. This is the **desertification**. In many previously fertile areas, ever higher temperatures and the absence of rainfall even for long periods determine long periods of **drought** followed by **famines** and **human migration** phenomena.
- **Wildfires** are also increasingly frequent due to the higher temperatures of long periods of drought. Their control is becoming more and more complex and the areas are bigger than in the past. The wildfires increase the greenhouse effect, releasing enormous quantities of carbon dioxide into the environment and reducing the surfaces of the planet covered with trees. In fact, trees are the only natural element capable of withdrawing CO_2 from the atmosphere, neutralising the greenhouse effect.

- Finally, the effects of climate change can also affect the oceans. In particular, many previously temperate seas are undergoing **tropicalization**. That means many species of living beings are moving their range to the north due to the rising sea temperatures. The increase in atmospheric $C0_2$ then leads to a greater presence of this gas in marine waters. Progressively all seawaters become more acidic and capable of dissolving large portions of coral reefs. This phenomenon, defined as **ocean acidification**, can also affects many marine organisms with shells.

Co-funded by the Erasmus+ Programme of the European Union

5.4 Activity: Make a survey! What people know about climate change?

Build, alone or in a team, a test to see what people know about climate change. You can follow these simple steps:



1. Write 10 questions about what you have learned about climate change. The best is to make close questions quiz (true/false).
2. Open this website https://www.surveymonkey.com/ and turns your quiz into a survey that can be done online (the computer teacher can help you).
3. Send the link through your email to friends and your contacts and wait for the results!
4. When you have enough answers try to interpret the results, with the help of your teacher, try to explain what you find to your classmates.

5.5 Activity: Greta Thunberg speech - Climate change and future of the new generations

Watch the speech of Greta Thunberg, one of the most popular young activist against climate change. You can do it alone or with your classmates and teacher. At the end, open a debate on the topic "**Climate change and new generations**".

You can find the video at this link:
https://www.ted.com/talks/greta_thunberg_the_disarming_case_to_act_right_now_on_climate_change?referrer=playlist-climate_change_oh_it_s_real

Co-funded by the Erasmus+ Programme of the European Union

6. Food

6.1 Food: impact of agriculture and livestock

Another important topic that has led human beings over time to change our planet is **food**.

All our food choices affect the natural environment. The production of food for a world population of almost 8 billion people requires an intense exploitation of the soil, connected to both agricultural and livestock activities.

In Agriculture, we can identify some specific forms of impact: **land use, water consumption and promotion of climate change**.

Intensive agriculture, practiced on a large scale and based on monoculture, leads to the **destruction of many habitats**, promotes **deforestation** and year after year threatens the Biodiversity of ecosystems.

Monoculture involves the growing of a single crop using the majority or whole of the land.

This method of farming is particularly popular in industrialized regions and in the production of typical products of the equatorial belt: bananas, coffee and palm oil. Try to find the connection between monoculture and its impact with activity at 6.2 paragraph (Case study: the cultivation of oil palm).

Livestock is strictly connected to agriculture: just think that about 3/4 of agricultural products are not aimed at human feeding but necessary to produce meat for our tables!

Co-funded by the Erasmus+ Programme of the European Union

Have a look at this file: simple material, short and with lots of useful data and information:
https://cdn.downtoearth.org.in/library/0.37171200_1556529315_factsheet.pdf

The exhaustive exploitation of the seas and oceans leads to the same consequences but the effect is hidden by the waters themselves.

Our food choice has different impact. Scientists introduced the concept of "**foodprint**" to define the impact of our eating habits on the planet. Try to test how much your eating habits affect the environment with this test:

https://foodprint.org/quiz/

6.2 Case study: the cultivation of oil palm

- Watch these videos about production of palm oil:

https://youtu.be/7jojJj-s5w8 https://youtu.be/JdpspllWI2o

- Try to identify the main types of impact of this type of monoculture on the environment and write here the keywords.
- Compare what you wrote with your classmates and the teacher.

Co-funded by the Erasmus+ Programme of the European Union

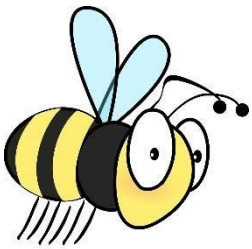
7. Biodiversity

A topic that is always connected to agriculture and livestock is the **loss of biodiversity.** Look at this video to understand what is Biodiversity: https://www.youtube.com/watch?v=b6Ua_zWDH6U

Each species has a well-defined role within its ecosystem, and thanks to this role, it helps to keep it in balance: its decrease has an impact on the stability of the habitat. A healthy ecosystem, among other things, tolerates disease or disruption better, and reacts more effectively to change.

Biodiversity is also important because it provides us with goods, resources and services: the so-called **ecosystem services**, from which all human, animal and plant communities benefit directly or indirectly.

Biodiversity in cultivated and wild plants, for example, forms the basis of agriculture and makes food production possible, contributing to the nutrition and health of the entire world population. **If there were no pollinators** (bees, wasps, flies, butterflies, but so are bats and birds), **more than a third of the food we eat** (fruits, vegetables, seeds) **would be missing**. Bees, which in recent years have been decreasing drastically due to pollution (including electromagnetic pollution), are essential for the life and reproduction of over 130,000 plants. Biodiversity also makes it possible to obtain new plant varieties to cultivate or animals to rear, able to adapt to changing climatic and environmental conditions. The loss of biological diversity, or its impoverishment, has serious social and economic repercussions, reducing the availability of food, energy and even medicinal resources.



Co-funded by the Erasmus+ Programme of the European Union

8.

The result of human activities connected with food is the presence of many species of animals in danger of extinction. If you want to know more visit this site:

https://www.iucnredlist.org/

Rights of people

The use of terrestrial resources by humankind in an unfair way has finally led over time to a negative social impact among human beings. We often talk about **social sustainable development** when we promote goals that want to bring respect for the rights of people all over the world.

In 1948, the United Nations General Assembly approved and proclaimed the **Universal Declaration of Human Rights**, a document of international legislation on inalienable human rights. You can find simplified text here:

https://www.amnesty.org.uk/files/udhr_simplified_0.pdf

THINK: How many of the thirty articles refer to denied rights linked to human activities linked to the exploitation of the planet's resources?

Inequalities, gender gap, and many other topics are some of the problems that we can see in the world. If you want to learn more, try to see these in-depth videos:

- If you want to know better the relationship between **Rights and Sustainable Development:**

https://www.youtube.com/watch?v=ozT5DWs4zd4

Co-funded by the Erasmus+ Programme of the European Union

9.

- Answer at the question **“Development is a human right** ?”

https://www.youtube.com/watch?v=pdKfypBTtdI - **Child labor** is certainly one of the most delicate issues if you want to deepen look what happens in Africa to produce your smartphone!

https://www.youtube.com/watch?v=JcJ8me22NVs

Conclusions

Human beings are certainly the architects of many problems of our planet but they can also be the only ones who can find solutions! Knowing the human impact is the first step to find solutions. Solutions are the challenges that we need to face by promoting and working on sustainable development. We will see solutions in next step.

Now let’s see what you remember with the last activity!

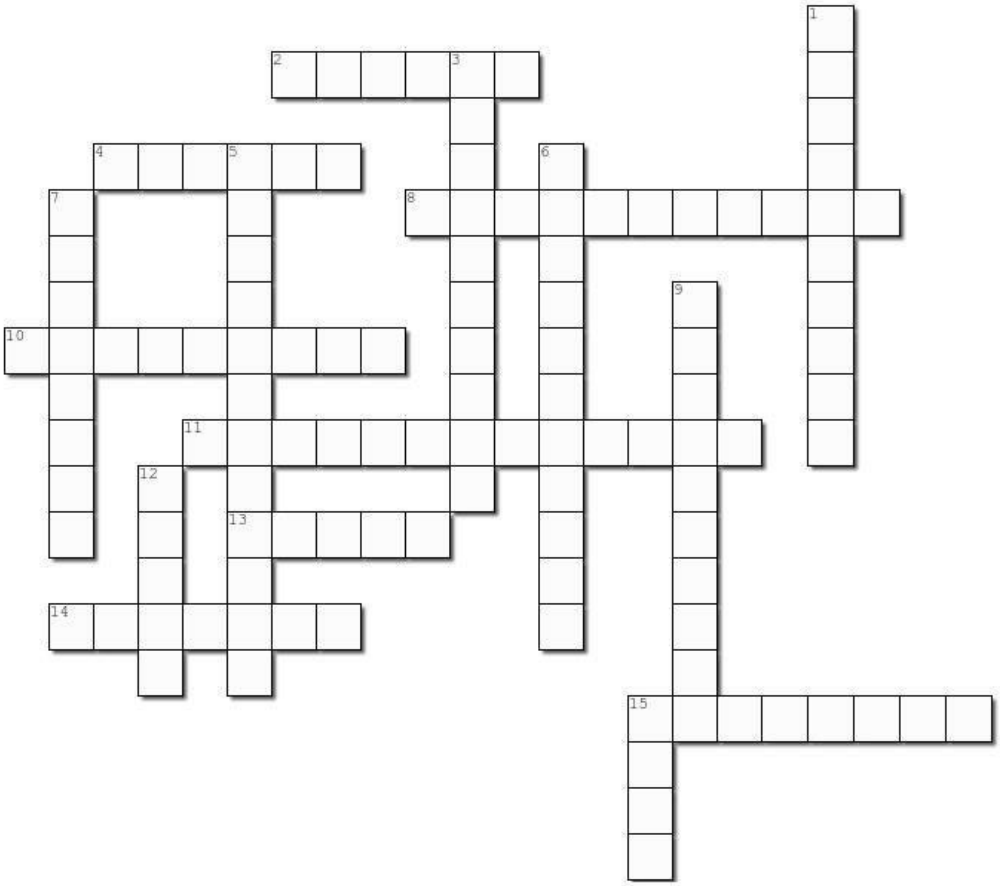
Co-funded by the
Erasmus+ Programme
of the European Union

10.

Name:_____

Human impact on Earth

Complete the crossword puzzle below



Created using the Crossword Maker on TheTeachersCorner.net

Across

2. We use fossil fuels to produce it
4. Fossil fuel linked to ancient plants
8. Future ones are the hope of the planet
10. In India there are many like hills
11. It means cutting large areas of rainforest
13. The farthest place where man bring waste
14. There are islands made of it iun the middle of the ocean
15. It rises with the average temperature of the Earth

Down

1. Phenomenon that indicates the disappearance of a species
3. The effect linked to CO2
5. Defines diversity in nature
6. That one of the planet increases with CO2 in the atmosphere
7. They confuse plastic in the sea with fish
9. One of the main terrestrial sinks of carbon
12. The most dangerous species for the planet
15. It is produced by cars

Co-funded by the
Erasmus+ Programme
of the European Union