Be Green

Erasmus+ KA220-SCH
Cooperation partnerships in school education
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Co-funded by the European Union

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I. CLIMATE ACTION

1.1EU CLIMATE ACTION AND EUROPEAN GREEN DEAL

1.1.1 What is climate change?

https://ec.europa.eu/eurostat/web/climate-change/overview

Climate change refers to a change in climate patterns due to human activities, going beyond the natural variability in the climate. This is caused by greenhouse gases emitted into our atmosphere. Among the drivers of these emissions are the burning of fossil fuels, industrial processes, livestock farming, and waste treatment.

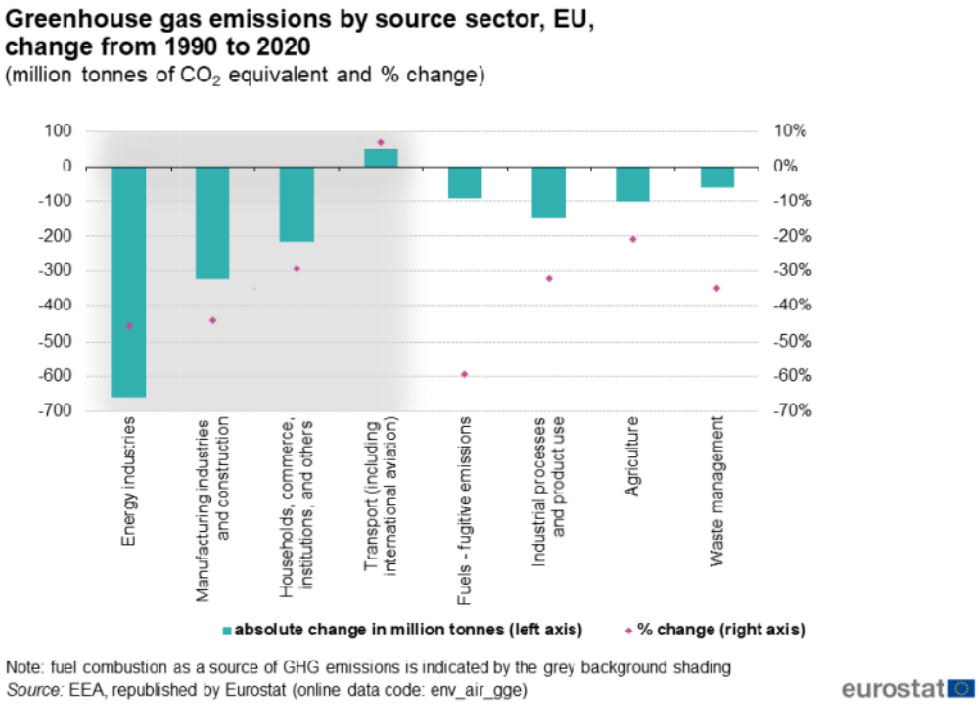
The direct impacts which we experience include an increase in the global temperature, rising sea levels and more extreme weather conditions. These impacts have subsequent wide-ranging effects on ecosystems, the economy, society and human health. We have to deal with the consequences while trying to counter the causes of climate change.

The first step is The Paris Agreement. https://www.consilium.europa.eu/en/infographics/paris-agreement-ratification-v2/

In small groups find information about EU Ratifications and discuss their importance.

1.1.2 Read the article "Climate change - driving forces."

https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Climate_change_-_driving_forces#General_overview



GHG emissions as result of human activities cause anthropogenic climate change. The EU is an ambitious contributor to the global efforts to fight climate change and reduce GHG emissions and is committed to being climate neutral by 2050.

This article analyses major driving forces behind long-term trends of greenhouse gas (GHG) emissions in the European Union (EU) based on statistics available from Eurostat.

GHG emissions in the EU have decreased by 32 % between 1990 and 2020 (the most recent reference year for which data officially reported to UNFCCC are available). Notably, 2020 has seen a special decline due to the COVID-19 pandemic. In 2021, GHG emissions are expected to increase back to the level of the long-term trend. The main driving forces behind the long-term fall in total GHG emissions are improvements in energy efficiency and in the energy mix.

General overview

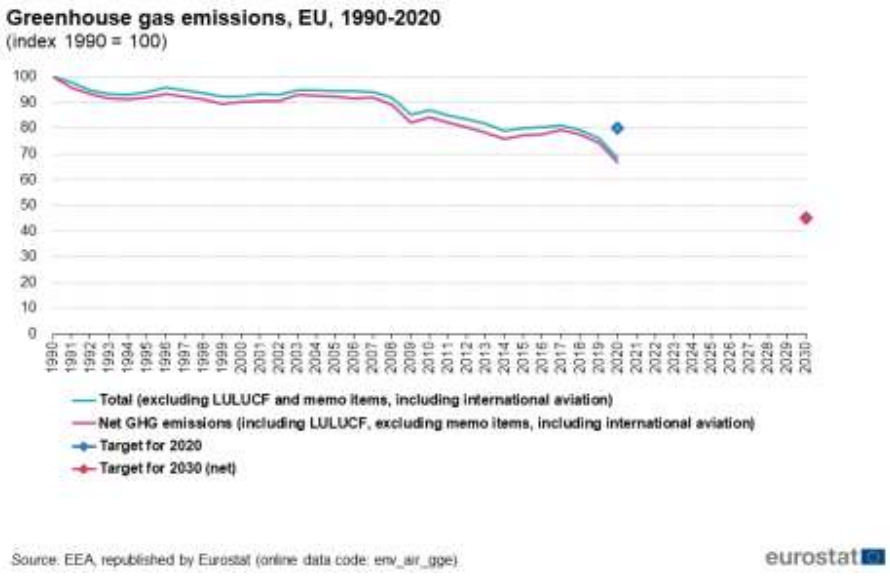
This statistical article is organised in the same order as the reporting on the main source sectors in the GHG emission inventories. First an overall picture is given, followed by sections

presenting the GHG emissions of each specific source sector together with the developments for the underlying drivers. The aim is to help the reader to understand which factors influence the development of GHG emissions.

The European statistical system (ESS) collects official statistics, some of which are used to estimate GHG emissions that are reported in GHG emission inventories. While national statistical institutes are usually not directly responsible for compiling GHG emission inventory data, they often support the compilation by providing auxiliary input data.

In the EU, GHG emission inventories of Member States are collected by the European Environment Agency (EEA) on behalf of the European Commission, more specifically the Directorate-General for Climate Action, in order to produce the EU GHG emission inventory. Eurostat contributes to the validation of the GHG emission inventories by providing energy statistics to the EEA. Eurostat also has a range of statistics that provide a solid basis for analysing the driving forces behind GHG emissions.

Total emissions, main breakdowns by source and general drivers



1.1.3. Use https://ec.europa.eu/eurostat/web/climate-change/visualisations

And make PPT presentation about 5 countries in Europe /North, South, East, West and centrally located/ about changes in:

First group – Greenhouse gas emissions

Second group - Greenhouse gas emissions intensity of energy consumption

Third group - Greenhouse gas emissions from agriculture

Fourth group - Average CO2 emissions per km from new passenger cars

Fifth group - Primary energy consumption

Sixth group - Final energy consumption

Seventh group - Share of renewable energy in gross final energy consumption

Eight group - Implicit tax rate on energy

Nineth group - Gross nutrient balance on agricultural land by nutrient

1.1.4. A European Green Deal

Striving to be the first climate-neutral continent

Watch the video https://audiovisual.ec.europa.eu/en/video/I-199819?&lg=EN, read the information:

Climate change and environmental degradation are an existential threat to Europe and the world. To overcome these challenges, the European Green Deal will transform the EU into a modern, resource-efficient and competitive economy, ensuring:

- no net emissions of greenhouse gases by 2050
- economic growth decoupled from resource use
- no person and no place left behind

The European Green Deal is also our lifeline out of the COVID-19 pandemic. **One third of the 1.8 trillion euro** investments from the Next Generation EU Recovery Plan, and the EU's seven-year budget will finance the European Green Deal.

The benefits of the European Green Deal

The European Green Deal will improve the well-being and health of citizens and future generations by providing:

-  **fresh air, clean water, healthy soil and biodiversity**

-  **renovated, energy efficient buildings**
-  **healthy and affordable food**
-  **more public transport**
-  **cleaner energy and cutting-edge clean technological innovation**
-  **longer lasting products that can be repaired, recycled and re-used**
-  **future-proof jobs and skills training for the transition**
-  **globally competitive and resilient industry**

Actions

-  Climate
-  Environment and oceans
-  Energy
-  Transport
-  Agriculture
-  Finance and regional development
-  Industry
-  Research and innovation

Look at the timeline of the Green deal.

https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en#timeline and present the evolving of the idea.

1.2PROTECTION OF THE OZONE LAYER

SCHOOL: ITES Vitale Giordano, Bitonto – ITALY

Teacher: prof. Maria Maddalena Bellocchio

Students: 2^ class

Time required for the activity: 8 hours

Disciplines involved: Science (Chemistry, Biology, Geography)

DESIRED RESULTS

Know causes and effects of the action of CFCs on ozone layer.

Identify connections and relationships in the natural environment.

Acquire, interpret and communicate information.

Cooperate and participate in group activities by performing their tasks.

PREREQUISITES

- What the atmosphere is

- Know the atmosphere and its stratification

- Know the meaning of ecosystem

- Know the meaning of pollution and some types of pollution

METHODOLOGY

Working in groups: cooperative learning, flipped classroom.

INFORMATIC TECHNOLOGY

Each student uses their own iPad and works with apps such as Canva, Thinglink, Padlet, Inspiration, Power Point, Keynote and others.

WORK STEPS

Flipped classroom:

Students, organized into cooperative groups by the teacher, begin the learning activity by watching a video and reading a document. At the end, in each group they discuss what they have seen and read and prepare a summary and a concept map of the content. Then the groups discuss to compare the results.

The Hole - A film on the Montreal Protocol, narrated by Sir David Attenborough https://youtu.be/MgUobxtdm4A

Basic Ozone Layer Science

https://www.epa.gov/ozone-layer-protection/basic-ozone-layer-science

Work in groups

The class is divided into 4 cooperative groups. Each group receives links to documents related to ozone depletion. Each group of students will produce a summary document and an infographic or poster to be exhibited in the "BE GREEN" corner of the school.

GROUP 1: Mechanism of action of CFC in stratospheric ozone depletion

Depletion of the Ozone Layer

https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Kinetics/07%3A_Case_Studies-_Kinetics/7.03%3A_Depletion_of_the_Ozone_Layer

Video: How Chlorofluorocarbons Destroy Ozone

https://youtu.be/IniJx-vRHG0

GROUP 2: UVA and UVB rays and the damage they do to health and the environment.

Radiation: Ultraviolet (UV) radiation:

https://www.who.int/news-room/questions-and-answers/item/radiation-ultraviolet-(uv)

UV radiation and your skin

https://www.skincancer.org/risk-factors/uv-radiation/

UVB and UVA as stressors in horticultural and agricultural crops

https://www.sciencedirect.com/science/article/abs/pii/S0304423818300967

GROUP 3: Montreal Protocol and amendments

About Montreal Protocol

https://www.unep.org/ozonaction/who-we-are/about-montreal-protocol

The Kigali Amendment to the Montreal Protocol: Another Global Commitment to stop climate change

https://www.unep.org/news-and-stories/story/kigali-amendment-montreal-protocol-another-global-commitment-stop-climate

GROUP 4: Hypothesize solutions to the problem and virtuous behaviors to protect stratospheric ozone

Studio sulle alternative agli idrofluorocarburi (HFC) in Italia

https://www.isprambiente.gov.it/it/pubblicazioni/rapporti/studio-sulle-alternative-agli-idrofluorocarburi-hfc-in-italia

How to protect the Ozone layer

https://carbonfund.org/how-to-protect-the-ozone-layer/

UV radiation and your skin

https://www.skincancer.org/risk-factors/uv-radiation/

UVB and UVA as eustressors in horticultural and agricultural crops

https://www.sciencedirect.com/science/article/abs/pii/S0304423818300967

FINAL EVALUATION

Final test: OCSE PISA [1] "Ozone test". (annex no.1)

[1] The Programme for International Student Assessment (PISA) is an international survey sponsored by the OECD established with the aim of assessing the educational attainment of adolescents in major industrialized countries every three years. PISA offers standardized tests that are used to assess the skills of students in various countries.

Presentations and multimedia products will be evaluated with specific rubrics for individual and group work.

Bibliography and sitography

Video: The Hole - A film on the Montreal Protocol, narrated by Sir David Attenborough https://youtu.be/MgUobxtdm4A

Basic Ozone Layer Science

https://www.epa.gov/ozone-layer-protection/basic-ozone-layer-science

Depletion of the Ozone Layer

https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Kinetics/07%3A_Case_Studies_Kinetics/7.03%3A_Depletion_of_the_Ozone_Layer

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https://www.sciencedirect.com/science/article/abs/pii/S0304423818300967

1.3PROTECTION OF FOREST AND AGRICULTURE

DESIRED RESULTS

Students learn about the necessity of protecting agricultural lands

- Students learn what good farming practices are
- Students learn what to do to protect forest lands
- Students learn that forest and agricultural studies can be carried out together.
- •Students use IT technology
- •Students develop their research and presentation skills

UNDERSTANDINGS:

Students researched new Technologies for conservation and development of farmland.They examined the news in the press.They prepared newsspaper and slides using web2 tools and they presented to their friends in class. They shared the results and main idea of each research with the class.

How does access to information affect the way we impact with the environment?

As students gain knowledge, they question the mistakes and produce solutions that are suitable for the area.

Lesson Introduction:

I expected for many people to be real friends
My faithfull beloved is black soil
I wandered arround with no end, I got tired for nothing
My faithfull beloved is black soil

I dedicated myself for such beautiful ones
I didn’t see any loyalty, I didn’t find any use
I had everything I want from the soil
My faithfull beloved is black soil

Photographs of intensive and extensive agriculture accompanied by Aşık Veysel's poem on black soil are shown to the students. Then the following questions are asked.






Question 1- What do you think are the differences between the photographs in the fields you see in the first group and those you see in the second group in terms of agricultural productivity?

Question 2- How would you evaluate the two regions seen in the photographs in terms of development?

Question3- What do you think are the advanced agricultural methods applied in the region?

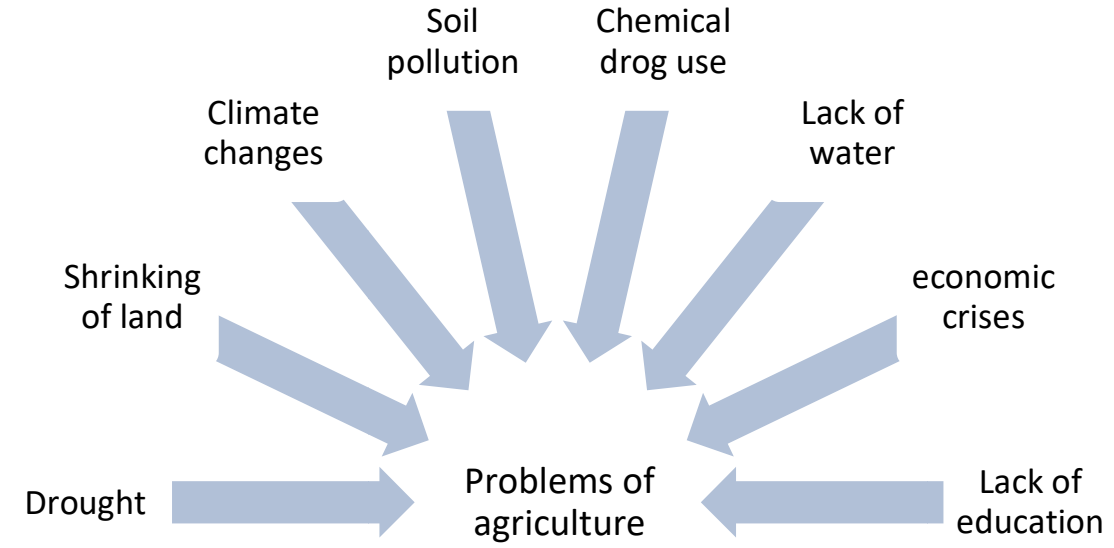
After these questions, the students are divided into two groups.

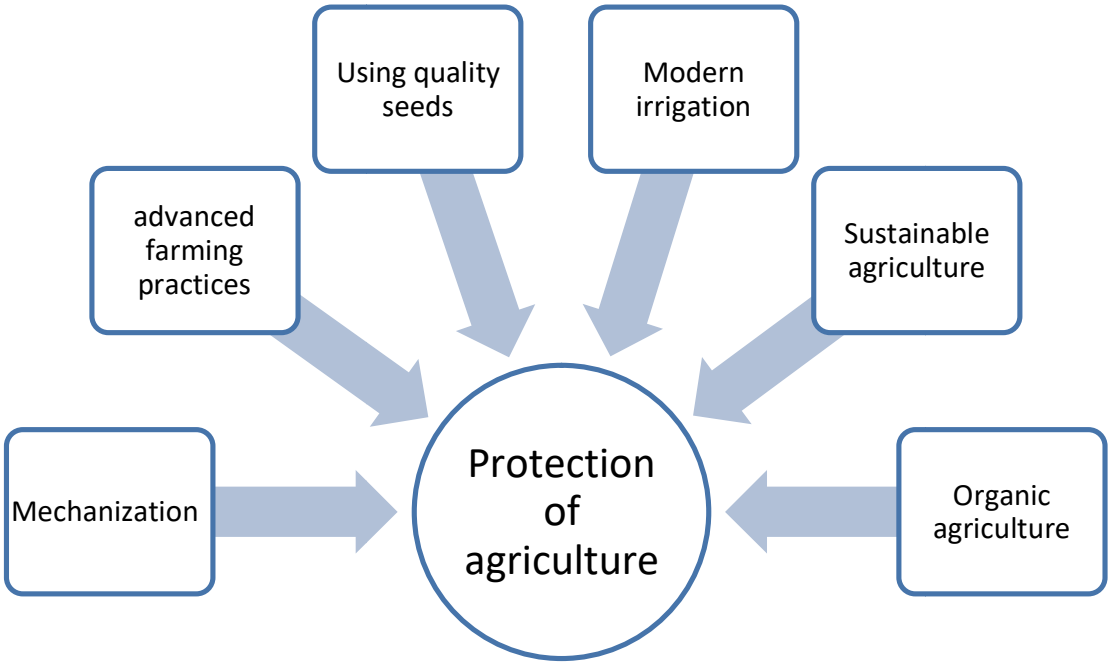
Group 1: Presents the general problems of agriculture by creating a concept map

Group 2: Presents the ways of improving agriculture on the concept map.

Source: https://www.zmo.org.tr/resimler/ekler/3e99ecaf98a5e17_ek.pdf

http://dogadergi.ksu.edu.tr/en/download/article-file/488961





After the introduction, a general explanation of the subject is given.

Soil, one of the indispensable elements of life like water and air, is a resource that cannot be produced and can renew itself under certain conditions. Agriculture is the starting point of the food chain, defined as primary production. The increase in the world population on the other hand, the decrease in resources and the problems in agriculture push people to seek new methods

for increasing productivity in agriculture. Sustainable agriculture is the production of sufficient and quality foodstuffs at affordable costs; It includes systems and practices that will improve the protection of farmers, agricultural land, the environment and natural agricultural resources. Sustainable agriculture is not done one way. Until today, different practices (organic agriculture, good agricultural practices) in different ways have been gathered under the umbrella of sustainability. In sustainable agriculture, it is aimed to keep the economy alive in the short and long term by reducing the damage to the environment and to increase the quality of life of those engaged in agriculture, while maintaining productivity in agriculture.

Conservation, balanced use and development of the soil is only possible by making the necessary planning by using the developing science and technology, determining the properties well, mapping it, creating a database and applying the policies.

5 ways to accelerate the transition to sustainable agriculture

Research and innovation - Research enables us to better understand the challenges and provide evidence of what innovative solutions are needed in agriculture.

Regenerative practices and nature-based solutions - Being sustainable is not enough; We must also work to improve soil health and increase biodiversity to future-proof our food system.

Farm-to-table education and training – From educating consumers about agriculture to connecting farmers with new companies to learn about new innovations, education and training are key to accelerating the transition to sustainable agriculture.

Transparency and traceability – By increasing transparency through concepts such as environmental labeling, consumers and retailers can make more informed decisions about the food they buy and the producers they work with.

Cross-sectoral collaboration - By working together and sharing knowledge, expertise and perspective, the agri-food industry can achieve greater results.

Good Agricultural Practices (GAP) adopted for the protection and development of agriculture; It is a production model that ensures sustainability and food safety in agriculture by controlling agricultural production in a way that does not harm the environment, human and animal health, and certification of the products obtained. The four principles of good agricultural practice have been defined as:

a) To produce sufficient, safe and nutritious food economically and effectively,

b) To provide and maintain a natural resource base,

c) Protect suitable agricultural holdings and contribute to sustainable livelihoods,

d) To meet the cultural and social demands of the society.

https://www.youtube.com/watch?v=mKd2LEDBTgM

https://www.youtube.com/watch?v=qXs9Wsna1Ok

Advances in technology are capable of solving problems in the agricultural sector. Remote monitoring of crops in fields and gardens obtained using satellite and drone technologies with sensors and cameras allows measuring plant health, irrigation need, disease and pest risks. High quality, efficient biotechnological methods that are compatible with changing environmental conditions due to climate change should be used.

Nanotechnological studies in food and agriculture; It offers solutions such as smart and packaging production, nanosensors that detect pesticide residues in vegetables and fruits, controlled drug release systems, new generation organic fertilizer production, film and greenhouse covers. The space and cost-saving vertical farming trend should increase rapidly.

Systems such as data-driven agriculture with optimum parameters, low-cost artificial intelligence, machine learning, autonomous and robotic trends should be expanded. In the world, 400 billion dollars of agricultural production of 3 trillion dollars is wasted. Technologies to prevent loss and waste should be used.

In particular, the fallow method should be limited and rotational planting and advanced irrigation technologies should be expanded.

https://www.youtube.com/watch?v=l0bpy857deM

https://www.youtube.com/watch?v=mqZ77jYb6ko

https://www.youtube.com/watch?v=0BBaVZK2C

https://www.agritechtomorrow.com/

In the "From Farm to Table" and Biodiversity Strategies, which include the EU's goals in agriculture, food and biodiversity under the European Green Deal, the goal of a robust and resilient food system that works in all conditions and providing access to an adequate food supply for citizens, pesticides, antimicrobials and there is an urgent need to reduce reliance on over-fertilization, increase organic farmland, improve animal welfare and reverse biodiversity loss.

The farm-to-table strategy will strengthen the efforts of farmers and fishermen to combat climate change and protect the environment and biodiversity.

Sustainable practices will be adopted at the point of precision agriculture, organic agriculture, agroecology, agroforestry and animal protection. Farmers will be rewarded for successful environmental and climate performance, including measures such as eco-labeling, managing and storing carbon in the soil, improving water quality and improving nutrient management to reduce emissions.

It is aimed that at least 25% of the agricultural lands in the EU will be covered by organic farming methods by 2030, and the EU agricultural food incentive policy is being developed in this context. The agri-food promotion policy will promote quality standards both in the EU internal market and in countries trading with the EU.

Another issue addressed within the scope of the Green Deal is the reduction of methane emissions. Methane is the second most important greenhouse gas in terms of its impact on climate change and constitutes 10% of all greenhouse gas emissions.Agricultural production and food sector also stand out as the sector that releases the most methane. Therefore, the measurement and reporting of methane emissions comes to the fore.

On the other hand, it is emphasized that by 2030, the Commission will encourage applications for all kinds of packaging and packaging to be made of biodegradable and plant-based plastics and will impose sanctions on single-use plastics.

Source: https://api.izto.org.tr/storage/Documents/original/XqMKcb6iZrvhi22m.pdf

https://www.fao.org/3/cb4477en/online/cb4477en.html#chapter-4_1

Second Part

Question: Another resource as important as agricultural lands is our forests. Do you think agriculture and forest assets can be protected together?

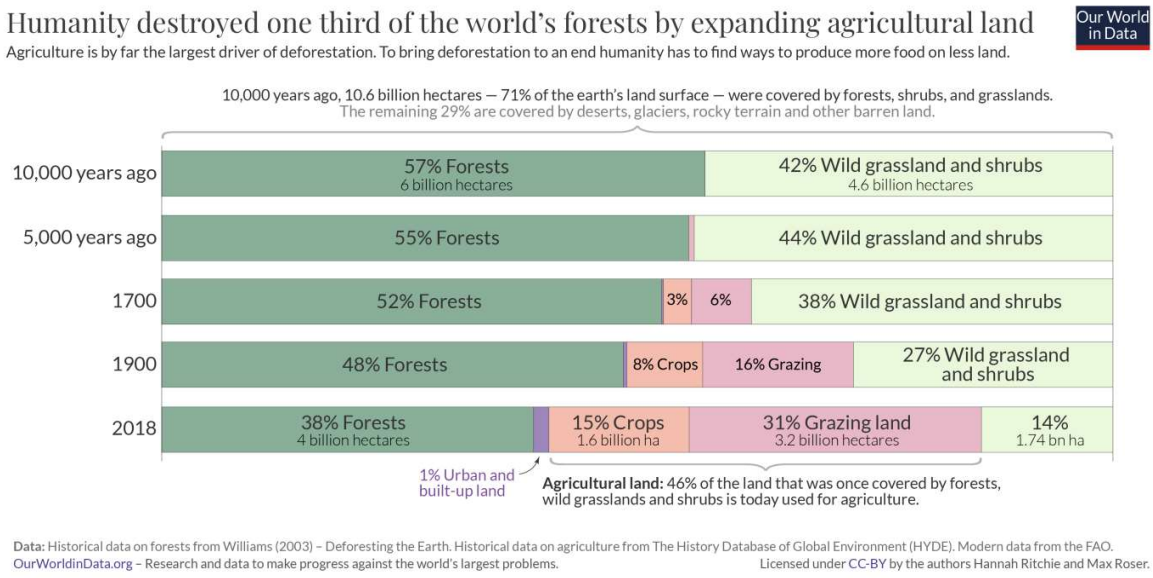
A forest is an ecosystem dominated by trees. According to the parameters set by the FAO, an area must cover at least half a hectare, or about one and a half acres, to be considered a forest. How much of the world's land surface is covered with forests today? In the visualization, we see the distribution of the global land area. 10% of the world is covered by glaciers and 19% is more barren land - deserts, dry salt flats, beaches, dunes and exposed rocks. That leaves what we call 'habitable land'.

Forests make up just over a third (38%) of the habitable land area. This is about a quarter (26%) of the total (both habitable and non-habitable) land area.

https://ourworldindata.org/world-lost-one-third-forests#:~:text=Shortly%20after%20the%20end%20of,size%20of%20the%20United%20States.

47% of the world's forests are tropical rainforests, 9% are temperate zone tropical rainforests, 11% are temperate zone broadleaf forests and 33% are coniferous forests. 7% of the world's forests are exploited from these forests, and two-thirds of industrial wood production is paid for globally. Half of the world's forests are located in 5 countries: Canada, USA, Russia, China and Brazil. The 10 countries that lost the most forest area: Brazil, Australia, Indonesia, Nigeria, Tanzania, Zimbabwe, Congo, Burma, Bolivia and Venezuela. This interactive map shows the share of total land area covered by forests.

https://www.google.com/url?q=https://ourworldindata.org/forest-area&sa=D&source=docs&ust=1654274605984355&usg=AOvVaw24ktScjFO33Nq4aYMbcVzq



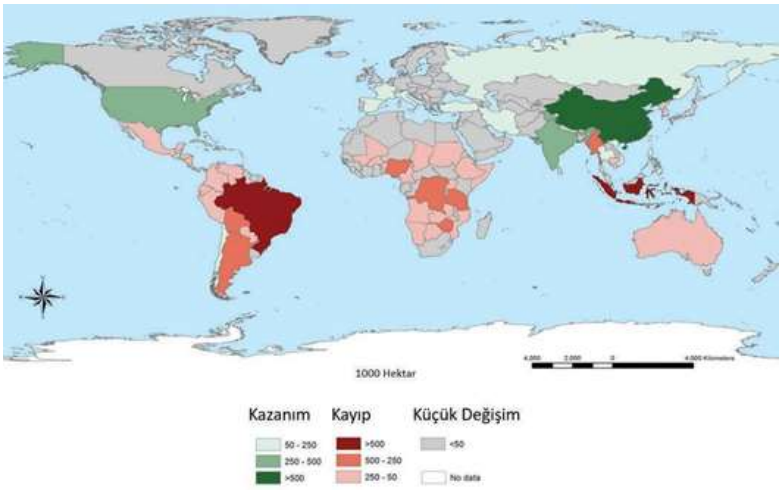
Let's examine the United Nations Food and Agriculture Organization's (FOA) maps showing the significant forest cover on all continents of the world. These forest land maps were created based on FOA data. Dark green represents closed forests, medium green represents open and fragmented forests, light green represents some trees in shrubs and bushes

https://www.google.com/url?q=https://www.treehugger.com/maps-of-the-worlds-forests-1343036&sa=D&source=docs&ust=1654274696243250&usg=AOvVaw2Yu7CUFKiWoGo7sUx_gEs0

National Geographic reports that more than 80 percent of the planet's native forests have been lost to deforestation, calling this dire situation the "forest Holocaust." The US State Department estimates that forests "four times the size of Switzerland" are cleared each year. The impact of deforestation on climate change has fueled NASA's interest in documenting its progress around the world. Here are seven examples of deforestation as seen from space.

https://www.treehugger.com/striking-examples-of-deforestation-from-nasa-4869145

The forest, which is composed of organic materials and is a living entity, is faced with various dangers caused by many biotic (living) and abiotic (non-living) factors. After insects, the most damaging factor to the forest is humans. In particular, population growth, urbanization, industrialization and the inadequacy of agricultural lands cause a decrease in the increasing forest lands. In the world; An average of 50 million hectares of land per year is damaged by forest fires. in Europe; Every year, an average of 550 thousand hectares of land is damaged by forest fires.



Change of world forest areas between 1990-2015

https://www.euronews.com/tag/forest-fires

https://wildfiretoday.com/

https://www.globalforestwatch.org/blog/fires/us-fires-climate-emissions/

https://www.youtube.com/watch?v=cYpECFx8G5A

https://www.youtube.com/watch?v=MaR3NAw5frM

Unfortunately, it seems that forestry has not been an important international organization until recently. Most of the important international organizations related to forestry that continue their activities today started to be established from the middle of the last century and only started to be noticed towards the end of the century. Some of the most important of these organizations are:

United Nations Food and Agriculture Organization (FAO),European Union Economic Commission (UNECE), International Union for Conservation of Natural Resources (IUCN) , International Environment Program (UNEP), FAO World Forestry Congress

Conclusion Section

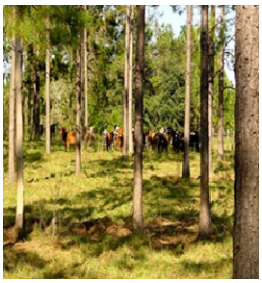
CAN AGRICULTURE AND FORESTRY BE DONE TOGETHER?

Agroforestry is the deliberate integration of trees or shrubs into crop and animal production. Agroforestry requires putting the right tree in the right place for the right reason. It combines agriculture and forestry practices to create profitable and sustainable farms, ranches and woodlands. There is no right or wrong time to start using agroforestry practices on your land. Here are five popular apps to consider.

WIND BREAKERS are the planting of trees, shrubs or both in single or multiple rows that protect plants, soil, animals, homes and people from wind, snow, dust or odors. Windbreaks save energy and reduce home heating costs. Windbreaks also help net big gains in carbon storage, increase income by increasing crop yields and protect livestock from heat and cold stress.

RIPARIAN FOREST BUMPERS are trees, shrubs and grass found alongside rivers, streams and lakes to help conserve water resources by filtering farm runoff and preventing erosion. Buffers can support wildlife habitat, produce crops, improve water quality and reduce flood damage.

SILVOPASTURE manages feed, animals and trees on the same acre, combining trees with a livestock operation. Silvopasture benefits from feed production and improves carbon sequestration, while providing shade and shelter for livestock. This combination can also bring in extra income from lumber products, Christmas trees or entertainment.



ALLEY CROPPING grows crops among maturing trees called alleys. This system diversifies operations by creating both annual and long-term revenue streams. It can also protect crops, improve water quality, improve nutrient utilization and improve carbon sequestration.

FOREST AGRICULTURE grows and protects high value specialty crops under forest canopy adjusted to the correct shade level preferred by the crops. This is done by thinning an existing forest to leave the best shade trees for continued timber production, while creating ideal growing conditions for the lower crop. Non-timber forest products grown using forest farming methods not only provide an additional source of income but also help preserve habitat for wildlife.

https://www.youtube.com/watch?v=_dWJVHIE9S8

Students present their papers and research

1.4TRANSPORTATION AND THE ENVIRONMENT: ENERGY, FUELS AND EMISSIONS

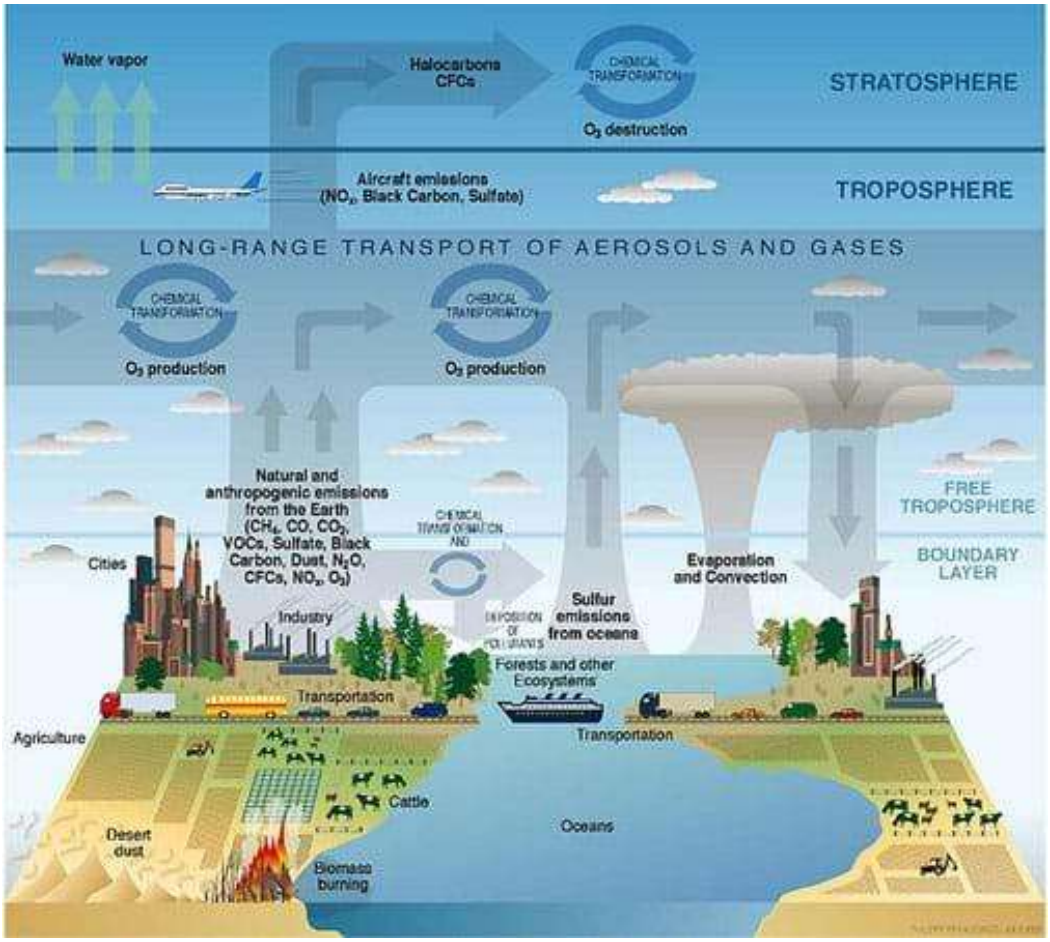


Figure 1. Atmospheric pollution comes from natural and human-made sources and then continuously interacts with the Earth's processes. (source : Alamy world archives)

1) Describe and comment on document1

2) Watch this video (Youtube) and explain what you have understood

Students see how air pollution, like particulate matter, can become a global issue by tracing the movement of radiation released during an accident at the Chernobyl nuclear power plant.

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

Introduction

Looking at transportation and the environment, students learn that some human-made creations, such as vehicles, can harm the natural environment. They also learn about alternative fuels and vehicles designed by engineers to minimize pollution. The final task gives students a chance to design their own eco-friendly vehicles.

Engineers design and build many different things that benefit society. Unfortunately, some of these designs lead to the release of pollution into the environment. Pollution can have a negative effect on the health of humans and the environment and even cause deterioration of national landmarks. Environmental engineers specialize in cleaning up and minimizing the amount of pollution that is emitted to assure clean air and water for the population. Many different types of engineers work together to explore options of how to make daily processes, such as driving a vehicle, cleaner and better for the environment.

Learning Objectives

After this lesson, students should be able to:

- Explain that cars are a major contributor to air pollution.
- Understand that alternative forms of transportation and new types of cars can produce fewer harmful emissions.
- Explain that environmental engineers focus on keeping air and water clean for humans and to protect the environment.
- Name renewable energy sources.
- Design their own ecological car of the future

<u>Answer these questions in groups, then recap to the class :</u>

What are the different kinds of transportation?

cars, trains, bicycles, motorcycles, boats, etc.

Can anyone think of any alternative modes of transport?

***Hybrids* are an alternative mode of transportation and *biodiesel* is an alternative fuel**.

Does anyone know about biodiesel?

Biodiesel is an alternative to regular diesel that burns much cleaner and pollutes the air less than regular gasoline. It is usually made from soybeans, and some people say that the

exhaust from biodiesel vehicles smells like French fries! Right now, the emissions from regular automobiles are one of the main sources of pollution, emitting 4 of the top 6 pollutants. Pollution from cars contributes to the formation of smog — a sometimes severe problem in many big cities, such as Los Angeles. However, engineers have designed different kinds of vehicles which produce fewer harmful emissions.

As a class, let's discuss these new types of motorized vehicles that are known for being *"green."*

These vehicles include hybrids, electric vehicles, low emission vehicles, vehicles that run on biodiesel, and scooters.

Why do you think it's important to reduce emissions from cars? And, why is it important to save the environment?

Saving the environment is crucial for long term human and environmental health.

Can anyone think of some things that we can do that will help save our environment and help keep it clean?

One way that we can help preserve the environment is to use renewable energy sources. Oil is a limited resource which is burned for energy and is not renewable.

Can anyone think of renewable sources of energy that are better for the environment than oil?

These sources include solar, water and wind power, as well as biodiesel.

How many cars do you have in your family?

Let's tally up the total number of cars for the entire class. Knowing how many cars there are total from this class, we are going to estimate how many cars are driven in our county. (Note: To help the students, find population data for the local county. It may help to use the following method: if we have 30 students in the class, and 45 cars, that's about 1.5 cars per person. So, if there are 100,000 people in our county, and we multiply 100,000 by 1.5, that would be about 150,000 cars for our whole county.)

Does this sound like a reasonable number to you?

Going beyond our estimation of cars in our county, it is estimated that there are 600 million cars driven worldwide.

Lesson Background and Concepts for Teachers

Pollution Types

Six common *air pollutants* have been identified: ozone, particulate matter, carbon monoxide, nitrogen dioxide, sulfur dioxide and lead**.** Automobiles and other modes of transport (buses, trucks, etc.) play a large role in the emissions of many of these types of dangerous pollution, emitting four of the six common pollutants into the environment. While environmental policies have helped to greatly reduce the amount of emissions per vehicle, the number of vehicles on the road, and the distance traveled per vehicle, have both greatly increased.

Ozone is composed of three molecules of oxygen, and its chemical formula is O_3. Ozone can be "good" or "bad" depending on its location. "Good" ozone is located high in the atmosphere and protects the earth from damaging UV rays from the sun. This beneficial ozone layer is slowly being destroyed by human-made chemicals. A good example of this is found in the "ozone-hole" over the North and South Poles. "Bad" ozone is found lower in the Earth's atmosphere. It is created (see the equation below) when emissions from cars, power plants, industrial boilers, refineries, chemical plants, and other sources react chemically in the presence of sunlight. "Bad" ozone contributes to both environmental and human health problems.

bad ozone = volatile organic compounds + nitrogen oxides + sunlight

As illustrated in Figure 1, motor vehicles have an enormous impact on the formation of ozone by emitting nitrogen oxides (NOx) and volatile organic compounds (VOCs).

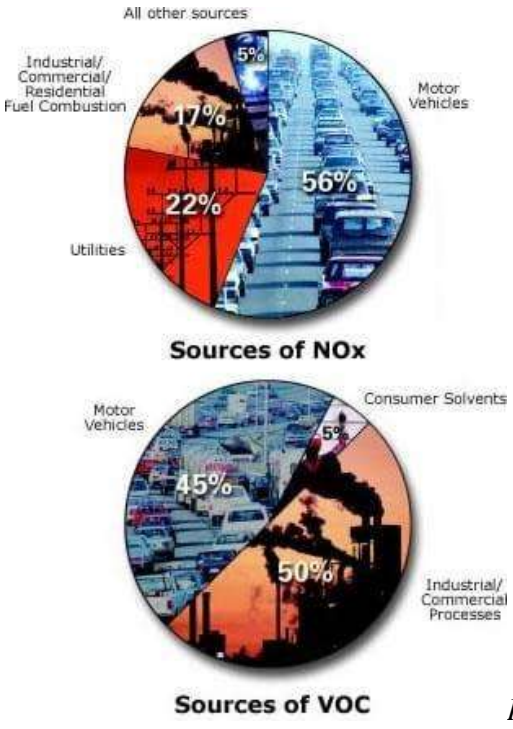


Figure 2. Sources of NOx and VOCs.

Particulate matter is what you see when there is haze or smog in the air. Particulate matter can either be directly emitted from vehicles, factories, farming activities and fires, or it can be the indirect result of burning fuels in the presence of sunlight and water vapor, such as fuel combustion in vehicles and power plants (see Figure 2). Particulate matter plays a huge role in health problems and also impacts the delicate chemical balance of eco-systems. Particulate matter is also responsible for the oftentimes permanent staining of statues and buildings.

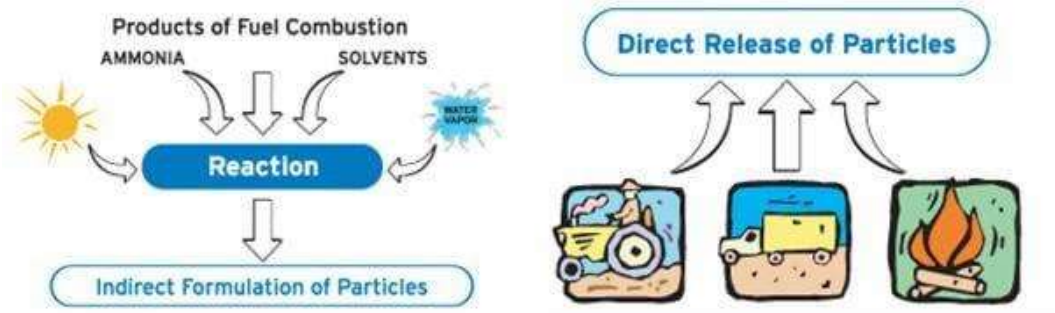


Figure 3. Particulate matter is both directly and indirectly emitted into the environment.

Carbon monoxide (CO) is a gas that is released when fuel is not burned completely. Carbon monoxide is very dangerous to human health, and, ironically, more than one half of the CO emissions come from on-road vehicles. Other sources include non-road vehicles, such as trains and airplanes, industrial processes, fuel combustion and miscellaneous sources, such as forest fires. The breakdown of percentages of CO contribution to our environment is shown in Figure 3. Carbon monoxide, an organic compound, also contributes to the formation of ground level smog or ozone.

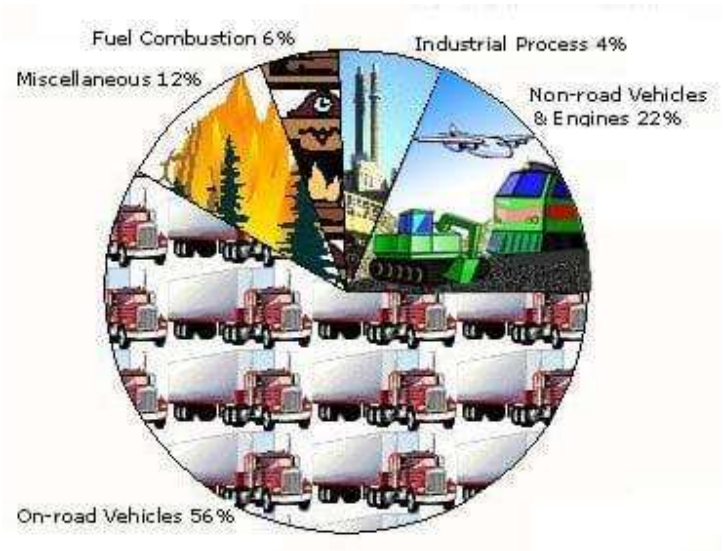


Figure 4. On-road vehicles account for more than half the carbon monoxide (CO) emissions.

Nitrogen oxides (NOx) refers to a group of gasses that contain nitrogen and oxygen. They are one of the primary components of ozone, and the main source is, again, motor vehicles. NOx contributes to the formation of acid rain and deteriorates water quality. NOx emissions also contribute to atmospheric particles which cause respiratory problems and visibility impairment.

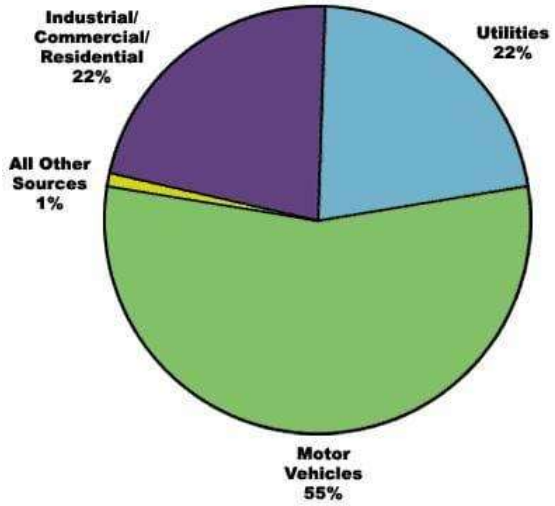


Figure 5. Motor vehicles account for more than half the nitrogen oxide (NOx) emissions.

Sulfur dioxide (SO_2) comes mainly from burning coal in large industrial processes, but also from trains and boats with coal-burning engines. Sulfur dioxide contributes to respiratory illness, acid rain and visibility impairment. Motor vehicles contribute 5% of sulfur dioxide emissions. The majority of *lead pollution* now comes from metal processing. However, in the 1970s, motor vehicles were responsible for almost 80% of lead pollution. Environmental laws leading to the removal of lead from gasoline have essentially eliminated on-road vehicle lead pollution.

Vehicle/Fuel Alternatives

As seen recently in the news media, alternative fuels and vehicles have been developed and are gaining mainstream popularity.

The main two types of alternative vehicles are *hybrid* and *electric*. The common hybrid vehicle is a gas-electric hybrid, utilizing both gas and electric engines to increase fuel efficiency and greatly decrease emissions. Electric vehicles rely solely on electric battery power to run the vehicle, which causes them to have no need for gasoline and very low emissions. Each vehicle has its limitations, though both show a movement towards decreasing vehicle emissions and taking responsibility for protecting our environment.

Biodiesel is an animal fat- or vegetable oil-based alternative fuel which has much lower emissions than regular unleaded or diesel fuels. Biodiesel is a sustainable and non-toxic resource that can be made locally and from recycled ingredients, such as vegetable (soybean) oil used at restaurants. These ingredients are processed at a refinery and turned into a fuel-grade product.

Remember, you cannot just put vegetable oil into your vehicle's gas tank and expect it to run – that would definitely harm your car's engine.

Other possibilities for alternative vehicles in the future include increasing the efficiency of hybrids and ease of use of electrics as well as the development of hydrogen-powered cars. Hydrogen cars are close to zero emissions and use an infinitely renewable resource.

Clean Energy

One method of producing energy has less impact on the environment.

Biodiesel – Fewer harmful emissions than regular gasoline or diesel; must have a diesel engine to use biodiesel, and gas stations selling biodiesel are still sparse in some states.

Final task

- Cars from the Future: Presenting Your Eco-Friendly Design Ideas

-Students can do their part to design the future of eco-friendly transport with the final task :

An alternate mode of travel that is more environmentally friendly than current motor vehicles.

Lesson Closure

China is the most populated country in the world with over 1 billion residents. With so many people, it is logical to assume there is a lot of pollution. You have just learned about different ways to reduce pollution in automobiles, which are one of the biggest contributors to air pollution.

Let's brainstorm how to reduce pollution from these sources.

Some solutions include using wind and/or solar power for homes/businesses, having more people drive low-emission vehicles, hybrid vehicles, etc. Also, carpooling and riding bikes more often would help greatly reduce carbon monoxide emissions. Some of these solutions include using a renewable source of energy. Who can remember two (or more) sources of renewable energy? (Answer: wind, solar, water, biodiesel) Can anyone explain why electric, hybrid or biodiesel cars are more efficient than regular cars? (Answer: They all have fewer harmful emissions than regular cars or regular gasoline.)

Now, learn the Vocabulary/Definitions :

air pollutant: Six major sources of emissions to our environment include: ozone, particulate matter, carbon monoxide, nitrogen dioxide, sulfur dioxide and lead.

biodiesel: A cleaner burning automotive fuel often derived from vegetable oil.

electric vehicle: A vehicle that is powered using electricity instead of gasoline.

emissions: Substances released into the air by automobiles, factories or power plants.

hybrid vehicle: A vehicle that uses both an electric and gasoline motor to run.

hydrogen: A chemical element used in fuel cells.

ozone: Composed of three oxygen molecules; ozone high in the atmosphere protects us from the sun's UV rays, while ground level ozone contributes to smog.

pollution: The release of harmful substances into the environment.

smog: A mixture of pollutants, mainly ground-level ozone that cause decreased visibility as well as damage to the environment and human health problems.

Assessment

Have the students form small groups and talk about different types of transport.

- What engineers do they think are involved in each type of transportation?
- How does each type of transport contribute to air pollution?
- Ask the students if they can think of means of transport that do not contribute to air pollution.
- Ask them why air pollution is a nasty thing. (Answer: Because it makes people sick, hurts animals, and harms plants, trees, buildings, etc.)

Assessment

Ask the students to brainstorm a list of different methods of transportation. Have the students break up into groups and have each group rank the list in order from cleanest to not-as-clean. Have the students make a list of features that they will judge each mode of transport on, such as "*green*ness," efficiency, ease of use, etc. Rate each type of vehicle and total the numbers to find out which one is the best. Have each group quickly present the order that they decided, and as a class come to a consensus about which travel modes are the best for the environment.

Example:

	Greenness	Ease of Use	Cost	Fuel Efficiency	Cool Factor	TOTAL
Hybrids	8	10	5	8	8	39
Electric Cars	9	8	5	10	9	41
Regular Cars	5	10	7	4	3	29

References

National Biodiesel Board. http://www.biodiesel.org/resources/faqs/default.shtm

"Good Up High Bad Nearby." Office of Air and Radiation, U.S. Environmental Protection Agency. http://cfpub.epa.gov/airnow/index.cfm?action=gooduphigh.ozone

The basics of AQ: https://www.epa.gov/environmental-topics/air-topics

Links to information on specific pollutants: https://www.epa.gov/environmental-topics/air-topics

The home page for indoor air quality information: https://www.epa.gov/indoor-air-quality-iaq

Teacher resources developed by the EPA: https://www.epa.gov/new-bedford-harbor/environmental-education-resources-teachers-and-students

Air Quality Data by Country: https://openaq.org/#/countries?_k=591ioq

1.5Climate Action

Greenhouse gases

Watch this short video to explain what the greenhouse effect is. https://www.youtube.com/watch?v=SN5-DnOHQmE

Many of the chemical compounds in the earth's atmosphere act as greenhouse gases. When sunlight strikes the earth's surface, some of it radiates back toward space as infrared radiation (heat). Greenhouse gases absorb this infrared radiation and trap its heat in the atmosphere, creating a greenhouse effect that results in global warming and climate change. Many gases exhibit these greenhouse properties.

The process is something like this:

The sun's rays hit the earth

=>Some of them are radiated back toward space as infrared radiation (heat)

=>The sea's surface absorbs a large proportion of the heat but part of it is left in the atmosphere because of greenhouse gases such as Co2

=>The temperature here on earth is 15°C – without all greenhouse gases it would be -18°C

=>Human actions release an enormous amount of greenhouse gases into the atmosphere. This is due to industry, agriculture and by burning fossil fuels such as oil and gas.

=>This causes escalation in greenhouse effect and the rising of earth's temperature.

Greenhouse gases are a **natural phenomenon** and without them there wouldn't be life on earth. But enough is enough. Some of these gases are natural but gases like the ones from industry, agriculture and the burning of fossil fuels are exclusively man made.

A great deal of the CO2 released into the atmosphere comes from transport of goods.

Eliminating pollution:

What can we do?

Most greenhouse gases come from human activities, like burning fossil fuels for transportation or energy.
Share a ride with others, carpool, or take a bus.

- Telecommute.

- Ride your bike.
- Don't let your car idle.
- Fly less.

Greenhouse gas emissions affect all of us by contributing to climate change, which threatens our water supplies, coastlines, forests, and economy. Most greenhouse gases come from human activities, like burning fossil fuels for transportation or energy. These gases trap heat in the Earth's atmosphere, causing a greenhouse effect. As greenhouse gases increase, the Earth's surface temperature also rises, diminishing snowpack, raising sea levels, and increasing droughts and forest fires. You can help reduce the risks we face from climate change by taking steps to reduce the greenhouse gases coming from your home, vehicle, and activities.

Transportation



Energy use



Emissions from fossil fuels burned to heat homes in many countries (not Iceland), are one of the greatest contributors to greenhouse gases. Making your home more energy efficient will reduce your carbon footprint and save you money.

Make your home more efficient

Buy products with Energy Star labels. Reduce the use of electronics

- Around your home



Making a few small changes around your home can help reduce greenhouse gases and save you money.

- Get your family involved

Talk to your family about how greenhouse gases affect our environment, economy, and everyone's life. Then develop a plan to reduce electricity use around your home. Remind everyone to check lights and switches before they leave the home. Encourage your family to buy used products. If you must buy new, be sure it can be recycled or reused. And, if it can't, reconsider buying it.

Vehicle emissions account for a large proportion of greenhouse gas emissions and are up there with the biggest contributors of carbon pollution in the world. To change the way we use transportation can have a big impact on reducing the overall emissions from fossil fuels a great deal.

II. ELIMINATING POLLUTION

2.1CLEAN WATER

Lesson: Water cycles: issues and rational uses

Group 1: Theory: the water cycle and planetary boundaries.

Document: Blue and green water cycle: A sixth planetary boundary crossed in 2022.

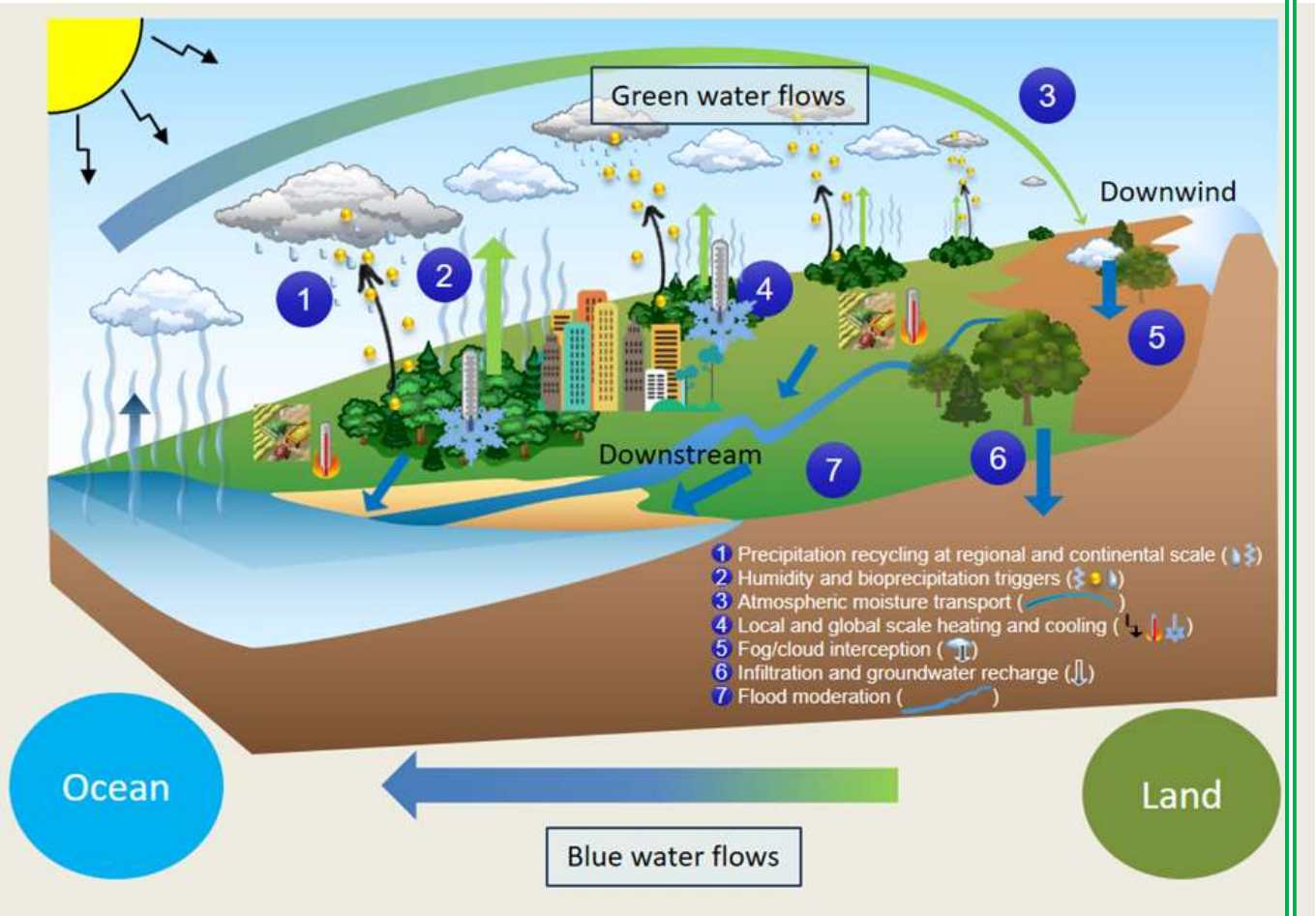
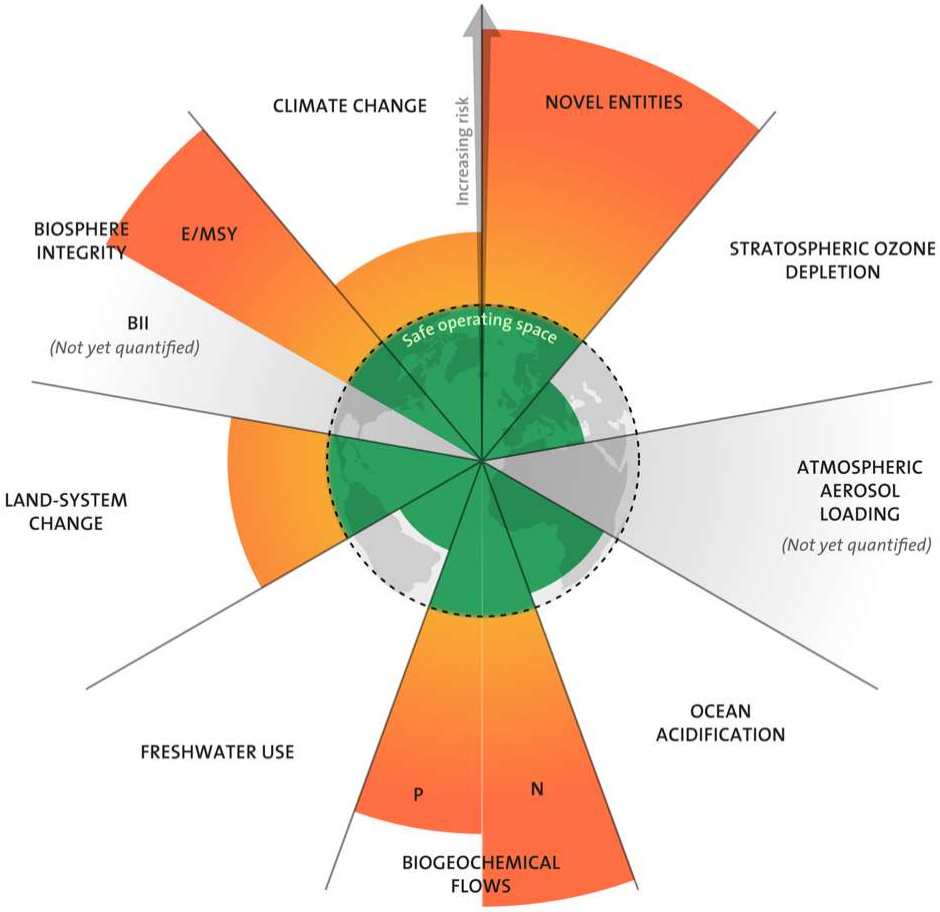


Figure 1: Green and blue water flows in the landscape. Green water is the water that is intercepted or taken up by plants and returned to the atmosphere by evapotranspiration. Blue water is the water that runs off or percolates and ends up in aquifers, rivers and lakes. The individual water cycle processes that are enhanced by trees and forests are enumerated in the legend (modified after Ellison et al., 2019; and Falkenmark and Rockström, 2005).
référence site : https://efi.int/forestquestions/q7

Document: Planetary boundaries as updated by Stockholm researchers

***Resilience Centre*(Suède). © Stockholm Resilience Centre, Azote** :
Credit: Designed by Azote for Stockholm Resilience Centre, based on analysis in Persson et al 2022 and Steffen et al 2015.
In January 2022, 14 scientists concluded in the scientific journal Environmental Science and Technology that humanity has exceeded a planetary boundary related to environmental pollutants and other "novel entities" including plastics.



Website : https://www.stockholmresilience.org/research/research-news/2022-04-26-freshwater-boundary-exceeds-safe-limits.html

Group 2 : TedConférence "Laissons l'environnement guider notre développement", Johan Rockstrom, juillet 2010
https://www.ted.com/talks/johan_rockstrom_let_the_environment_guide_our_development/transcript?language=fr

The students work in two groups to divide the reading task, viewing and analyzing the documents.
After consulting the various documents above, present an oral summary organized around two axes:
- Group 1: Present the water cycle by distinguishing blue water from green water. What are the planetary boundaries that have been crossed in 2022 and why is this development worrying? Present the dangers of an imbalance in the water cycle.
- Group 2: after watching the Ted Conference show the links between environment and development.

Part 2: Putting students into activity: What solutions to the challenges of the imbalance of the water cycle?

Document: Emma Aziza's interview (extracts) :
référence site : https://mayane.eu

Emma Haziza, is a hydrological scientist, a specialist in the water cycle, and a founder of Mayane at the research center applied to climate change.
Mayane, a multidisciplinary approach to the service of territories: "Mayane is a structure dedicated to the development of solutions in the face of risk and aimed at combating the effects of global warming and its territorial consequences.
Dealing with climatic and hydrological risks requires above all the development of a risk culture adapted to each territory and support aimed at reducing the vulnerability of the issues exposed."

Here is an extract from her interview on Friday May 6, 2022 on French national radio, France Inter, by journalist Jérome Cadet:
" […]in Chile in the United States, in Madagascar mega droughts are underway, in France we are not there yet but at the beginning of May a dozen departments have already taken restrictive measures and since last week, a study by German and Swedish researchers taught us that the freshwater cycle was now threatened. That's why we invited you this morning Emma Haziza. Hello, to you, you are hydrologist scientists, that is to say that you study the water cycle, you are the founder of Mayane, a research center applied to climate change. […]
Jérome Cadet: I spoke to Emma Haziza just now about this alert on the freshwater cycle: according to these scientists, this is the 6th planetary limit to have been crossed. We are in fact talking about water green , what exactly is it?
Emma Haziza: Indeed, in this model we analyze this planetary limit that we will cut in 2 on one side the blue water on the other side the green water. So already blue water what is it? It is the water of our lakes, our rivers, our groundwater. In fact it is the water that we are able to see, fairly well controlled because we control it, if not the underground levels. On the other hand, green water is water that is included in our soil. So it's water that we don't see, that isn't directly available to humans. plants. It is the water that is used by all microorganisms in the soil since 1/4 of living terrestrial species live in the soil and therefore in reality green water allows the renewal of soils and agriculture.

Jérome Cadet: Its cycle is threatened, according to these scientists, what happens to this green water, does it evaporate?
Emma Haziza: So actually, on almost all continents there is massive evaporation which is linked to a certain number of phenomena. Among the planetary limits that had already been exceeded, we have the nitrogen cycle, the phosphorus cycle and then precisely the quality of the land. We can see that here, it's really finally the domino effect that happens behind, from the moment when you have soils that are of very poor quality or in reality we no longer have organic matter, we have more capacity in the soil to conserve our water. And therefore, all these microorganisms, these bacteria, everything that exists in the soil precisely allow us to get mineral salts and feed the plants. When you lose that , you lose the plant's ability to fetch water. Soils evaporate and eventually lose those elements that are no longer present in those soils and can no longer hold water. This is mainly because of intensive agriculture which everywhere, on all continents, is making the soil arid. Finally, this intensive agriculture contributes to salinizing the soil, because we will look for water a little deeper, we will change the physico-chemical conditions. And in the atmosphere this water is steam and water vapor is the first greenhouse gas, so it finally warms the atmosphere and by warming the atmosphere we increase the capacity of the soil even more to lose its water. It is therefore a vicious circle which continues and accelerates.
Jérome Cadet: So does that mean that these lands are no longer cultivable in the long term? The United Nations Convention to Combat Desertification warns this week that 20 to 40% of land on the planet is now degraded.
Emma Haziza: Everywhere in the world we can really see a massive degradation and we have a consequence on the water cycle. Why ? Because when you look at how this water cycle works, […] we first have a mass of water which will evaporate massively above the oceans and this mass of water will be transmitted, when you look at the relationship between what evaporates and precipitation there is much more evaporation on the oceans. This mass of humid water arrives on the continents, when it arrives on the continents and it will actually quickens what is happening? We are going to have a continuous renewal on the continents such that more than 60 to 63% of our rains come from our continents precisely because we have cycles which are constantly reforming with rain, you will have an evaporation which will then allow to moisten the soil and so on. If you lose this supply and behind the soils no longer retain and no longer allow this cycle of water, in reality the capacity of the continents to conserve this water which ends up in the atmosphere and in the oceans.
[…] The question of water is actually much broader, because in reality an average European consumes between 5000 and 7000 liters of water per day. It is not by taking showers every day that we will improve the situation. It's really the question of our plate, the way we dress, what we buy, it's what we call virtual water. It is hidden everywhere in all our modes of consumption, and it is water that is used elsewhere. The problem is that this water, which until then was quite present elsewhere and which we find in all our supermarkets behind all the products we consume, is being lost on all continents as well. So droughts elsewhere are starting to have direct impacts here.
Jérome Cadet: So the key is agriculture, if I understand you correctly?
Emma Haziza: Indeed, the biggest key is agriculture because 93% of the world's water is used in agriculture. So indeed it is the key to allow our land to find organic matter , to find its cycles and to rebalance. Because we are in a complete imbalance. When we talk about going beyond

planetary limits, that doesn't mean that everything stops overnight, it means that we tip into a moment when we are in the unknown. That is to say we navigate in a territory where we do not know what will happen and where we no longer control the domino effects. This is what we are in the process of relaxing at the moment.
Jérome Cadet: If I understand what you are telling us Emma Haziza, we must change the agricultural model but we must also feed, feed 7, 8, 9 billion humans? Are the 2 compatible?
Emma Haziza: If everyone on the planet followed our model of meat eating, we wouldn't last long. Why? Because we are still lucky that a large part of the continents eats more chicken than red meat. I tell you why? 4.1 tons of grain will provide one ton of chicken meat. If we look at the beef it's 3 times more. So you need 3 times more land, except that we don't have the land. So in fact it's a problem of agricultural space which is not possible, it's a problem of the quantity of water consumed behind, without counting methane emissions and everything behind it. Finally, getting to more plants is the biggest concrete action we can have here in France.

Jérome Cadet: Processed products are the agri-food industry that provides a living for hundreds of thousands of people.
Emma Haziza: it provides a living for hundreds of thousands of people, today in the model that has been imposed on us. But actually I think that the more we go back to systems with local products, the more fruits and legumes we eat, the more we will contribute to saving the planet. And above all try, as we can see with the latest study that has just been released on pesticides, to support a much more virtuous system, the more we will help protect our land and convert our land and it is we who are in this cycle at the end, because we are part of this water cycle. We ourselves are made up of water so in fact we have to understand that we are inside this cycle.
Jérome Cadet: Carrying on producing for everyone at fair prices will also be based on price, we talked about the price of water but it keeps going up.
Emma Haziza: So the problem is that when you look at the degraded state of groundwater, the more the state of the groundwater is degraded, the more it must then be treated to supply drinking water, the more the price of the water. There is something that at some point does not work. We must go back to the source, precisely stop this massive pollution, in particular the different forms of pesticides and heavy metals, all that we find in our groundwater today. In France alone we have 35% of our tablecloths which are in poor condition so and again we are in France, we are not in India or Africa. Everything that is due to our practices even today since we can clearly see that everything that happens in our lives ends up in our rivers: we find our hormones, we find our vaccines, our antibiotics, everything we consumes ends up in our rivers and then ends up in our groundwater. So we can clearly see that our lifestyles will ultimately have a direct impact and when we look more closely we realize that many products that are supposed to be banned in Europe still end up in our rivers[…]
Question from a France Inter auditor on the recycling of wastewater in Singapore:
The question of the management of city water is an part of the ecological transition. What do you think of it in Singapore, they recycle waste water. Is this something we could do in France? […]
Emma Haziza: We can see that we have champions of the reuse of wastewater on the agricultural level in certain countries. In France we are really in its infancy, but indeed when you see even the water that is used for watering, for cleaning cities, we can really reuse water that has been

treated, but which has not used heavy treatments for drinking levels. The use of non-potable is one of the ways that is considered clearly because then this water is recovered in the soil. On the other hand, in this context of cities, the soils of cities must be massively dewatered, these are the models of “sponge cities”. I believe that we could go very quickly in France when we look at all the big cities to precisely "debitumerate", de-impermeabilize, allow water to be recovered from the soil, it creates islands of coolness to deal with the heat waves and it limits the risk of flooding so it has direct impacts. […]

Source : https://www.franceinter.fr/emissions/l-invite-de-8h20-le-grand-entretien/l-invite-de-8h20-le-grand-entretien--may 6th, 2022.

Document: phytopurification:

“What is phytopurification? With more than 150 liters of wastewater discharged per day per person, it is essential to choose an effective water treatment system. Whether you choose to build an ecological or more traditional house, it is possible to opt for a non-collective sanitation installation that is very respectful of the environment thanks to phyto-purification.

Plants at the service of water treatment

For their growth, plants need nutrients, mostly drawn from the soil. In order to optimize absorption and be sure to have everything they need, some plants associate with bacteria, which will settle in their roots.

This is symbiosis, whereby bacteria digest organic matter and transform it into mineral matter, which is then absorbed and assimilated by the plant. In exchange for providing these nutrients, plants provide bacteria with oxygen, which is essential for their survival.

This system of symbiosis between plants and bacteria makes it possible to combine the aesthetics of a garden and the treatment of wastewater at a lower cost and of course without smell!

The big advantage is that there is no or very little need for energy to sanitize the water. Flow management can be done manually or using a small, energy-efficient pump.

Three simple, self-contained steps

Just like a classic sanitation system, wastewater is sanitized in several stages until clear water is obtained.

- Pre-treatment: Black water and gray water pass through a first basin containing gravel and plants, very often reeds which have a very developed root system. the 10 years.
- Treatment of chemical compounds: Following the first basin, there is a second basin composed of several plants and substrates carefully chosen for their ability to absorb nitrates and phosphates contained in particular in urine or faeces.

Some chemical compounds in household products can also be broken down, but it is strongly advised to choose ecological products to limit pollutants.

- Biological treatment: All the accumulated deposits are then broken down and transformed into nutritious products for the plants.

The flow can be done on a vertical planted filter (aerobic), horizontal (anaerobic), or even both.

Generally, 2 vertical filters are installed next to each other, with alternating flows to allow bacteria time to properly degrade the pollutants.

The water filtered for the first time then naturally passes through a horizontal filter which takes care of the biological treatment and the treatment of the chemical compounds. For this, the land must have a minimum downward slope of 5%. Otherwise, a sump pump is required.
This makes it possible to retain the large particles and to make a compost out of them to be eliminated every 10 years.

A wide variety of purifying plants
Phytopurification. Many wet plants have the ability to absorb phosphate, nitrate or nitrogen, which are the main pollutants contained in wastewater.
However, it is essential to adapt the choice of these plants to each installation in order to adapt to the climate of the region and therefore be sure of its development. There are vascular and non-vascular plants and also persistent emergent plants such as bulrushes, sedges, cattails or water lilies.

Install a phytopurification system
Concerning the surface that the installation takes up on your land, it is necessary to plan 2 to 5 m² per person which offers a beautiful garden, even if it is not accessible.
The cost of a phyto-purification station is less expensive than a conventional installation, since it takes between 4000 and 5000 € for a house of 4 to 5 people.
A phytopurification installation may require some maintenance, especially for mowing the reeds, even if the choice of plants is adapted to climatic fluctuations during the year.
So if you are ready to embark on a few hours of gardening a year, do not hesitate to ask your builder about the possibilities available to you to equip your new house with a phytopurification system.
Published on August 1, 2019

https://www.mafuturemaison.fr/dossier/construire/la-phytoepuration-le-choix-ecologique-du-traitement-de-leau/

Instructions for the second part: Based on the documents provided and your personal research, produce an infographic on the challenges and solutions to the imbalance of the water cycle on a planetary scale.
On the infographic should appear:
- The challenges posed by its imbalance: food, multiplication of extreme climatic events, geopolitical tensions, etc.
- The solutions envisaged to respond to the imbalance in the texts: At the choice of the student: the field of agriculture, depolluting plants. The Mayane website can help you https://mayane.eu
Choose your infographic template on the site

https://create.vista.com/fr/templates/infographic/

Skills to work on:
- Reading, analysis of documents of various types
- Producing a summary: hierarchy of information and organized argumentation
- Speaking orally in front of an audience.

- Making a mental map (infographic)

Goals to reach :
- Understand the issues around the question of water for the future of the Planet.
- Understand the need for governance at all scales

2.2PROTECTION OF THE OZONE LAYER

GRADE: HIGH SCHOOL

DESIRED RESULTS

Students understand what microplastic is

- **Students understand the causes of microplastic pollution in water**
- **Students offer solutions to reduce microplastic pollution.**
- **Students use IT technology**
- **Students develop their research and presentation skills**

UNDERSTANDINGS:

Students work in groups and investigate **microplastic pollution** from different sources.They create their own presentations,videos and newspapers. They share the results and main idea of each research with their classmates.

Informational technology /IT/

Our students have learned to use many web 2 tools.

Information can be presented in an effective way by using technology

They can turn their research into a presentation.

How does access to information affect the way we impact with the environment?-

As students gain knowledge, they realize the mistakes of people about the environment. They query the errors, produces solutions.

ELIMINATING POLLUTION TO REDUCE POLLUTION FROM EXCESS NUTRIENTS AND MICROPLASTICS

What is microplastic?

Microplastics are the name given to plastics with sizes between 5 mm and 1 micrometer. Due to their size, they are very difficult to detect with the naked eye.

Two types of microplastics are contaminating the world ocean: primary and secondary microplastics.

Primary microplastics are plastics that are directly released into the environment as small particles. They can be added voluntarily to products like scrubbing agents in toiletries and cosmetics (e.g. shower gels). They can also be caused by the abrasion of large plastic objects during manufacturing, use, or maintenance, such as tyre erosion while driving or the abrasion of synthetic textiles during washing.

Secondary microplastics are microplastics that form when larger plastic products degrade into smaller plastic fragments after being exposed to the sea. Photodegradation and other weathering processes of poorly managed waste, such as abandoned plastic bags, or unintentional losses, such as fishing nets, cause this. Because the origins of secondary microplastics are difficult to track due to their deterioration, determining how much of the macroplastics has now transformed to microplastics is challenging. As a result, the report focuses on the quantification of primary microplastics, which is possible with existing data sets.

Microplastics can have a toxic effect according to their chemical structure.They can carry bacteria and viruses that adhere to them into our body.Scientists have shown that these substances can weaken immune function and hinder growth and reproduction. However, more research is needed to understand the extent of the danger.

https://portals.iucn.org/library/sites/library/files/documents/2017-002-En.pdf

https://www.theguardian.com/environment/2022/mar/24/microplastics-found-in-human-blood-for-first-time

https://www.euronews.com/tag/microplastics

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2873020/

https://mikroplastik.org/mikroplastik-nedir/

https://wwftr.awsassets.panda.org/downloads/plastik_raporu_web_icin_1.pdf?7800/wwf-akdeniz-plastik-raporunu-yayimladi-akdenize-en-cok-plastik-turkiyeden

https://plasticseurope.org/wp-content/uploads/2021/12/Plastics-the-Facts-2021-web-final.pdf

The dimensions of the danger are great, as can be seen in the figure below, published in EUROPEAN COMMISSION (Brussels, 30 April 2019) report on microplastic pollution.

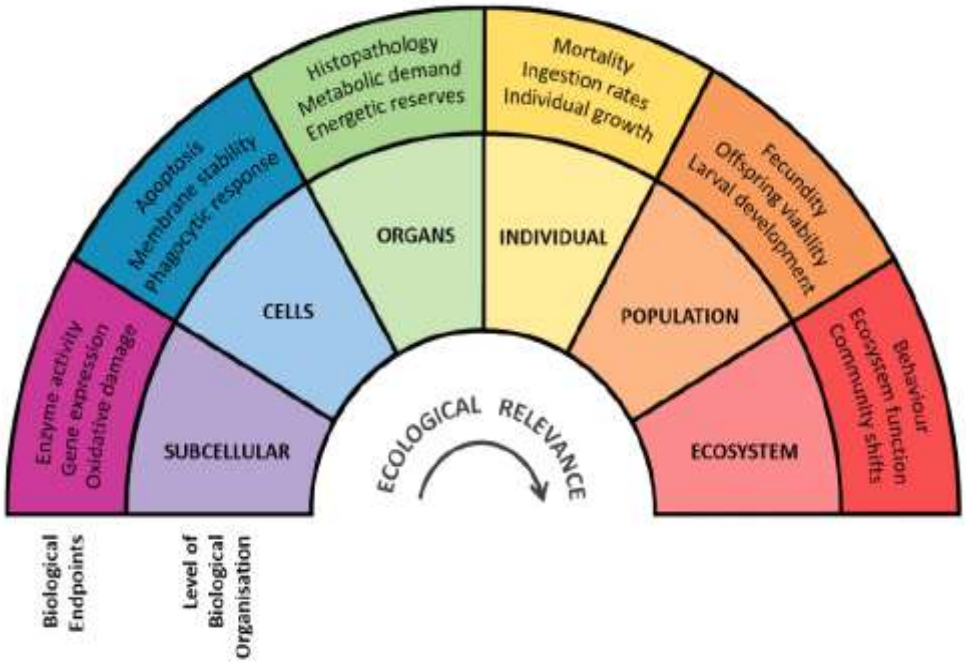
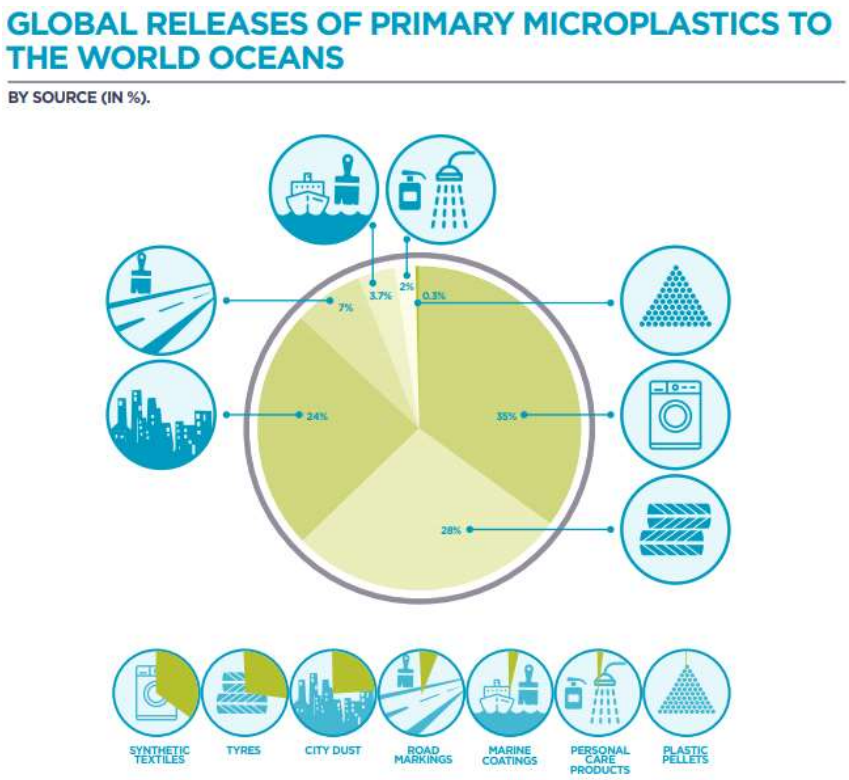


Figure 1 *– Impacts of nano and microplatics on biota reported at various levels of biological organisation (a biological endpoint is a marker of disease progression). Most studies have been at sub-organismal levels and studies at a community or ecological level are relatively sparse (SAPEA, 2019)*

For example, many animal species ingest plastic mistaking it for food – from large mammals, birds and fish to tiny zooplankton, some dying as a result (de Sá, Oliveira, Ribeiro, Rocha, & Futter, 2018).

Laboratory experiments show that microplastics can give rise to a range of mechanical, chemical and biological impacts on biota causing damage, dysfunction and physiological disruptions. They provide evidence of inflammation and stress, as well as negative effects on food consumption, growth, reproduction and survival of a range of species SAPEA (2019: 2.5.1).



This figure was taken

https://portals.iucn.org/library/sites/library/files/documents/2017-002-En.pdf

In this case, what are the measures to be taken at the international and national level?

What could be the international measures?

•Signing of a legally binding worldwide agreement to avoid the pollution of the oceans with plastics.

• Mapping and tracking to prevent leaks in industrial activities.,

• Remove and properly dispose of all waste generated by ghost fishing in the oceans.

•Setting up international plastic waste trading legislation that defines recycling criteria for plastic waste exporters.

• For all plastic items placed on the market, manufacturer accountability plans should be established, and deposit practices should be implemented when appropriate.

What could be the national measures?

•National targets should be set for the following: increasing the rate of plastic waste recycling and reuse from 30% to 100%

•Trash management should be more systematic and sustainable, and infrastructure investments should be undertaken to improve the management and recycling of plastic waste.

•The producer liability system and deposit funds should have separate collection targets (e.g. Back lower fees for using recyclable packaging or recycled materials).

• By 2025, single-use plastic bags and microplastics added to products will be prohibited. By 2025, all countries should be looking for alternate options to reduce plastic waste.

•A roadmap should be drawn up, including incentives (eg tax exemptions) for plastic bags and other disposable products that can be substituted to ban products and reduce littering.

•Microplastics should not be used in consumer products (such as detergents and cosmetics) and technical products.

•In addition, all plastic products that are deliberately released into the environment and are not biodegradable should be banned.

• Making effective recycling and integrated waste management plans in order to achieve 100% success in the collection and separation of waste.

What could be the industry measures?

• Recyclable or sustainable packaging solutions should be produced. Currently, 30 percent of packaging is non-recyclable plastic. There is the use of raw materials and fossils from polymers obtained from non-renewable resources.

• Recycled materials and plastic production to use alternative materials used in processes and supply chains. redesign of infrastructures.

• The use of single-use plastic products should be reduced, and a zero-waste policy should be encouraged to adopt a plastic-free work environment at an institutional level.

• Not using unnecessary small plastic products and packaging

• All hotel and marina operators, including the tourism sector, should abandon the use of disposable bags, bottles, caps or straws.They should introduce effective waste collection and recycling systems.

Recommendations to consumers

• Where possible, biodegrade or recycle plastic. Wood material, sponges made of cellulose; ceramic dishes, glass cups; napkins made of cotton fabric; yoga mats made of bamboo fibers, etc. use it.

• Avoid disposable products: choose a replaceable toothbrush or razor; Do not use plastic straws, shopping bags, water bottles, plates or cutlery, cotton buds, pens and lighters.

• Do not use plastic to preserve food products: Plastic Instead of cling film, bags or storage containers, use glass, a material that, unlike plastic, does not emit any contaminants and does not react.

• Do not use soap and cosmetic products containing microplastics: Check the ingredients in the product, polyethylene, polypropylene, polyvinyl chloride... They are all plastic.

• Buy unpackaged products: When purchasing fruit, vegetables, cheese, meat, fish and other food products, to minimize the use of packaging, they are sold by weight, not individually packaged ones; When buying detergents, choose whole sale products.

• Pay attention to waste and recycling practices in your city or neighborhood and recycle as much of your waste as possible.

• Be a responsible citizen, do not use single-use plastic products and dispose of all your waste (cigarette butts, packaging and plastic toys) in a way that does not pollute the coasts and the environment.

Five Ways to Live Plastic-Free

• Carrying a bag will always keep you away from the possibility of being caught off guard. If you put a reusable storage container, a water bottle, a personal glass and a couple of cloth bags in the bag, you will avoid using many disposable plastics.

• Plastic straws are the most useless in the world except for medical use. If you don't have a problem that you have to be fed with a plastic straw, when you order while eating out, specify that you do not want a straw.

• Reduce the use of cling film at home, prefer storage containers

- Plastic is used seriously in the dishes that are made to order. Foam or other plastic packaging in which the desired products are placed is a serious threat. The wet wipes, toothpicks, sauces and other extras in the bag always mean plastic. Then, instead of ordering food, it is best to go and eat at the restaurant or eat at home.

- Avoiding wastage while doing laundry

Nutrient Excess

- Nutrient pollution, a form of water pollution, refers to contamination by excessive nutrient input. It is the primary cause of eutrophication of surface waters, where nutrients often containing nitrogen or phosphorus promote algae growth.

https://www.epa.gov/nutrientpollution/issue

https://youtu.be/vCicSNnKUvM

https://oceanservice.noaa.gov/facts/eutrophication.html

https://oceanservice.noaa.gov/podcast/jan15/os5-eutrophication.html

https://cevreselgostergeler.csb.gov.tr/kiyi-ve-deniz-sularindaki-besin-maddeleri-i-91719

https://acikders.ankara.edu.tr/pluginfile.php/131910/mod_resource/content/1/restorasyon%20teknikleri_II.pdf

http://www.biyolojiegitim.yyu.edu.tr/kf/tootrfksyn/index.htm

https://www.youtube.com/watch?v=UGqZsSuG7ao HYPERLINK "

https://www.biyologlar.com/otrofikasyon-nedir

Nitrogen and phosphorus are nutrients that are natural parts of aquatic ecosystems. Nitrogen is also the most abundant element in the air we breathe. Nitrogen and phosphorus support the growth of algae and aquatic plants, which provide food and habitat for fish, shellfish and smaller organisms that live in water.

But when too much nitrogen and phosphorus enter the environment - usually from a wide range of human activities - the air and water can become polluted. Nutrient pollution has impacted many streams, rivers, lakes, bays and coastal waters for the past several decades, resulting in serious environmental and human health issues, and impacting the economy.

Too much nitrogen and phosphorus in the water causes algae to grow faster than ecosystems can handle. Significant increases in algae harm water quality, food resources and habitats, and decrease the oxygen that fish and other aquatic life need to survive. Large growths of algae are called algal blooms and they can severely reduce or eliminate oxygen in the water, leading to

illnesses in fish and the death of large numbers of fish. Some algal blooms are harmful to humans because they produce elevated toxins and bacterial growth that can make people sick if they come into contact with polluted water, consume tainted fish or shellfish, or drink contaminated water.

Nutrient pollution in ground water - which millions of people in the United States use as their drinking water source - can be harmful, even at low levels. Infants are vulnerable to a nitrogen-based compound called nitrates in drinking water. Excess nitrogen in the atmosphere can produce pollutants such as ammonia and ozone, which can impair our ability to breathe, limit visibility and alter plant growth. When excess nitrogen comes back to earth from the atmosphere, it can harm the health of forests, soils and waterways .(https://www.epa.gov/nutrientpollution)

Eutrophication is the increase in the growth of plants, animals and microorganisms in lakes and rivers and is a natural phenomenon. However, if this event is allowed to continue uninterrupted, oxygen deficiency will occur in the waters. Thus, microorganisms living in anaerobic conditions multiply to the detriment of the aerobic microorganism. Under these conditions, the decomposition of organic matter into H2O and CO2 cannot be completed, it begins to accumulate in a reduced form. Thus, microorganisms living in anaerobic conditions multiply to the detriment of the aerobic microorganism. Under these conditions, the decomposition of organic matter into H2O and CO2 cannot be completed, it begins to accumulate in a reduced form. In addition to the accumulation of these organic compounds, low molecular weight compounds are formed, which are the metabolism products of anaerobic microorganisms. These compounds are severely toxic to aerobic microorganisms. The interactions between algae, photosynthetic bacteria and anaerobic bacteria living in lakes where water circulation occurs only in the upper layers are in balance as follows. In the upper water layers, there are algae and other green plants that perform photosynthesis. This zone is the aerobic zone of the water that

aerates. At the bottom, there is an anaerobic zone, where dead plant residues accumulate and there is no water circulation.Between these two regions, there is an airless area that receives enough light from the top, where anaerobic photosynthetic bacteria use H2S, butyric acid and other fatty acids, which are the metabolism products of anaerobic bacteria, which decomposes organic residues in the lake bottom, as electron donors in photosynthesis, thus toxic to green plants. These compounds are decomposed and lost.Thus, while the organic residues descending to the lake bottom are decomposed, the toxic compounds formed are retained by the anaerobic photosynthesizing bacteria in between before they reach the plants and other living things in the upper floors. This biological balance is sometimes disturbed as a result of an excessive increase in the algae population living in the upper waters. Generally, the low amount of phosphorus in the water is the most important factor limiting the algae population. An increase in phosphorus concentration in water for any reason causes algae to grow excessively. In this case, the amount of toxic compounds formed by the anaerobic decomposition of the excess algae residues accumulated at the lake bottom reaches dimensions that the photosynthetic anaerobic bacteria in the intermediate layer cannot hold. Reaching the upper floors, these toxic compounds destroy life, including the fish there. The critical level for P concentration that will cause eutrophication in waters is 0.01 ppm and the nitrogen level is 0.3 ppm.

Generally, eutrophication in a water body is observed with the following events:

• Increase in aquatic organisms and plant mass,

• Change in organism type, eg growth of blue-green algae in addition to green algae and the proliferation of coarser fish species instead of salmon fish.

•Observing maximum and minimum values in daily oxygen concentration measurements throughout the lake depth,

• Decrease in light transmittance of water and increase in color,

• Decreased oxygen concentration in deep regions during periods of stratification,

• Increase in dissolved N and P concentration.

Sources and Solutions

Animal waste contributes excess nutrients to our waterways when manure is improperly managed.Our homes, yards and streets contribute to nitrogen pollution in a variety of ways, but solutions exist to address this pollution at its source. https://www.epa.gov/waterreuse

The primary sources of excess nitrogen and phosphorus are:

- Agriculture: The nitrogen and phosphorus in animal manure and chemical fertilizers are necessary to grow crops. However, when these nutrients are not fully utilized by plants they can be lost from the farm fields and negatively impact air and downstream water quality.

- Stormwater: When precipitation falls on our cities and towns it runs across hard surfaces - like rooftops, sidewalks and roads - and carries pollutants, including nitrogen and phosphorus, into local waterways.

- Wastewater: Our sewer and septic systems are responsible for treating large quantities of waste, and these systems do not always operate properly or remove enough nitrogen and phosphorus before discharging into waterways.

- Fossil Fuels: Electric power generation, industry, transportation and agriculture have increased the amount of nitrogen in the air through use of fossil fuels.

- In and Around the Home: Fertilizers, yard and pet waste and certain soaps and detergents contain nitrogen and phosphorus, and can contribute to nutrient pollution if not properly used or disposed. The amount of hard surfaces and type of landscaping can also increase the runoff of nitrogen and phosphorus during wet weather.

How you can help prevent nutrient pollution:

https://www.epa.gov/nutrientpollution/what-you-can-do

Cleaning Supplies-Detergents and Soaps

Choose phosphate-free detergents, soaps, and household cleaners.

Select the proper load size for your washing machine.

Only run your clothes or dish washer when you have a full load.

Use the appropriate amount of detergent; more is not better.

Pet Waste

Always pick up after your pet.

Avoid walking your pet near streams and other waterways. Instead, walk them in grassy areas, parks or undeveloped areas.

Inform other pet owners of why picking up pet waste is important and encourage them to do so.

Water Efficiency

Use low-flow faucets, shower heads, reduced-flow toilet flushing equipment, and water-saving appliances such as dish- and clothes washers.

Using less electricity at home can reduce emissions of nitrogen pollution from energy production.

- Turn things off or unplug them when you're not using them.
- Adjust the thermostat by a few degrees to be slightly warmer in the summer and cooler in the winter.
- Replace old light bulbs with new energy efficient bulbs.
- Use a power strip to turn on and off electronic devices.
- Open shades to utilize daylight instead of turning on lights; on cool days this helps to keep rooms warmer.
- In the summer, close shades when not in the room to keep rooms cooler and use less electricity.
- Hang-dry clothes instead of using the dryer.
- Find out if it is possible to switch to wind generated energy.

Use a commercial car wash; commercial car washes must dispose of wastewater appropriately, and many filter and recycle their water.

Consider the following steps if you're cleaning your car at home:

So that water is filtered before reaching a water body, wash your car on a pervious surface like grass or gravel (rather than concrete or asphalt).

Use phosphate-free, nontoxic soaps.

Only use a small amount of soap.

Reduce water use and use a spray nozzle to control water flow to reduce runoff.

Sponge and rags should be wrung out over a bucket or in a sink rather than on the ground.

Fill the sink or toilet with wash water, or dump it on the grass if you want to dispose of it outside.

Lawn Care

Fertilizer should only be used when absolutely essential and in the recommended amounts.

Fertilizer should not be applied on windy or rainy days.

Fertilizer should not be applied near streams.

2.3CLEAN AIR – QUALITY STANDARDS

SCHOOL: ITES Vitale Giordano, Bitonto – ITALY

Teacher: prof. Maria Maddalena Bellocchio

Students: 2^ class

Time required for the activity: 12 hours

Disciplines involved: Science (Chemistry, Biology, Geography, Informatic)

DESIRED RESULTS

- **Know the causes and effects of the presence of air pollutants**
- **Identify connections and relationships in the natural environment.**
- **Acquire, interpret and communicate information. –**
- **Cooperate and participate in group activities by carrying out tasks.**

PREREQUISITES

- What the atmosphere is

- Know the atmosphere and its stratification

- Know the meaning of ecosystem

- Know the meaning of pollution and some types of pollution

METHODOLOGY

Working in groups: cooperative learning, flipped classroom.

INFORMATIC TECHNOLOGY

Each student uses their own iPad and works with apps such as Canva, Thinglink, Padlet, Inspiration, Power Point, Keynote and others.

WORK STEPS

1) **Role-playing game:**

Role-playing activity: students participate in a simulated city council meeting on pollution in their city, in which citizens participate, each with their own experience. Students participate according to the rules of role-playing and become concretely aware of the pollution problem.

2) **Materials to study for the whole class: Air quality standards**

- **Explore the website European Environment Agency:** https://www.eea.europa.eu/themes/air/air-quality-concentrations/air-quality-standards
- **Explore the website European Air Quality Portal:**

https://aqportal.discomap.eea.europa.eu

- **WHO global air quality guidelines (2021)**

https://ancler.org/who-global-air-quality-guidelines-2021/

3) Work in groups

The class is divided into 4 cooperative groups. Each group receives links to documents related to air quality standards. Each group of students will read and study at school and at home the assigned documents and produce a summary document and infographics or posters to be exhibited in the "BE GREEN" corner of the school. At the end, the class will participate in an outdoor workshop on lichens, biological indicators of air quality.

GROUP 1: PARTICULATE MATTER (PM_{10} and $PM_{2,5}$)

- **PM10 Particolato atmosferico o polveri sottili - Istituto Superiore di Sanità**

https://www.issalute.it/index.php/la-salute-dalla-a-alla-z-menu/p/pm10-particolato-atmosferico-o-polveri-sottili

- **Qualità dell'aria ambiente: Particolato (PM2,5)**
https://www.salute.gov.it/imgs/C_17_paginaRelazione_1438_listaFile_itemName_2_file.pdf

- **Particulate Matter (PM10 – PM2,5) Pollution**

https://www.epa.gov/pm-pollution

GROUP 2: TROPOSPHERIC O3

- **Tropospheric Ozone**

https://scied.ucar.edu/learning-zone/air-quality/ozone-troposphere

- **Qualità dell'aria ambiente: Ozono troposferico (O_3)**
https://www.salute.gov.it/imgs/C_17_paginaRelazione_1438_listaFile_itemName_3_file.pdf

GROUP 3: Nitrogen oxides - Sulfur Dioxide (NO_2 -SO_2):

- **NO2 -SO2: Impact of nitrogen oxides on the environment and human health:**

  https://www.sciencedirect.com/science/article/abs/pii/S2211339816300661

- **Ossido e biossido di azoto (NOx e NO2)- Ministero della salute**

  https://www.salute.gov.it/imgs/C_17_opuscoliPoster_283_ulteriorallegati_ulteriorallegato_0_alleg.pdf

- **Sulfur Dioxide Basics**

  https://www.epa.gov/so2-pollution/sulfur-dioxide-basics

GROUP 4: Carbon Monoxide. (CO)

- **Basic Information about Carbon Monoxide (CO):**

  https://www.epa.gov/co-pollution/basic-information-about-carbon-monoxide-co-outdoor-air-pollution

- **Carbon Monoxide (CO) Pollution in Outdoor Air**

  https://www.epa.gov/co-pollution

FINAL EVALUATION

- Structured final tests on air pollutants
- The final products of the lichen workshop (presentation, video) will be evaluated as the final work of the experience with special evaluation rubrics.

Link to the website on lichen workshop:
https://sites.google.com/view/qualitdellarialaboratoriosuili/biochigeo-matematica

Bibliography and sitography

- **PM10 Particolato atmosferico o polveri sottili - Istituto Superiore di Sanità**

https://www.issalute.it/index.php/la-salute-dalla-a-alla-z-menu/p/pm10-particolato-atmosferico-o-polveri-sottili

- **Qualità dell'aria ambiente: Particolato (PM2,5)**
https://www.salute.gov.it/imgs/C_17_paginaRelazione_1438_listaFile_itemName_2_file.pdf

- **Particulate Matter (PM10 – PM2,5) Pollution**

https://www.epa.gov/pm-pollution

- **Tropospheric Ozone**

https://scied.ucar.edu/learning-zone/air-quality/ozone-troposphere

- **Qualità dell'aria ambiente: Ozono troposferico (O_3)**
https://www.salute.gov.it/imgs/C_17_paginaRelazione_1438_listaFile_itemName_3_file.pdf

- **NO2 -SO2: Impact of nitrogen oxides on the environment and human health:**

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- **Sulfur Dioxide Basics**

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- **Basic Information about Carbon Monoxide (CO):**

https://www.epa.gov/co-pollution/basic-information-about-carbon-monoxide-co-outdoor-air-pollution

- **Carbon Monoxide (CO) Pollution in Outdoor Air**

https://www.epa.gov/co-pollution

2.4INDUSTRY AND IMPROVE PREVENTION

1. Read the article "The challenge of reducing industrial pollution"

Industrial pollution in Europe is decreasing, thanks to a blend of regulation, developments in manufacturing and environmental initiatives. However, industry continues to pollute and moving towards zero pollution in this sector is an ambitious challenge.
We can categorise pollution by where we find it — in air, water or soil — or we can look at different pollution types, such as chemicals, noise or light. Another way to look at pollution is to go to its sources. Some pollution sources are spread out, such as cars, agriculture and buildings, but others can be better assessed as individual emission points. Many of these point sources are large installations, such as factories and power plants.

Industry is a key component of Europe's economy. According to Eurostat, in 2018, it accounted for 17.6 % of gross domestic product (GDP) and directly employed 36 million people. At the same time, industry also accounts for more than half of the total emissions of some key air pollutants and greenhouse gases, as well as other important environmental impacts, including the release of pollutants to water and soil, the generation of waste and energy consumption.

Air pollution is often associated with the burning of fossil fuels. This obviously applies to power plants but also to many other industrial activities that may have their own onsite electricity or heat production, such as iron and steel manufacturing or cement production. Some activities generate dust that contributes to particulate matter concentrations in the air, whereas solvent use, for example in metal processing or chemical production, may lead to emissions of polluting organic compounds.

Industrial air emission trends
Air emissions from industry in Europe have decreased over recent years. Between 2007 and 2017, overall emissions of sulphur oxides (SOx) declined by 54 %, nitrogen oxides (NOx) by more than one third and greenhouse gases from industry, including power plants, by 12 % [The European environment — state and outlook 2020, pp. 274-275].

These improvements in environmental performance by European industry have occurred for a number of reasons, including stricter environmental regulation, improvements in energy efficiency, a move towards less polluting types of manufacturing processes and voluntary schemes to reduce environmental impact.

For many years, environmental regulation has limited the adverse impacts of industrial activities on human health and the environment. Key EU measures targeting industrial

emissions include the Industrial Emissions Directive, which covers about 52 000 of the largest industrial plants, and the Medium Combustion Plants Directive.

The EU Emissions Trading System (EU ETS), meanwhile, limits greenhouse gas emissions from more than 12 000 power generation and manufacturing installations in 31 countries. The EU ETS covers around 45 % of the EU's greenhouse gas emissions.

However, despite these improvements, industry is still responsible for a significant burden on our environment in terms of pollution and waste generation.

Public accountability — the E-PRTR and transparency of industrial emissions data
The European Pollutant Release and Transfer Register (E-PRTR) was set up in 2006 to enhance public access to environmental information.

In essence, the E-PRTR enables citizens and stakeholders to learn about pollution in all corners of Europe, who the top polluters are and whether or not pollutant emission trends are improving.

The E-PRTR covers more than 34 000 facilities across 33 European countries. E-PRTR data show, for each facility and year, information concerning the amount of pollutants released to air, water and land, as well as off-site transfers of waste and pollutants in waste water. E-PRTR data are freely available on a dedicated, interactive website. The website archives historical data on releases and transfers of 91 pollutants across 65 economic activities.

Moreover, the E-PRTR is now integrated with wider reporting under the Industrial Emissions Directive, including further information for large combustion plants. Together with the European Commission, the EEA is currently working on a new website to improve access to these data and information.

Counting the costs of industrial air pollution
In order to account for the external costs of air pollution, an individual pollutant's adverse impacts on human health and the environment are expressed in a common metric, a monetary value, which has been developed through cooperation between different scientific and economic disciplines.

Damage cost estimates are just that — estimates. However, when considered alongside other sources of information, they can support decisions by drawing attention to the implicit trade-offs in decision-making, such as the cost-benefit analyses used to inform impact assessments and subsequent legislation.

The EEA estimated in 2014 that the aggregated cost of damage over the 5-year period 2008-2012 caused by emissions from E-PRTR industrial facilities was at least EUR 329 billion (2005 value) and rising. What is perhaps even more striking in this analysis is that about half of the damage costs occurred as a result of emissions from only 147, or 1 %, of the 14 000 facilities in the data set.

The majority of the quantified damage costs is caused by emissions of the main air pollutants and carbon dioxide. Although damage cost estimates associated with heavy metal and organic pollutant emissions are significantly lower, they still cause hundreds of millions of euros in harm to health and the environment and can cause significant adverse impacts on the local scale. The EEA is currently working on a new study that will update these figures.

Reducing industrial pollution — assessment, legislation and implementation
The EEA regularly assesses trends in industrial pollution in Europe based on E-PRTR and other data. These assessments show that industrial pollution has decreased over the past decade for emissions to both air and water. Existing and incoming EU policy instruments are expected to further reduce industrial emissions, but pollution is likely to continue to have adverse impacts on human health and the environment in the future.

A strong, growing, low-carbon industry based on circular material flows is part of the EU industrial policy strategy. The goal is to create a growing industrial sector that draws less and less on natural resources, reduces pollutant emissions to air, water and land, and generates decreasing amounts of waste.

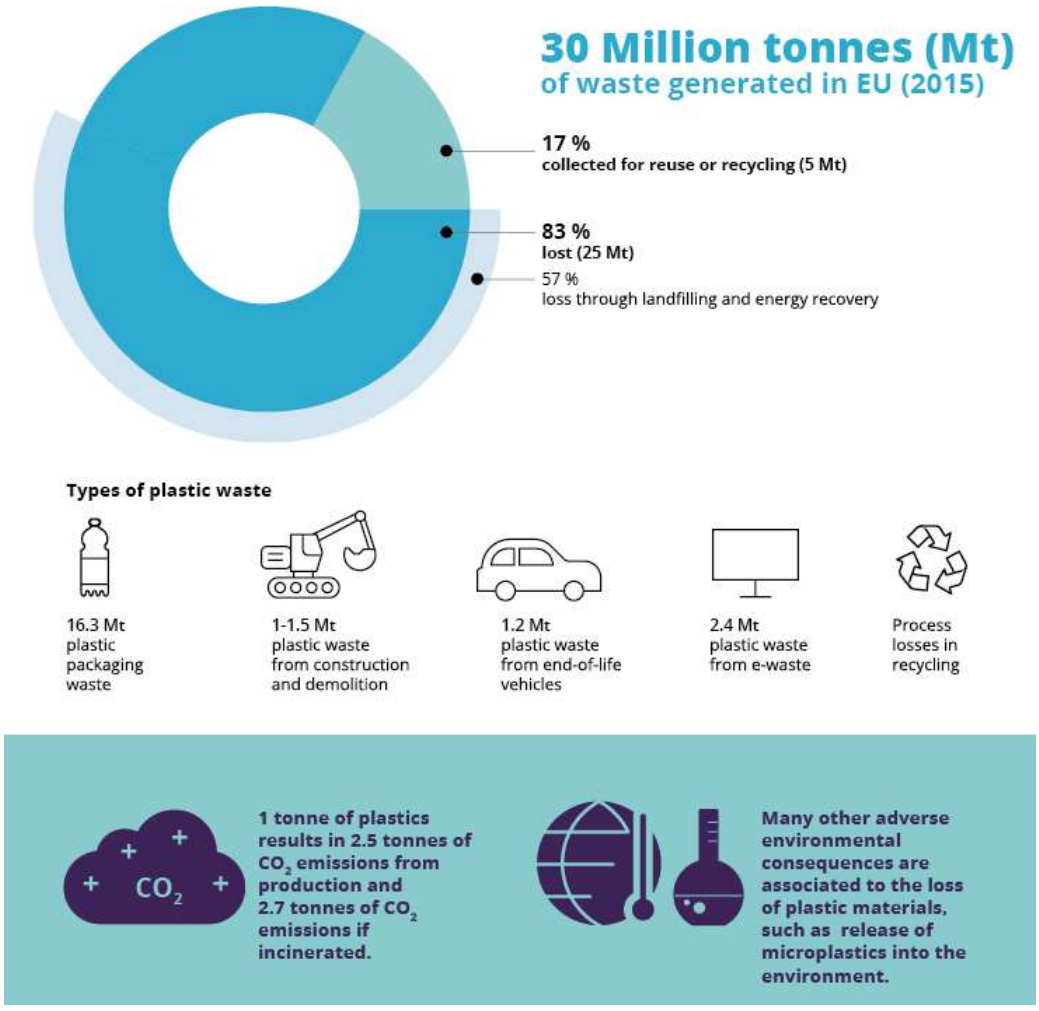
Meanwhile, other EU legislation sets more concrete air emission reduction targets, such as the National Emission Ceilings Directive and the Industrial Emissions Directive, which aim to achieve the ambitious prevention and reduction of emissions, in particular through the continuous uptake of so-called best available techniques (BATs).

According to a recent EEA analysis, using best available techniques and implementing the more ambitious targets of the Industrial Emissions Directive would result in substantial emission reductions: 91 % for sulphur dioxide, 82 % for particulate matter and 79 % for nitrogen oxides.

Fully implementing these directives would help the EU achieve environmental objectives, such as those on air and water quality. However, the emission-related directives often act independently and there is clear scope for further integration of the environmental objectives into the EU’s industrial policy. Moving towards zero pollution will require even more robust legislation, implementation and monitoring to ensure that the industries of tomorrow are both clean and sustainable.

Plastic pollution

Plastics have brought many benefits to our daily lives but the problem is that these products never truly disappear. Therefore, we should perhaps think about plastics as a type of pollutant from the point of their production and prevent plastic products and waste from leaking into the environment.



2. Use https://www.eea.europa.eu/countries-and-regions and find information about industrial pollution in different European countries. Compare information and create PPT presentation "5 most polluted countries in Europe based on their industrial pollution profile".
3. Use https://industry.eea.europa.eu/explore/explore-data-by-pollutant and represent on Google Earth information about air pollution with CO2 in your country. Fix, name,

compare and show pollution with CO2 in 3 most polluted areas for last 10 years – from different economic sectors.

2.5CHEMICALS –TOXIC-FREE ENVIRONMENT

Chemicals are everywhere in our daily life. They form part of nearly all devices we use to ensure our well-being and protect our health. Chemicals are the building blocks of the low-carbon, zero pollution, energy- and resource-efficient technologies, materials, and products that we need for making our society and economy more sustainable. At the same time, chemicals can have hazardous properties that harm human health and the environment. They can cause cancer, affect the immune, respiratory, endocrine, reproductive and/or cardiovascular systems, weaken human resilience and capacity to respond to vaccines and increase vulnerability to diseases.

Hazardous, or toxic, waste is the potentially dangerous by-product of a wide range of activities, including manufacturing, farming, water treatment systems, construction, automotive garages, laboratories, hospitals, and other industries. The waste may be liquid, solid, or sludge and contain chemicals, heavy metals, radiation, pathogens, or other materials. Even households generate hazardous waste, from items such as batteries, used computer equipment, and leftover paints or pesticides.

Toxic waste can harm people, animals, and plants, whether it ends up in the ground, in streams, or even in the air. Some toxins, such as mercury and lead, persist in the environment for many years and accumulate over time. Humans or wildlife often absorb these toxic substances when they eat fish or other prey.

What is a toxic-free environment and how will we achieve it?

The EU Chemicals Strategy sets out the steps to take to achieve a toxic-free environment and ensure that chemicals are produced and used in a way that maximises their contribution to society while avoiding harm to the planet and to current and future generations. The Strategy foresees that the most harmful chemicals are avoided for non-essential societal use, and that all industrial chemicals are used more safely and sustainably. In parallel, it is equally important to increasingly promote the green transition of the chemical sector and its value chain.

The European Commission published a chemicals strategy for sustainability on 14 October 2020. It is part of the EU's zero pollution ambition, which is a key commitment of the European Green Deal.

Objectives

The EU's chemicals strategy aims to

- better protect citizens and the environment
- boost innovation for safe and sustainable chemicals

Actions

- banning the most harmful chemicals in consumer products - allowing their use only where essential
- account for the cocktail effect of chemicals when assessing risks from chemicals
- phasing out the use of per- and polyfluoroalkyl substances (PFAS) in the EU, unless their use is essential
- boosting the investment and innovative capacity for production and use of chemicals that are safe and sustainable by design, and throughout their life cycle
- promoting the EU's resilience of supply and sustainability of critical chemicals
- establishing a simpler "one substance one assessment" process for the risk and hazard assessment of chemicals
- playing a leading role globally by championing and promoting high standards and not exporting chemicals banned in the EU

Chemicals:

- Protect Europe's citizens and ecosystems, the Commission will adopt the zero-pollution action plan to prevent pollution of air, water and soil.
- Develop more sustainable alternatives.
- Combine better health protection with increased global competitiveness.

- Improve rules on assessment of substances launched on the market.

a. ***Energy and the environment explained:*** https://www.eia.gov/energyexplained/energy-and-the-environment/greenhouse-gases.php
b. **Climate change (greenhouse effect and climate change):** https://landvernd.is/koltvioxid-og-grodurhusaahrif/
c. **Green Deal: Chemicals Strategy towards a toxic free environment:**
    a. https://ec.europa.eu/commission/presscorner/detail/en/qanda_20_1840

d. **Toxic free environment:**
    a. https://eeb.org/library/towards-a-toxic-free-environment/

e. **Zero pollution:**
    a. https://environment.ec.europa.eu/strategy/zero-pollution-action-plan_en

III. SUSTAINABLE MOBILITY

3.1ENDING SUBSIDIES FOR FOSSIL FUELS

Grade: HIGH SCHOOL

DESIRED RESULTS
Established Goals (Standards, Performance Indicators, Learning Goals): **1. Knowledge of the need to end fossil fuel subsidies.** **2. Integrating the topic for overall understanding.** **3. Expanding knowledge and consolidating skills on the topic.**

Understandings:	**Essential Question:**
1. Students understand importance of reduce harmful emissions from fossil fuels. 2. Students understand the need for sustainable mobility. 3. Students understand why fossil fuel subsidies should be phased out.	Why should fossil fuel subsidies be phased out?
Students will know: 1. Students know what fossil fuels are. 2. Students know the main types of fossil fuels (coal, oil and natural gas). 3. Students know about the damage that fossil fuel uses do to the climate. 4. Students know what renewable energy is.	**Students will be able to do:** 1. They are going to recognize the effects of fossil fuel use on our climate and health. 2. To recognize the sources of renewable energy. 3. They are going to recognise climate-friendly vehicles.

EVIDENCE/ASSESSMENTS:

Performance Task:

Representative task - the form of presentation of the project result at the end – Presentation

Goals:

Be aware of the effects of fossil fuel use on the climate and human health. Understand why you need to stop fossil fuel subsidies.

Role:

The class is divided into 5 groups. Each member of a particular group has a role that goes with specific tasks. Every one group must fill information in a worksheet, which will help to gather the necessary information for the production of individual episodes (parts) of the film. Everyone will be involved in the film.

Product:

Movie: "Why Must End Fossil Fuel Subsidies?"

Other Evidence/Assessments:

1. Worksheet
2. Mobile device and Internet
3. Talk on "For and Against the End of Fossil Fuel Subsidies"
4. Cooperative learning

LEARNING PLAN

Learning Activities:

1. Getting to know the project
2. Divide the class into groups, explain role of everyone in the group
3. Give away a worksheet
4. Students are divided into groups, working with the materials they have received to complete their worksheet. Upon completion of the cooperative work, the results will be presented, discussed and supplemented if necessary. At the end, there will be a short talk on "Pros and Cons of Ending Fossil Fuel Subsidies."

5. Presentation of the final product

Introduction to the topic:

World's energy huge amount comes from fossils formed millions of years ago, and this has environmental consequences.

For the purposes of the project, the class is divided into 5 working groups.

First group

Students receive a link to follow.

https://www.nationalgeographic.com/environment/article/fossil-fuels

He takes them to a short video to watch to understand what fossil fuels are. They also have short material to read so they can answer the questions on their worksheet in detail. Questions on the worksheet:

1. What the fossil fuels are?
2. What are the main types of fossil fuels?

Coal Oil Gas cooking

Second group

Non-renewable energy

Students are introduced to the information they are given to explore.

https://education.nationalgeographic.org/resource/non-renewable-energy

Answer the questions on the worksheet.

Questions:

1. What is non-renewable energy?
2. What are non-renewable energy sources?
3. What is the main element in fossil fuels?
4. What are the advantages of fossil fuels?
5. What are the disadvantages of fossil fuels?
6. Other non-renewable energy sources

- Nuclear power

Third group

To use the power of law to stop the destructive grip of the fossil fuel industry on our world.

https://earthjustice.org/our_work/oil-coal-gas

After studying the material, students must answer the questions on the worksheet.

Questions:

1. How to keep coal, oil and gas on earth?
2. How to end the extraction and burning of fossil fuels?

Brown pelican, covered in oil,

sits on the coast of Louisiana in June 2010

Oil pump

3. How much of climate-polluting emissions come from fossil fuel extraction?
4. Why do fossil fuel pipelines have a negative impact on the climate not only in Europe? https://earthjustice.org/features/fighting-pipelines-fossil-fuels-oil-and-gas

Scan the QR code to see the network of pipelines on the territory of the United States.

АДМИНИСТРАЦИЯ ЗА ЕНЕРГИЙНА ИНФОРМАЦИЯ НА САЩ

5. Why do we need to shut down gas and coal power plants?
6. What is the negative impact of the toxic waste product from coal combustion (coal ash) on human health?
   https://earthjustice.org/advocacy-campaigns/coal-ash
7. New frontiers - petrochemistry

Group Four

100% clean energy without pollution

Climate-friendly road vehicles

https://eurocities.eu/latest/full-stop-fossil-fuelled-mobility-in-cities/

1.Why should we put an end to the sale of fossil fuel-powered cars?

https://theicct.org/publication/the-end-of-the-road-an-overview-of-combustion-engine-car-phase-out-announcements-across-europe/

- Decarbonising transport
- Zero-emission vehicles

Group Five

Making transport more sustainable by ending fossil fuel subsidies

https://www.greens-efa.eu/en/FAIRER-FARES

3.2EXTENDING EMISSION TRADING FOR THE MARITIME SECTOR

INTRODUCTION

- Read this article :

Reducing emissions from the shipping sector
"While maritime transport plays an essential role in the EU economy and is one of the most energy-efficient modes of transport, it is also a large and growing source of greenhouse gas emissions. In 2018, global shipping emissions represented 1 076 million tons of CO2, and were responsible for around 2.9% of global emissions caused by human activities.

These emissions are projected to increase from 90% to as much as 130% of 2008 emissions by 2050 for a range of plausible long-term economic and energy scenarios. If the climate change impact of shipping activities grows as projected, it would undermine the objectives of the Paris Agreement, a global framework to avoid dangerous climate change by limiting global warming to well below 2°C and pursuing efforts to limit it to 1.5°C.

At EU level, maritime transport is a substantial CO2 emitter, representing 3 to 4% of the EU's total CO2 emissions, or over 144 million tons of CO2 in 2019

To date, no adequate measures are in place, either at the global level or in the EU, to achieve the necessary emissions reductions for the maritime transport sector to contribute to the EU's increased climate ambition. Additionally, reducing maritime transport emissions is part of the EU economy-wide reduction commitment under the Paris Agreement.

Although a global approach to address greenhouse gas emissions from international shipping led by the International Maritime Organization (IMO) would be the most effective and thus preferable solution, the relatively slow progress in the IMO has triggered the EU to take action and make new proposals to make sure maritime transport plays its part in achieving climate neutrality in Europe by 2050. "

Source: Reducing emissions from the shipping sector (europa.eu)

PREREQUISITES OF STUDENTS

- What do you know about climate change?

Evidence | Facts – Climate Change: Vital Signs of the Planet (nasa.gov)

- What do you know about greenhouse gas emissions?

Greenhouse gas emissions - Wikipedia

WORKING DOCUMENTS

- Watch this video : https://youtu.be/yfNgsKrPKsg
- Read these articles :

  Reducing carbon emissions: EU targets and measures | News | European Parliament (europa.eu)

  Cutting emissions from planes and ships: EU actions explained | News | European Parliament (europa.eu)

  EMSA Launches Monitoring, Reporting and Verification System Verifavia Shipping (verifavia-shipping.com)

PRODUCTIONS

Based on the documents provided, elaborate mental maps, your research and personal reflections. Write an oral presentation.

Group 1

Which solutions European Union find to control CO_2 emissions from maritime sector?

Group 2

Present the main obligations for companies in order to reduce CO2 emissions. Explain obligations for companies in the future.

SKILLS WORKED

READING AND ANALYSIS OF DOCUMENTS
WORK ON THE SYNTHESIS OF DOCUMENTS
CREATION OF A MIND MAP
ORGANIZATION OF THE ARGUMENTATION
ORAL EXPRESSION

OBJECTIVES TO BE ACHIEVED

Understanding the significance of emissions trading.

Knowing the advantages of emission trading.

3.3REDUCING FREE ALLOWANCES TO AIRLINES

The European Union's environment policy aims to destroy, reduce and prevent the polution, maintain sustainable mobility by using natural resources without damaging the ecological balance, have any environmental harm exterminated from its resource and assure the entegration of protecting the environment with other sectoral policies (such as energy or transport). The European Commission accepted several suggestions to make EU's climate, energy, transport and tax policies suitable to reduce at least %55 of the greenhouse gases by the year 2030 compared the 1990 levels.

AIMS AND OBJECTIVES

- Contributing to the objective "European Green Deal" which determines reducing 90% of transport emissions by the year 2050 compared to 1990 levels
- Implementing the program called "Carbon Offsetting and Reduction Scheme for International Aviation" (CORSIA) within International Civil Aviation Organization
- Providing equal treatment to airlines taking flight on same routes regardless of nationality by sustaining a route-based approach.
- The number of consecrations that are given to aircraft operators for free will be reduced periodically by 2027 in order to reach a fully equal auction system.

The European Commission has published "Sustainable and Smart Mobility Strategy" on December 9, 2020. The plan aforementioned identifies the attempts in order to reduce the carbon emissions caused by transportation, and also make the transportation system smarter and more sustainable.

https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/free- allocation/allocation-aviation_en

https://en.wikipedia.org/wiki/Emissions_trading

Aviation is known to be one of the fastest growing sources of green house gases. EU gets in action to reduce aviation emissions and works with the international community to develop precautions that have global access.

On July 14, 2021 the European Commission accepted several laws regarding their plans to reduce greenhouse gases by %55 including the by-target, reaching to climate neutrality on EU until 2050. The set suggests that the EU climate regulation (including EU ETS, Effort Sharing Regulation and land and transport regulation) ‘s some sections’ should be reviewed and the set also shows that the EU intends to reach it’s climate goals under The Commission’s “European Green Deal” with real principles.

https://climate.ec.europa.eu/eu-action/european-green-deal/delivering-european-green-deal/aviation-and-eu-ets_en

3.4SUSTAINABLE ALTERNATIVE TRANSPORT

One of the greatest environmental challenges we face today lies in mobility. People need a seemingly infinite network of vehicles and transportation systems to uphold societies and economies. Cars, busses, trains, trucks and other modes of transport each leaving their indelible mark on the environment.

Read the following article: https://www.consilium.europa.eu/en/policies/clean-and-sustainable-mobility/

Sustainable mobility refers to the provision of infrastructure, services, technologies, and information to enable access to goods and services, and participation in activities in a manner that, like all other forms of "sustainability," allows for the continuation of such access and participation across future generations. Around one-quarter of global CO2 emissions come from the transportation of people and goods. Creating sustainable transportation solutions is one of the greatest challenges facing cities today but also a great opportunity for the low-carbon development of cities. The shift in the transportation model relies on clean fuels, electricity from renewable sources and, in short, sustainable, innovative and intelligent mobility.

The way we travel has an impact on economic sustainability, on the social cohesion of cities and, of course, on air quality. Sustainable mobility advocates a way of moving around that does not harm the environment through polluting emissions and meets the needs of citizens while taking care of the city's spaces.

Sustainable urban mobility requires a mind shift: where transport in private cars and trucking give way to different modes of public transport. Like bicycle and pedestrian lanes,

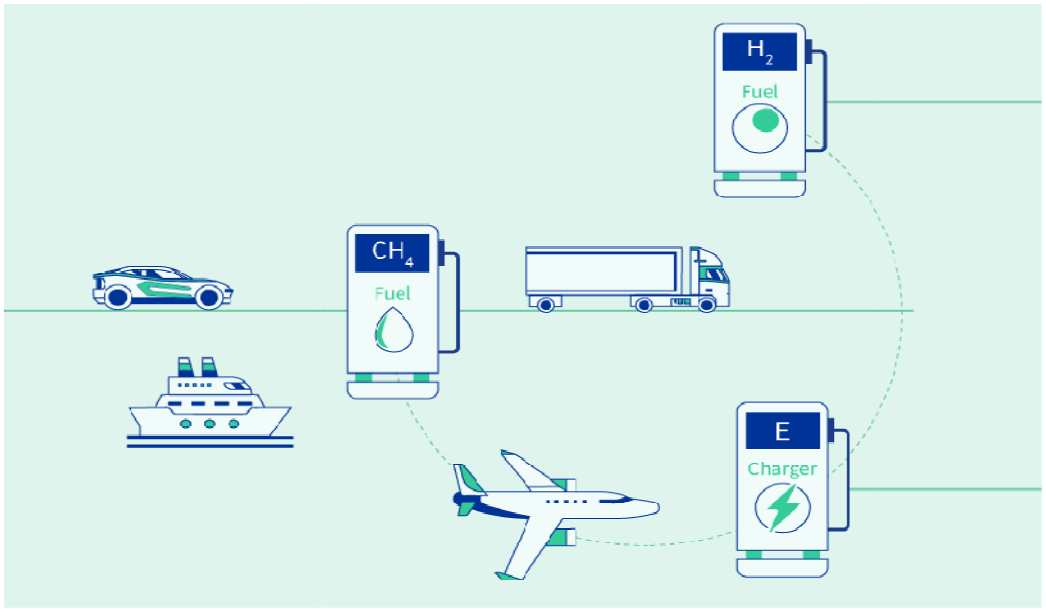
electric vehicles, car sharing and rail freight. More and more cities around the world are rising to the challenge. Creating solutions that ensure the vital flow of people, goods, and services. While mitigating climate change and creating climate-safe cities. Cities Rise to the Challenge – Sustainable Mobility

The EU has pledged to become climate-neutral by 2050. To this end, the transport sector needs to undergo a transformation which will require a 90% reduction in greenhouse gas emissions, while ensuring affordable solutions to citizens.

The Fit for 55 package is the EU's plan to deliver on the European Green Deal's climate goals and it includes a set of proposals to revise EU legislation, also in the field of transport.

Where tourism and its future is discussed and written in the world, sustainability is always at the top of the page. It is obvious that tourism in Iceland and elsewhere needs to emphasise environmental issues and in effect should be guided by sustainability.

Travel companies and tour operators around the world are now putting sustainability at the forefront - because the travelers themselves are increasingly doing so. More and more tourists are willing to buy tours and services that are certified according to the rules that apply to what is considered sustainable. This is especially true for the tourists that all countries want to attract: the people who are willing to pay well for quality and environmentally friendly products and services.



Sustainable Transportation refers to any means of transportation that is 'green' and has low impact on the environment. Sustainable transportation is also about balancing our current and future needs. Examples of sustainable transportation include **walking, cycling, transit, carpooling, car sharing, and green vehicles**.

Travel companies and tour operators around the world are now putting sustainability at the forefront - because the travelers themselves are increasingly doing so. More and more tourists are willing to buy tours and services that are certified according to the rules that apply to what is considered sustainable. This is especially true for the tourists that all countries want to attract: the people who are willing to pay well for quality and environmentally friendly products and services.

Watch this short video: Sustainable Transportation Solutions for a Sustainable Future.

- What are the alternative modes of transportation offered in the video?
- What are the advantages of choosing sustainable transportation?

The greatest challenge of Sustainable Mobility is to find a healthy balance between the resource consumption of all transport users and the regenerative capacity of the ecosystem.

To find and realise this, a comprehensive strategy is needed that must master the following four challenges at its core.

Reduce traffic or if possible avoid it	**Promote environmentally friendly modes of transport** e.g. fewer cars	**Increase energy efficiency** e.g. alternative fuels and new technologies	**Use post-fossil fuels and green efficiency** or if possible avoid it

Specifically, sustainable mobility concepts should promote the following goals:

- Reduce traffic jams
- Reduce the number of accidents
- Limit individual traffic
- Reduce waiting times at traffic lights
- Enable green waves
- Reduce CO_2 & particulate matter
- Avoid stop-and-go traffic
- Make it easier to find a parking space
- Make public transport services more attractive
- Make logistical trips more effective
- Reduce noise & sound levels
- Enable more green zones

In order to achieve the above (and other) goals, many concepts are already being discussed that enable Sustainable Mobility, such as:

- Reduction of traffic
- Promotion of environmentally friendly means of transport
- Promote micromobility and cycling
- More car-sharing
- Expansion of electro-mobility and alternative drive

As the many examples and concepts show: Sustainable mobility is not simply ticked off with the implementation of a single measure, but requires a mix of measures.

We would like to conclude with a few important core ideas:

- It is impossible to organise traffic completely without emissions.
- Vehicles and drive technology must not be the sole focus.
- Economic incentives for behavioural change are just as essential.
- Successful, sustainable concepts require the acceptance of the population.
- Mobility is a key prerequisite for participation in our society.
- Sustainable mobility will not be 100% achieved until the resources required for it are renewable and the ecosystem can regenerate.

Sustainable mobility is ideally environmentally friendly, socially just, affordable, economical, efficient and safe.

3.5IMPROVE PUBLIC TRANSPORT

SCHOOL: ITES Vitale Giordano, Bitonto – ITALY

IMPROVE PUBLIC TRANSPORT

Students: 2^ class (20 students)

Time required for the activity: 7 hours

Disciplines involved: Science (Chemistry, Biology, Geography)

DESIRED RESULTS

- **Analyzing data on public and private transport and drawing conclusions**
- **Know the fuels used in motor vehicles and the type of pollution they cause.**
- **Acquire, interpret, and communicate information.**
- **Cooperate and participate in group activities by performing their tasks.**

PREREQUISITES

- **Know the meaning of 'sustainable development'**
- **Know the meaning of pollution and some types of pollution**

METHODOLOGY

Working in groups: cooperative learning in classroom 3.0 (each student has his or her own iPad).

1) DISCUSSION CIRCLE (1 hour)

Initial **discussion circle** on the topic "public transport".

Discussion circle: the teacher and the students sit in a circle and participate in a conversation that explores ideas, questions, experiences, and opinions. This circle includes the whole class.

All students participate and highlight advantages, disadvantages, problems, and possible solutions on the topic of public transport.

2) WORKING IN GROUPS (4 hours)

Students work in cooperative groups. At the end of the work, each group creates a presentation that they share in a class assembly with their peers.

GROUP 1: Current fuels (and resulting forms of pollution); fuels of the future.

Students answer questions:

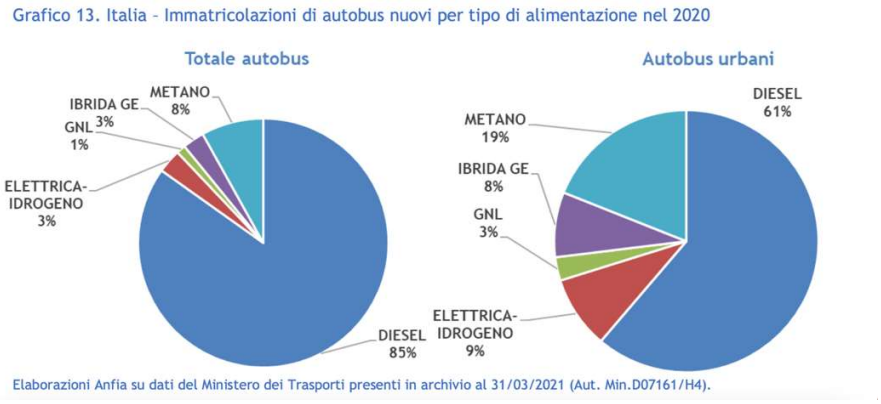
which fuels are most used in public transport?

What kind of pollution do they produce?

Which non-polluting fuels will be used in the future?

https://www.europarl.europa.eu/news/it/headlines/society/20190313STO31218/emissioni-di-co2-delle-auto-i-numeri-e-i-dati-infografica

https://www.flowsmag.com/2022/02/16/hydrogen-mobility-effective-alternative-lpt/



GROUP 2: Increasing public transport. Hypotheses.

Students analyse the needs of travellers.

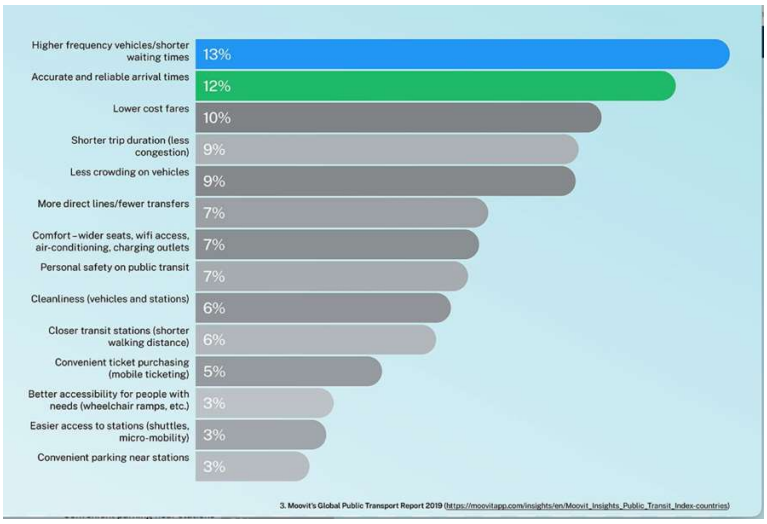
Students answer the question:

how can the use of public transport be encouraged?

Hypotheses for improving public transport.

https://blog.gunneboentrancecontrol.com/it/4-modi-per-migliorare-il-trasporto-pubblico

https://blog.gunneboentrancecontrol.com/it/5-public-transportation-challenges-and-their-solutions



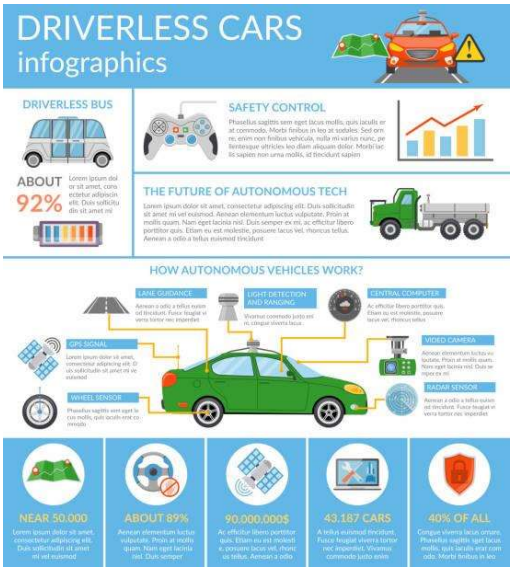
GROUP 3: New scenarios for sustainable mobility.

The students answer the question: how will public transport change in the future thanks to new technologies?

https://s3platform.jrc.ec.europa.eu/safe-and-sustainable-mobility

https://www.cng-mobility.ch/it/chi-siamo/

https://www.wired.it/article/wired-trends-2023-mobilita-tendenze-futuro/

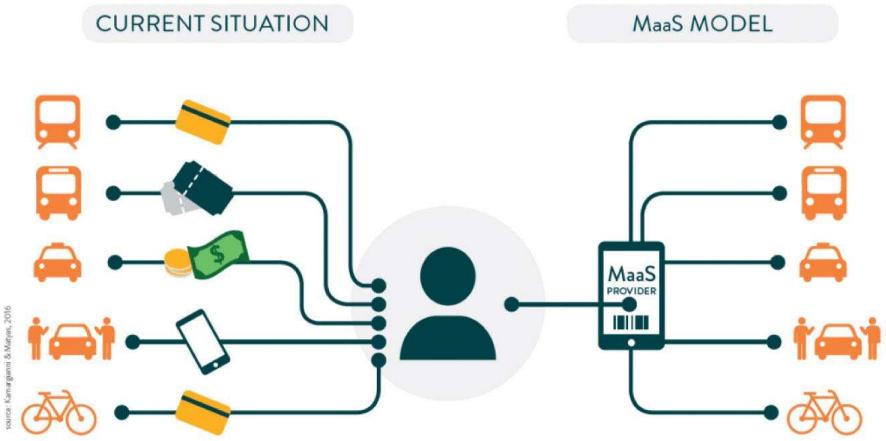


GROUP 4: MaaS: 'Mobility as a service'. What it is and how it works.

Students answer the question: what is MaaS? Mobility as a service. What it is and how it works.

https://innovazione.gov.it/progetti/mobility-as-a-service-for-italy/

https://www.e-vai.com/blog/mobility-as-a-service-che-cose-e-come-funziona/



3) EXAMINING THE RESULTS OF GROUP WORK (1 hour)

Group discussion on the results of the presentations.

4) FINAL PRODUCT (2 hours)

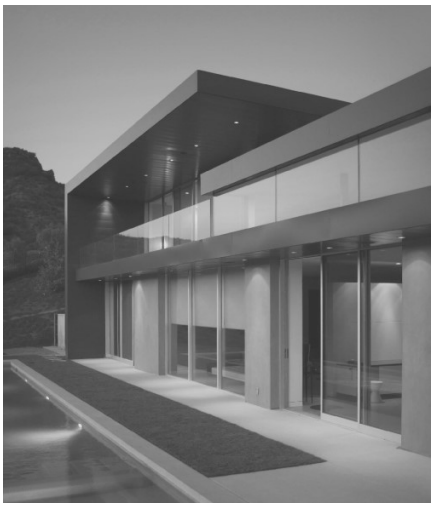
Each group creates a final infographic (poster) inviting the use of public transport.

5) **ASSESSMENT:**

Each group and each student will be assessed with specific evaluation rubrics for participation in the activities: presentation, initial and final discussions, final infographic (poster).

IV. BUILDING AND RENOVATION

4.1ENERGY-EFFICIENT BUILDINGS



CONTENT

- Introduction
- Presentation to students
- Final results
- Assessment
- Goals to reach

Introduction

The architect, a major player in habitable space, declares: “Changing the built space and designing a living space requires the development of other construction methods.

The promotion and sustainable accessibility of housing and the city can also be favored by the return of bioclimatic architecture, which adapts to the characteristics and particularities specific to its location (climate, landscape and nature, etc.) and makes it possible to design buildings with low energy consumption.

The reuse of the existing built environment, the fight against urban agglomeration and the valorization of wastelands are also other urgent areas to consider.

Finally, developing methods of co -design and co -construction of housing for future residents in order to create spaces more in line with expectations and economic reality is another example of practice to explore. "

Source : https://journeesarchitecture.culture.gouv.fr/actualites/7e-edition-placee-sous-le-theme-architectures-a-habiter

Presentation to students

READ AND WRITE A DEFINITION OF THE CONCEPT “ENERGY EFFICIENCY”:

https://en.wikipedia.org/wiki/Efficient_energy_use

READ THE INFORMATION:

“EXPERIENCE IN EFFICIENT CONSTRUCTION OF THE BUILDINGS OF TOMORROW”

https://www.ecologie.gouv.fr/experimenter-construction-du-batiment-performant-demain-0

Activities and documents

GROUP 1

https://www.demainlaville.com/3-entreprises-batiments-a-energie-positive-en-france/

GROUP 2

https://www.demainlaville.com/3-entreprises-batiments-a-energie-positive-en-france/

http://www.elithis.fr/2021/05/05/la-tour-elithis-danube-les-resultats-apres-3-ans-dexploitation/

Final results

GROUP 1

IN MIND MAP FORM, KNOW THE ANSWER TO THE FOLLOWING QUESTION:

What can you do to transform a building into a positive energy building?

GROUP 2

IN MIND MAP FORM, KNOW THE ANSWER TO THE FOLLOWING QUESTION:

What are the energy properties and advantages of a positive energy structure?

GROUP 1 + 2

BUILD ON DOCUMENTATION, DEVELOP MENTAL MAPS, YOUR RESEARCH AND PERSONAL PERSPECTIVES -> WRITING AN ORAL PRESENTATION

Assessment

READING AND ANALYSIS OF DOCUMENTS

DOCUMENT PROCESSING

CREATING A MENTAL MAP

ORGANIZATION OF ARGUMENTS

ORAL EXPRESSION

Goals to reach

UNDERSTAND that optimizing the energy demand of buildings involves several areas.

UNDERSTANDING THAT THE HOUSE OF THE FUTURE IS PART OF THE OVERALL PROMOTION OF ENERGY IMPROVEMENT

OBTAIN A CURRENT BALANCE BETWEEN DEMAND AND SUPPLY

4.2DIGITIZATION IN BUILDINGS

GOALS

Students learn what digitalization is.

Students learn the contributions of the improving technology to energy yield.

Makes inferences about the changes that may occur in the future as a result of the effects of technology.

Students learn what the smart home system brings.

Gains the skills of change, perception of continuity, perception of time.

INTRODUCTION

“Does anyone know or watch the Jetsons cartoon?” will be asked to the students.

https://www.youtube.com/watch?v=GIWHl0cfQuc

A little part of the cartoon will be shown to the students.

Made in the USA in the 1960s, futurist cartoon “the Jetsons” tells about the Jetsons family who live in the Skypad Apartment, in a city called Orbit. A family of four, the Jetsons were living a peaceful life in a house full of interesting inventions: flying cars, robot servants; and their dogs. The lives of the Jetsons may have seemed weird or nonsense to the viewers of that time, though today we see that the Jetson’s foresight of time is not wrong at all.

Question: Two groups of students are wanted to discuss with each other regarding the questions ‘What is digitalization? What are the positive and negative effects about it?’

Digitalization, is the process where existing sources and information (for example our documents, files) are transferred to the digital realm in a way that computers are able to understand it.In other words, it is the coordination of both the digital world and the real world.

Digital Technologies being integrated into our homes make the smart-home concept a big part of our lives. Let us see what kind of abilities smart homes have with this video.

https://www.youtube.com/watch?v=sJmplWe_cX0

Figure : https://www.mysmartlife.eu/mysmartlife/

It is more widely believed nowadays that successfully fighting the problems of the future and its difficulties in the construction sector is by using more advanced digital technologies.As administering the buildings become easier with smart buildings that have sensor floors which have become a new trend within the rapid-spreading smart city concepts, next to environmental factors, it also becomes possible to acquire more information about the building in different aspects.

Figure : The FAREcho "Energy Portal" and its interface with ICT system components
https://www.smartbuild.eu/about-us/about-smart-build-project.html#resultsachieved

DEVELOPMENT

Question: What are the effects of energy consumption and CO2 emission to buildings, and what are your suggestions on how to solve it?

Buildings are responsible of both 36% of CO2 emission and 40% of energy consumption within the European Union. Buildings in the USA produce 36% of total energy consumption, 30% of greenhouse gas emission, and 30% of total waste.

EU supported NEWBEE (Novel Business model generator for Energy Efficiency in construction and retrofitting) suggests business models based on new performances where it will speed up the adoption of energy efficient answers in buildings

Information about this project can be obtained from the link below.

https://cordis.europa.eu/article/id/173493-retrofitting-the-easy-way-thanks-to-new-set-of-ict tools

Question: What should be features that will make our habitat more sustainable?

*The efficient usage of energy, water, and other resources

*Benefiting from renewable energies such as solar panels

*Usage of recyclization

*Usage of produced equipment which are non-toxic and sustainable in both environmental and social perspectives

*Taking account of the quality of life of the building occupants during the designing, constructing, and using phases

*Building designs being compatible to the environment and climate conditions The

following digitial services should be integrated within buildings for these goals.

Power generation, power consumption and storage (Solar, CHP, etc.) remote access and control, light control and sun protection, device control (remote control, reduction of consumption in standby mode, automatic shutdown), monitorization and control of air quality, smoke, fire, water hazard monitoring, access control and security, smart metering (electricity, heating etc.), technical equipment monitoring, media control (TV, internet, telephone), control of billing data

World Green Building Council (WorldGBC), aims to provide sustainably built environments to everyone everywhere. Members support the council to pursue approaches best suited to

their own countries and markets.

Aims of the council:

Climate Action – complete decarbonisation of the built environment.

Health and Wellbeing - a built environment that delivers healthy, equitable and resilient buildings, communities and cities.

Resources and Circularity - a built environment that supports the regeneration of resources and natural systems, providing socio-economic benefits through a thriving circular economy.

For more information on this subject;

https://worldgbc.org/

Sustainable built environments accelerate the UN Sustainable Development Goals

EVALUATION

Students were tasked with calculating the household carbon footprint.

They were given the task of preparing a model of an environmentally friendly smart home. The model prepared by the students includes a solar street lamp, a unit that converts domestic waste into biogas with an elevator system and a windmill.

Our link for the model;

https://youtu.be/f67jygzAvNc

Sources students can use for this lesson:

https://www.epa.gov/smartgrowth/location-and-green-building

https://www.epa.gov/green-engineering/about-green-engineering#definition

https://www.epa.gov/ghgemissions/household-carbon-footprint-calculator

https://emiratesgbc.org/wp-content/uploads/2020/05/2019-Technical-Workshop-Presentation Siemens.pdf

https://worldgbc.org/what-is-a-sustainable-built-environment/

https://cordis.europa.eu/article/id/173493-retrofitting-the-easy-way-thanks-to-new-set-of-ict tools

https://smartbuilt4eu.eu/efficient-building-operation/

4.3CLIMATE PROOFING OF BUILDINGS

Grade: HIGH SCHOOL

DESIRED RESULTS	
Established Goals (Standards, Performance Indicators, Learning Goals): **1. Knowledge of the buildimg renovation and climate proofing of buildings.** **2. Integrating the topic for overall understanding.** **3. Expanding knowledge and consolidating skills on the topic.**	
Understandings: 1. Students will understand the importance of making our homes and buildings fit for a greener future. 2. Students will understand the key proposals for homes and buildings and why adapting your home to withstand the effects of climate change is important now. 3. Students will understand how the houses of the future will be climate proofed	**Essential Questions:** 1. Why Climate proof house is a house of the future? 2. How are we taking the need to adapt to climate change in different regions in Europe into account when constructing new buildings?
EVIDENCE/ASSESSMENTS:	
Performance Task: Representative task – Making models of homes and buildings fit for a greener future Goal: Be aware of the climate change and protection of homes. Role: The class is divided into 5 groups. Every one group has the same task – to make a project "My view about the homes of the future". The project can be: 1. A picture plan – detailed 2. A model – made by paper, clay or etc. 3. A movie – all steps before explained and the steps before	

Product: "My view about the climate neutral homes of the future"
Other Evidence/Assessments: 1. Reading text 2. Mobile device and Internet 3. Talk on "Climate change and protection of homes 4. Cooperative learning

LEARNING PLAN
Students watch the video "A Practical Guide to Climate-resilient Buildings" **https://www.youtube.com/watch?v=qVVwjHqWCI8** **TEXT for reading**

"Buildings are responsible for approximately 40% of EU energy consumption and 36% of EU greenhouse gas emissions thus contributing to climate change processes. At the same time buildings themselves are vulnerable to climate change and that the related impacts are resulting in shorter building lifetimes. In order to achieve the target of making Europe climate-neutral by 2050, renovation of buildings is considered to be an important initiative to increase energy efficiency in the building sector, to reduce greenhouse gas emissions and at the same time to improve the resistance against climate change events …. To reach the 55% emission reduction target by 2030 and achieve a climate-neutral Europe by 2050, additional measures must be implemented. Europe's commitment to reach climate neutrality by 2050 achieving net zero greenhouse gas emissions for EU countries as a whole (mainly by cutting emissions, investing in green technologies, and protecting the natural environment) and to accelerate efforts regarding climate change adaptation is emphasised in a set of policy initiatives under the framework of the European Green Deal"

Said Daina Indriksone and Irina Paegle from Latvia in their book Guidelines for climate proofing energy efficiency projects: focusing on renovation of multi apartment buildings in the Baltic Sea Region

https://www.bef.lv/wp-content/uploads/2020/03/Guidelines_FINAL_2022.pdf

https://climate-adapt.eea.europa.eu/en/metadata/adaptation-options/climate-proofing-of-buildings-against-excessive-heat

Many European constructive engineers try to use different options to implement climate proofing of buildings against excessive heat. They offered several options to implement climate-proofing

of buildings with respect to excessively high temperatures. Options can relate to building design and building envelopes (roof, ceilings, external walls, doors, windows – including solar control glasses that reduce the solar radiation entering the dwelling - and foundations). Building design solutions include traditional features of dwellings located in traditionally warm climate countries, as:

- the building aspect ratio - maximises the dispersion of internal heat and minimizes the uptake of heat through solar radiation.
- architectonical elements such as awnings, overhangs, window shades, porticoes, white or lightly coloured external walls and roof
- the solar orientation of the building, which can minimise the daily exposure of the building to sunlight.

A famous example of a building in which a complete package of state-of-the-art solutions has been applied is represented in the The Edge office building in Amsterdam; completed in 2014.

The Edge building includes dynamic windows, automatic shades and displacement ventilation. More than 25 000 thousand sensors track movement, lighting levels, humidity and temperature, which allow an immediate and more efficient response to energy needs, such as automatically switching off heating, air conditioning and lighting in unused areas. An app provided to those working in the building allows them to adjust temperature and lighting levels around them using their smartphone.

Picture © *Ronald Tilleman*

Cooling and heating involves the use of a heat exchanger that transfers heat in the desired direction between the building and an aquifer beneath it.

The organization of the space of buildings also matters: the presence of trees in particular increases air flow and reduces the impact of solar radiation and the heat island effect typical of modern cities.

The technical features of the building are crucial for its ability to control indoor temperatures. The materials of which the envelope is built and their mass in fact determine how quickly temperature differentials between indoors and outdoors are compensated. Thick-wall traditional buildings in the Mediterranean, for instance, require much less air conditioning than modern ones; alternatively, the use of materials with high thermal resistance can reduce the heat that enters the building. This option is particularly interesting for retrofitting existing building with insulation layers that compensate for the poor thermal properties of the original building materials.

Also, the use of mechanical or natural ventilation, or storing cold in materials with high thermal mass like tiles or stones, reduces the need of air-conditioning. Cold storage can be coupled with a heat pump (possibly based on a geothermal system, exploiting the differential between underground and surface temperatures) to increase the flexibility in the deployment of cold air. Adjusting indoor humidity can have a strong impact on perceived temperatures and ultimately on thermal comfort of the occupants of a building.

Roofs are also important heat exchange surfaces, and their design can help reducing significantly the energy needs of a building. Green roofs, for instance can significantly help reducing the heat island effect in cities by naturally cooling building surfaces through the action of water and vegetation. A cheaper but also effective option is painting roofs white or in light, highly reflective colours that bounce back solar radiation.

Adapting your home can take effect of climate change

If climate change is inevitable, we need to do something about. So, what are our options? In many countries, the aging building stock is ill-equipped to deal with its effects, but modifications can be made. Climate-Proof House explores how a typical home could be adapted to counter the most likely effects of a rising temperature: flooding, overheating and the spread of infectious diseases.

Below we explore a variety of adaptations a typical house could make to help resist the effects of climate change.

If climate change is inevitable, we need to do something about it – after all, no one can say we haven't been warned.

Picture The Climate-Proof Home

1. Green roofs

Covering roofs with live greenery like grass and plants can have a number of benefits. Not only can it reduce heat penetration, therefore slashing the risk of overheating, it can also help alleviate

any potential flood risks as more water runoff is absorbed. Studies also show that with just a 20% increase from current levels, green roofs could halve the urban heat island effect (the excessive temperatures of built-up areas caused by human activities) by 2050. And, as an added benefit, green roofs provide a habitat for biodiversity and will absorb gaseous pollutants too.

2. Solar shading

Homes in the european countrios have largely been designed to keep us warm, so when it comes to keeping us cool, they're likely to struggle. Installing shutters, curtains or reflective blinds at the window will help protect your home from the sun's heat, reducing indoor temperatures.

3. Fit insect screens

Screens offer protection from insects carrying diseases, such as mosquitos, while still allowing you to keep windows open in the evening for natural ventilation.

4. Treat wooden doors, frames and sills, or switch to inherently resilient ones

Fixtures that can get wet and then dry out with minimal damage will increase your home's resilience to flooding, and limit the time it takes to recover after an event, should the worse happen [13]. Options include treating existing wooden doors, frames and sills with a preservative to keep water out, or switching them to something inherently resilient. Considering that only 10% of people are aware that they live in a flood risk area, making small, precautionary changes like this could prove to be a good idea.

5. Switch to water-efficient appliances

Switching to water-efficient appliances is an easy way to reduce the amount of water we use in our homes. Installing a low-flow shower and ultra-low flush toilet can save a combined total of up to 15,000 litres of water per person per year. Water-efficient washing machines costs only slightly more than standard models yet could save round 5,000 litres of water per person per year.

6. Green spaces

Lawns are a natural way to reduce flood risk as they absorb more water than paving , so it pays to keep your garden as green as possible. If a driveway is a necessity, use permeable materials like gravel that will let water soak through and drain away easily.

7. Harvest rainwater

Homes that have a water meter installed, a water butt could save you money too.

8. Replace timber floors with concrete

Replacing lower-level timber floors with solid concrete is a practical measure that will further increase your home's resilience to flooding. Although costly, this solution could help reduce

insurance claims by up to 80% so is likely worth the investment over time, especially in areas at a high risk of frequent flooding.

9. Relocate appliances

Washing machines and dryers could be relocated to the first floor to keep them out of harm's way, while boilers could be fixed to the wall above the likely flood level. Reduce payback time by making these changes when appliances are due to be replaced [20].

10. Raise electrical sockets

Repositioning electrical sockets so they sit above the likely flood level helps guard against flood damage.

11. Introduce passive cooling measures

Passive cooling measures, i.e. those that require little to no energy consumption, are a practical way to combat overheating. Low-cost options include ceiling fans, or night purging, where you keep windows closed during the day and open at night to flush out warm air.

https://www.hillarys.co.uk/static/climate-proof-house/images/illustrations/what-is-climate-change.jpg

https://climate-adapt.eea.europa.eu/en/metadata/adaptation-options/climate-proofing-of-buildings-against-excessive-heat

Here are some of European greenest buildings at COP26 - and how they can help tackle climate change. Exemplary projects were selected for a virtual reality online exhibition of the world's greenest buildings as part of global climate summit COP26. The projects demonstrate the opportunities to tackle the climate change emergency and limit the environmental impact of buildings and cities.

Going beyond net zero to energy positive - future-proof offices

Powerhouse Brattørkaia, Trondheim, Norway

Powerhouse Brattørkaia, Trondheim, Norway

Image: Ivar Kvaal

Powerhouse Brattørkaia is the largest new-build energy-positive office building in Trondheim, Norway. The use of solar energy compensates for all of the energy used over the building's lifecycle, as well as extremely low energy consumption. Powerhouse Brattørkaia was also built as a fossil fuel-free construction site (with no direct carbon emissions).

The building generates more renewable energy during its operational phase than was used during the construction phase (including embodied energy of materials and potential disposal). Surplus renewable energy is supplied to neighbouring buildings, as well as electric buses in Trondheim.

Carbon negative footprint in one of the world's tallest timber buildings

Sara Cultural Centre, Skellefteå, Sweden

The primary inspiration behind the design was Skellefteå's long tradition of timber building; spruce and fir were sourced locally from sustainably managed forests, located within

Sara Cultural Centre, Skellefteå, Sweden

Image: Patrick Degerman

200km from the site and processed in a sawmill 50km away.The building relies on an innovative energy system, connected to the urban district heating and cooling grid, powered by 100% hydroelectric power. A geothermal heat pump and 1,200m^2 of solar panels on roofs and top floor façades help to switch from the urban grid during peak loads, avoiding unnecessary activation of the grid's fossil fuel back-up power source.

3D printed clay homes – traditional materials with modern construction

TECLA, Massa Lombarda, Italy

TECLA is the first 3D-printed sustainable home made entirely from local raw clay. This prototype home designed and built (or printed) in Italy, uses local clay that is excavated, shaped, inhabited and, once it is not needed anymore, it can just go back to the soil, in a virtually infinite loop that leaves no trace on the planet. The walls have an organic cave-like curvature, providing structural stability but also acting as a thermal barrier. The project can adapt its shape in relation to its climate and latitude.

The project responds to both the climate emergency and the growing global housing crisis. Housing modules can be constructed by printers within 200 hours while consuming an average of 6 kW of energy. A team of just two people are needed to support the building of the structure and typical construction waste is almost entirely eliminated.

Local, natural and low carbon – at scale

University of East Anglia Enterprise Centre, Norwich, United Kingdom

The project showcases low carbon, sustainable building with a highly ecological specification, in a design that achieves two major sustainability certifications (Passivhaus standard and BREEAM Outstanding). Future climate data was generated and used to simulate various design scenarios to ensure the best, most robust long-term solution.

The internal stud partitions were made from locally sourced pine. 70% of the cement replaced utilized a by-product of the iron-making industry lowering the embodied carbon as well as the concrete mix using local recycled sand and aggregate. And finally, the building was clad in local Norfolk thatch and reed. Other innovative material choices included a 100% recycled paper insulation, hemp fabric, re-processed glass, clay plaster and nettle boards. These features along with Passivhaus requirements for low energy fitting gave a 68% reduction in Whole Life Carbon against typical buildings.

University of East Anglia Enterprise Centre, Norwich, United Kingdom

Image: Dennis Gilbert

Europe’s most sustainable building: Resilience House, Denmark

https://stateofgreen.com/en/news/europes-most-sustainable-building-resilience-house-denmark/

4.4 CLIMATE PROOFING OF BUILDINGS

Energy from renewable sources means energy from non-fossil renewable sources: wind energy, solar aerothermal, hydrothermal, ocean, hydraulic, biomass, landfill gas, gases left over from purification processes, biogas.

BUILDING AND RENOVATION ENFORCEMENT OF RULES OF ENERGY PERFORMANCE

"Buildings are one of the largest sources of energy consumption in Europe. Boosting their energy efficiency would cut emissions, tackle energy poverty, reduce people's vulnerability to energy prices and support the economic recovery and job creation. The Renovation Wave Strategy (MEMO) presented in October 2020 set out measures aiming to at least double the annual energy renovation rate by 2030.

The revision of the Energy Performance of Buildings Directive (EPBD) is an essential element of this Strategy. It upgrades the existing regulatory framework to reflect higher ambitions and more pressing needs in climate and social action while providing Member States with the

flexibility needed to take into account the differences in the building stock across Europe."

The revised directive sets out how Europe can achieve a zero-emission and fully decarbonised building stock by 2050. The proposed measures will increase the rate of renovation, particularly for the worst-performing buildings in each Member State. It will modernize the building stock, making it more resilient and accessible. It supports better air quality, the digitalisation of energy systems for buildings and the roll-out of infrastructure for sustainable mobility. Crucially, the revised directive facilitates more targeted financing to investments in the building sector, complementing other EU instruments supporting vulnerable consumers and fighting energy poverty.

The analysis in the EU Climate Target Plan indicated that sharply reducing emission from new and existing buildings is key to deliver on the EU's 2030 and 2050 decarbonisation objectives. Achieving this reduction requires regulation to make buildings use the least amount of energy, reflecting the cost of carbon in the energy mix and providing financial support for investments in renovation. This is what this revision sets out to do, together with the new emissions trading system (ETS) for buildings and road transport and the Social Climate Fund proposed in the 'Fit for 55' package presented in July 2021.

As the lifetime of heating systems is about 20 years, the EPBD foresees that fossil-fuel powered boilers will not be eligible for public support as of 2027. While the EPBD proposal does not mandate an EU-level phase out date for fossil fuel boilers, it introduces a clear legal basis for national bans, allowing Member States to set requirements for heat generators based on greenhouse gas emissions or the type of fuel used. Several Member States consider such measures essential to achieve a decarbonised building stock and to improve air quality and health.

Energy renovation pays for itself over time, generating energy bills savings, which are generally a multiple of the investment needed to upgrade a building performance. Despite this, currently energy renovation often does not take place because of a variety of upfront obstacles. This can leave home owners and tenants exposed to higher energy costs and more vulnerable to energy price increases. This is especially true for those living in the worst performing buildings who are

Lack of financing is one of the major barriers to building renovation.To enable an efficient combination of public and private financing, the Commission highlights the need to make available technical assistance and is also working to make the State aid framework more conducive to the needs of the EPBD revision, in particular for the EU-wide Minimum Energy Performance Standards (MEPS). In parallel, the Commission is currently reviewing the General Block Exemption Regulation, also as regards State aid for improving the performance of buildings.

The construction sector faces the challenge of providing people with access to affordable and better housing, while reducing the environmental impact of new construction or major renovations. This proposal takes a first step towards addressing greenhouse gas emissions during the whole lifecycle of the buildings.

With this revision, the EPBD requires that in all new buildings, where technically feasible, 100% of on-site energy consumption is covered by renewable energy as of 2030, with an earlier adoption as of 2027 for public buildings. Member States should plan policies and measures with a view to a complete phase out by 2040 of the use of fossil fuels in buildings. The revision of the EPBD also provides enhanced visibility to the integration of renewables in the energy performance certificates (EPCs). The new template for EPCs includes the requirement to clearly showcase renewable energy production, how much it represents compared to the building's needs and how much it improves the overall building's emissions. Finally, the revision improves the recognition of renewable energy sources in the calculation of the overall performance of the building, particularly when a building is part of a larger energy grid, such as a district heating or cooling system.

Energy performance

The energy performance of a building means the amount of energy needed to meet the energy needs connected to normal use of the building, including, in particular, the energy used for: **heating, colling, ventilation, hot water production, lighting**

Total Renovation Strategies for Energy Reduction in Public Building Stock | EU SCIENCE

Constructions: how can we build sustainable buildings? (part 1/2) | Sustainable Energy

Constructions: how can we build sustainable buildings? (part 2/2) | Sustainable Energy

But what exactly is sustainable construction, and how does one transition into a more renewable development method? Are there any benefits, and what are the appropriate methods? Learn more by reading the guide below.

Sustainable construction involves using renewable and recyclable materials on building projects to reduce energy consumption and toxic waste. The primary goal of this initiative is to decrease the industry's impact on the environment by utilizing sustainable construction procedures, practicing energy efficiency, and harnessing green technology.

While several companies from different business sectors are doing ways to be more environmentally responsible, many focus their attention on the construction industry since it is considered the largest user of global resources. This sector alone is responsible for approximately 50% of the worldwide consumption of raw materials and is a significant waste producer. It makes construction unique because by changing outdated practices, the industry can significantly reduce the effects of global warming.

Sustainable Construction Methods

Many construction firms are now recognizing the importance of sustainable and green building methods. With the increased interest in sustainability and energy conservation, new advances in technology, materials, and practices have been developed over the past decade to enable and promote overall efficiency.

One of the best ways to implement sustainability in construction is through materials. Technological advancements have paved the way for a new generation of more robust, lighter, and renewable building materials such as insulated access doors and panels, which can help push traditional practices to be more environment-friendly.

These ecological materials also help promote a cleaner Earth by reducing the carbon footprint of the buildings that utilize these elements. They have the same purpose as their non-renewable counterparts while also aesthetically pleasing and much more efficient.

Ergonomic construction isn't just about using renewable materials; it's also about implementing methods that enhance sustainable efforts. Some of these methods include:

- Limiting the materials used to reduce waste
- Controlling waste management, such as separating and recycling waste
- Constructing green buildings
- Adaptive reuse projects that transform old buildings
- Managing construction sites to improve conservation efforts
- Examples include treating water on-site, no smoking, recycling food containers, etc.
- Conserving energy
- Choosing sustainable and recycled materials

Benefits of Sustainable Construction

Construction sustainability isn't just beneficial for the environment, but it also supports the well-being of individuals and communities. There are many proven benefits of adopting the green initiative in the building industry, and these include:

1. Promotes Healthier Living

It's no secret that our surroundings significantly impact our physical, mental, and emotional health. Over the past decade, designers and builders have developed a sustainable architecture that substantially affects the inhabitants' overall state in green buildings. The modern age has allowed us to branch out and modernize everyday appliances such as lighting and power sources, thermal conditions, ergonomic features, and even air quality. Occupants residing or working in sustainable buildings have experienced a noticeable improvement in their health, stress levels, and overall quality of life.

2. Reduces Waste

Over the past decades, global warming has remained a steadfast concern due to its increasing evident effects on our planet. Pollution and the depletion of our natural resources are at an all-time high. While we are almost at the point of no return, we can still minimize or slow down the imminent effects of climate change with our sustainable technological advancements. Construction firms have started relying on renewable resources and methods, which are beneficial for us and promote a cleaner environment.

3. Boosts the Economy

The construction industry is a known economic driver in the United States. The US Green Building Council (USGBC) stated that the green building industry contributes more than $134.3 billion in labor income to working Americans. It is safe to say that the green initiative in construction helps boost the economy by creating more jobs due to an increased demand for construction workers.

4. Promotes Cost Efficiency

One of the most substantial benefits of sustainable buildings is their lower maintenance costs with specially engineered design elements that help reduce water and energy bills. Reduced maintenance and operational costs mean huge savings invested elsewhere, such as higher employee wages or product development.

Although the cost required in building such structures may be initially higher than the traditional non-renewable forms of architecture, these efficient layouts can save corporate and building owners down the line.

5. Decreases Material Cost

Sustainable building methods utilize eco-friendly materials without compromising quality or structural integrity. Many of these materials are recycled and reused. Among which are biocomposites that are commonly substituted as sustainable building materials have proven to be as reliable and durable as their non-renewable counterpart.

For green architects, energy efficiency remains their number one priority and goal in building design. Building structures that obtain their energy from natural resources - such as the wind, sun, and water - are exceptionally favorable to our environment.

6. Enables Carbon Footprint Reduction

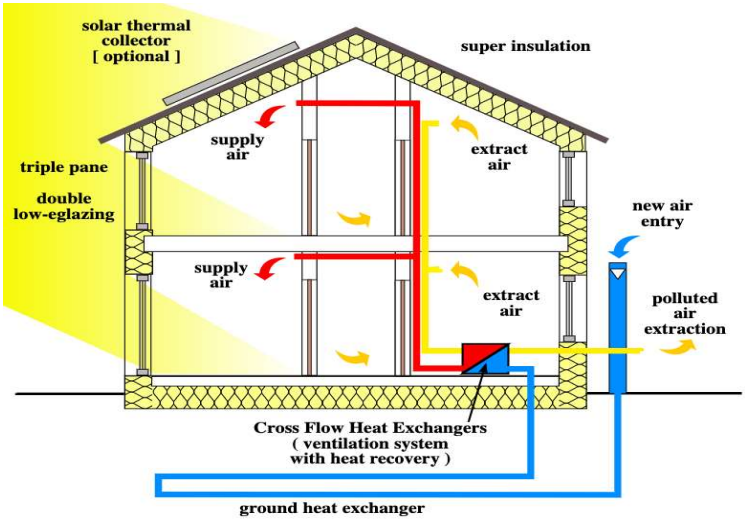
There has been an increase in large corporations supporting and adopting green initiatives. The Environmental Protection Agency (EPA) stated that buildings are responsible for 30% of all greenhouse gas emissions in the United States. Property owners and large businesses have taken heed, as imposing sustainability is an opportunity to do something positive for the company and society.

The demand for a more sustainable and economical solution has significantly grown due to the evident effects of global warming. The construction industry has already caused unfathomable damage to the environment. According to the United Nations Environment Programme (UNEP), “the increased construction activities and urbanization will increase waste which will eventually destroy natural resources and wildlife habitats over 70% of land surface from now up to 2032.”

To meet these objectives, numerous firms have started practicing necessary steps towards designing, renovating, or building structures in compliance with environmental rules and sustainable methods.

Although the cost of renewable construction is higher in all stages of the project, mainstream contractors and renowned firms are undertaking sustainable development in construction. The adaption of sustainable methods and materials has dramatically increased over the past few years, that the cost of sustainability in construction has come down.

Large construction firms and companies aren't the only ones to improve their methods and practices to better the environment. Regular people working on their building projects can do their part by choosing renewable materials and practicing sustainable techniques. Whether using the proper equipment or implementing reliable engineering geared towards conservation, simply doing your best to be energy efficient can help progress sustainability efforts.



4.5LINK BETWEEN DESIGN OF BUILDINGS AND THE CIRCULAR ECONOMY

SCHOOL : ITES Vitale Giordano, Bitonto –ITALY

Students: 2^ class (20 students)

Time required for the activity: 6 hours

Disciplines involved: Science (Chemistry, Biology), Geography, Economics.

DESIRED RESULTS

- **Know what circular economy is**
- **Know the link between the way of building and the circular economy**
- **Know the main rules of sustainable construction**
- **Acquire, interpret, and communicate information.**
- **Cooperate and participate in group activities by performing their tasks.**

PREREQUISITES

- **Know the meaning of 'sustainable development'**
- **Know the rules of waste separation and recycling**

METHODOLOGY

Working in groups: cooperative learning in classroom 3.0 (each student has his or her own iPad).

1) **WATCH THE VIDEO**

"Circular economy" (European Environment Agency)

https://youtu.be/_9mHi93n2AI

2) **DISCUSSION CIRCLE (1 hour)**

Initial **discussion circle** on the topic "circular economy".

Discussion circle: the teacher and the students sit in a circle and participate in a conversation that explores ideas, questions, experiences, and opinions. This circle includes the whole class.

All students participate and point out the differences between the 'linear' and 'circular' economies, highlighting advantages and disadvantages.

3) **READ THE ARTICLE (2,5 hours)**

"From field to house, agricultural waste becomes insulation panels"

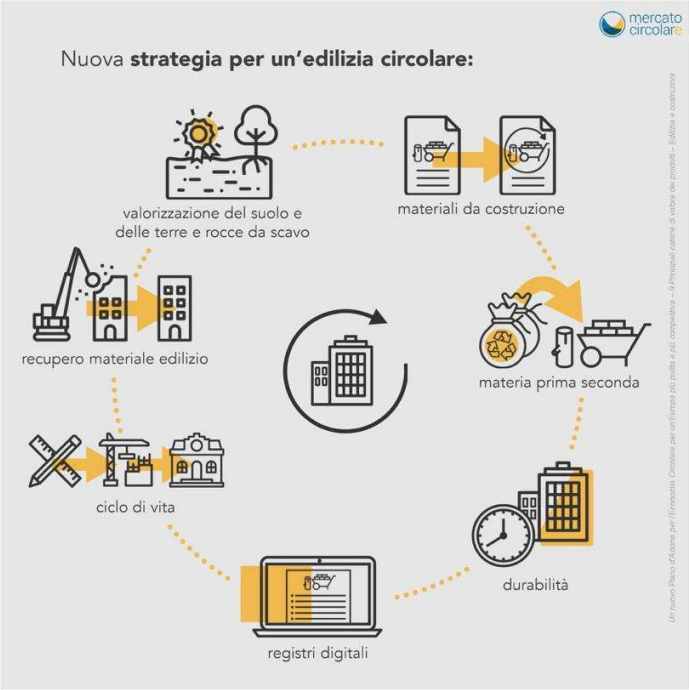
by Massimo Lorello - La Repubblica, 9 July 2021

<<The University of Bari and 'AWeS0Me' project has found a way to transform straw and pruning residues into a heat-insulating and sound-absorbing material. 'We will involve farms so that they can produce them themselves'

Olive leaves, straw and pruning waste in general. Until now, considered irretrievable waste from agricultural production, they have ended their existence in large bonfires set up in the countryside by farmers, all with the inevitable production of carbon dioxide. In order to stop this highly polluting habit, an effective system of agricultural waste disposal had to be found. Thus was born a project that does even more: it not only disposes of the waste without burning it, but also recycles it to make totally natural insulation panels. "We started from the urgency of giving waste a second life," says Francesco Martellotta, lecturer at the Politecnico di Bari and coordinator of the working group involved in the European project 'Agricultural Waste as Sustainable 0 km building Material' (AWeS0Me). "We were thinking about a possible, effective use of this waste. Hence the idea of making them into panels for insulating houses that can also help reduce energy consumption. We are talking about heat-insulating and sound-absorbing materials that could perfectly replace the much less sustainable materials that are routinely used'. The first phase of the project concerns the reconnaissance of the consistency and availability of waste to be used in the different regions involved in the initiative. "For several years we have been carrying out research into the thermal and acoustic properties of materials based on waste (not just agricultural waste),' Martellotta explains. 'In Italy, there are already

commercial products based on straw and hemp. We thought we would test the reuse of all the agricultural material in the area'. At the end of the test, having consolidated the reliability of the materials to make the panels, we will move on to the second phase: raising the awareness of farms and individual farmers. 'It will be a capillary campaign,' adds Martellotta, 'with all players, no one excluded. Of course, we will also involve the trade organisations'.>>

After reading, the students conduct a web search for panels made of traditional materials with similar functions to the panels described in the article. They compare the environmental impact of the types of panels identified.



4) STUDENTS WORK IN GROUPS (2,5 hours)

Each group works on one of the following topics and, at the end, students make an oral presentation of the results of their work

GROUP 1: New sustainable materials in building construction

https://archdesk.com/blog/sustainable-construction-materials/#

GROUP 2: Restructuring buildings in the circular economy

https://www.eea.europa.eu/publications/building-renovation-where-circular-economy/building-renovation-where-circular-economy

GROUP 3: How to improve the energy efficiency of housing

https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings_en

GROUP 4: What home automation is and how it relates to building sustainability

https://www.ilsole24ore.com/art/le-8-regole-casa-smart-ma-solo-5percento-italiani-sa-cos-e-ACSNho6

GROUP 5: Design for disassembly

https://economiacircolare.com/architettura-economia-circolare-edifici-che-si-smontano-ecosostenibili/

5) ASSESSMENT

Each group and each student will be assessed with specific assessment rubrics for the work they have done research, group work, oral presentation.

V. SUSTAINABLE INDUSTRY

5.1 TEXTILE SUSTAINABLE PRODUCTION

Grade: Secondary students

DESIRED RESULTS
Established Goals (Standards, Performance Indicators, Learning Goals): **1.** Knowledge about the sustainable and circular industry and circular economy as well. 2. Knowledge of EU vision for textile. 3. Key actions in the Textiles Strategy in EU.

Understandings:	**Essential Question:**
1. Understand that European consumption of textiles has the fourth highest impact on the environment and climate change. 2. Understand the problem ” Fast fashion is out of fashion”. 3. Understand the Profitable re-use and repair services are widely available	**The EU Commission’s 2030 Vision for Textiles** **How textile production pollutes the environment**
Students will know:	**Students will be able to do:**
1. What the concept of sustainability in the world of fashion is. 2. How the trends in the production and consumption of textiles works. 3. They are familiar with objectives, actions and timeline of the conception. 4. They are aware about the sustainable textile certifications.	1. Recognize the key actions in the Textiles Strategy 2. List the benefits of ”Fast fashion is out of fashion” 3. List the disadvantages contemporary textile industry.

EVIDENCE/ASSESSMENTS:

Performance Task:

Representative task - the form of presentation of the project result at the end – FASHION SHOW **"MY Sustainable Wardrobe – old clothes for a Green Future"**

Goal:

The EU Commission's 2030 Vision for Textiles.

Role:

The class is divided into small groups. Each member of a particular group has a role that goes with specific tasks. Each group will work on individual task linked to the global topic.

Represented teats will help students to gather the necessary information for the topic and present different aspects.

Product:

Production of the final product – recyclable clothes for the fashion show - sew and revamp or upcycle your old clothes and accessories through textile painting or embroidery

Other Evidence/Assessments:

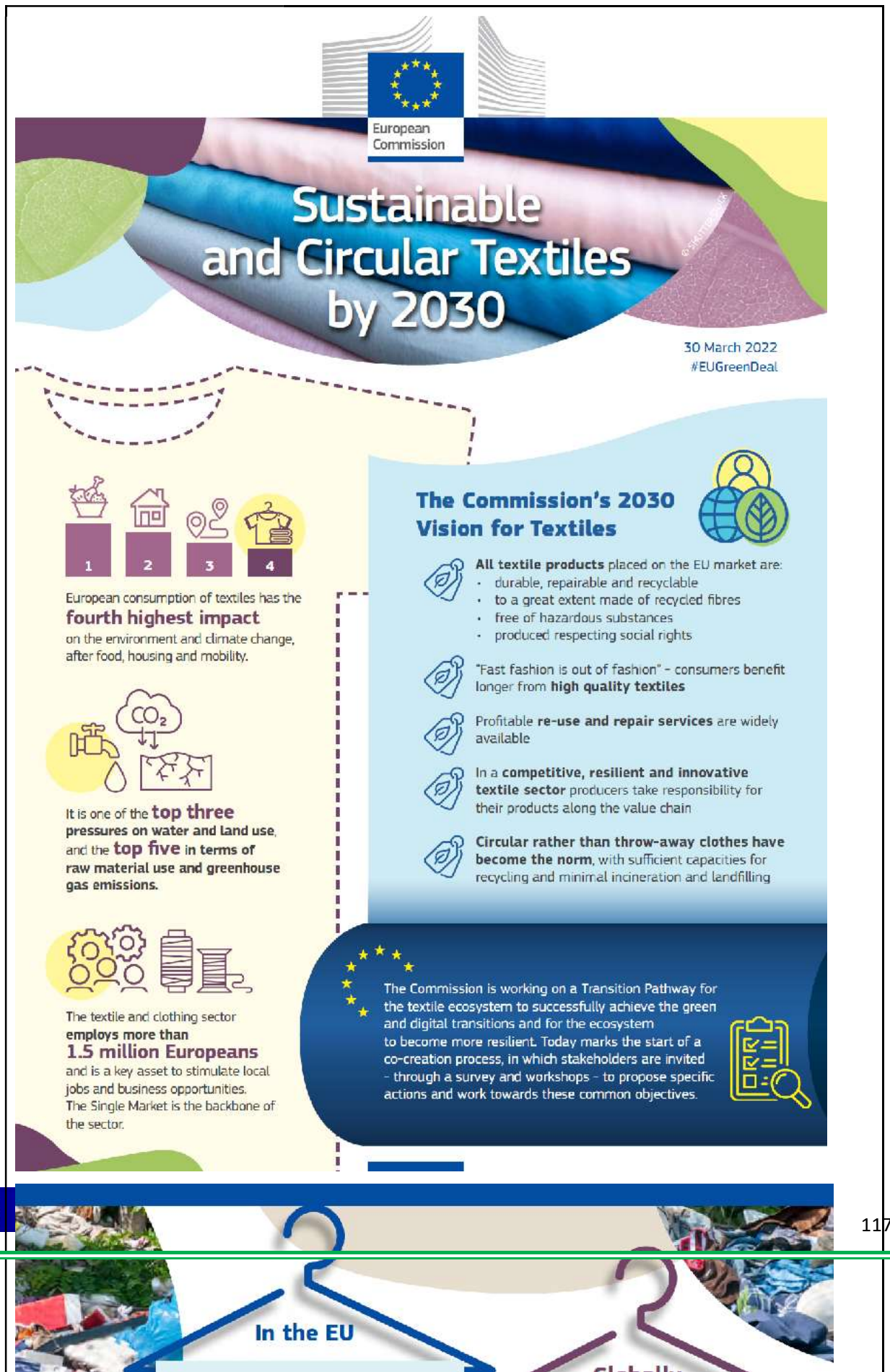
1. Mobile device and Internet
2. Talk on " The EU Commission's 2030 Vision for Textiles"
3. Cooperative learning

LEARNING PLAN

Learning Activities:

1. Getting to know the project
2. Divide the class into groups and define the role in the group
3. Students are divided into groups, working with the materials they have received to complete their presentations. Upon completion of the cooperative work, the results will be presented, discussed and supplemented if necessary. At the end there will be a short talk on " Fast fashion is out of fashion".
4. Presentation of the final product – organized Fashion show

Introduction to the topic:


European Commission
Sustainable and Circular Textiles by 2030
30 March 2022
#EUGreenDeal
1
2
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4
European consumption of textiles has the fourth highest impact on the environment and climate change, after food, housing and mobility.
It is one of the top three pressures on water and land use, and the top five in terms of raw material use and greenhouse gas emissions.
The textile and clothing sector employs more than 1.5 million Europeans and is a key asset to stimulate local jobs and business opportunities. The Single Market is the backbone of the sector.
The Commission's 2030 Vision for Textiles
All textile products placed on the EU market are:
durable, repairable and recyclable
to a great extent made of recycled fibres
free of hazardous substances
produced respecting social rights
"Fast fashion is out of fashion" – consumers benefit longer from high quality textiles
Profitable re-use and repair services are widely available
In a competitive, resilient and innovative textile sector producers take responsibility for their products along the value chain
Circular rather than throw-away clothes have become the norm, with sufficient capacities for recycling and minimal incineration and landfilling
The Commission is working on a Transition Pathway for the textile ecosystem to successfully achieve the green and digital transitions and for the ecosystem to become more resilient. Today marks the start of a co-creation process, in which stakeholders are invited – through a survey and workshops – to propose specific actions and work towards these common objectives.
In the EU

5.2 SUSTAINABLE CONSTRUCTION

PART 1 - Let's start with a recap and a definition of sustainability

Watch this video :

https://youtu.be/B5NiTN0chj0

Questions about the video :

- Give a definition of sustainability (in general , and in particular for our planet).
- Give the consequences of sustainability for our future.

PART 2 - What is sustainable construction?

Read this article :

The construction industry, by its nature, is one of the top users of natural resources. With the growing concern of finite natural resources and climate change, there is increasing pressure in the construction industry from the government and some private sectors to minimize their environmental impact.

While there are some challenges involved in embracing sustainable construction methods, there are also a lot of great benefits in adopting these methods.

What is Sustainable Construction?

Sustainable construction means using recyclable and renewable materials in building projects and minimizing energy consumption and waste production. The primary goal of the sustainable construction method is to reduce its impact on our environment.

Sustainable construction does not end after the completion of the building project, the design of the building itself should have a minimal impact on the environment over the structure's lifespan. It means that the design of the building should incorporate elements and materials that have a continuous influence on the structure's environmental impact. These can include energy-efficient roof hatches on the rooftop, solar panels, appropriate insulation to prevent heat loss, and minimizing energy consumption from the grid that mostly comes from fossil fuels and long lifespan building materials.

Is Sustainable Construction Important?

From the emission up to the energy consumption, the construction industry contributes a significant impact on the environment.

Aside from its potential for building structures over wild habitats, its energy consumption is high. Most of the heavy machinery and equipment still heavily lean on fuels. Even inefficient

electricity usage will result in unnecessary combustion of fuels to sufficiently supply those grid power supply lines. The construction industry contributes 36 percent of energy usage and 40 percent of CO2 emissions worldwide.

The shipping and fabrication of materials can significantly impact carbon emissions. Mining raw materials such as metals can result in water pollution. The concrete manufacturers or cement plants have resulted in tons of CO2, increasing significantly every year. Construction can also produce hazardous waste due to improper disposal or management, resulting in the pollution that affects the environment and the people in that area.

Ways to Make Construction Project Sustainable

There are several ways to make construction or building structure projects more sustainable.

Renewable Energy

There have been significant steps made in bringing renewable energy to construction sites. One of the popular solutions is the modular battery system that can quickly deploy onsite and recharge via solar panels. These systems can power vehicles, electric power tools, and security equipment in construction sites. These batteries can offset tons of CO2 and about a hundred liters of diesel per week, resulting in a significant positive impact on the environment when applied on large construction projects.

Building With Sustainable Construction Materials

- ***Wood*** *- Adequate management of forests will provide habitat for wildlife and supply valuable building materials.*
- ***Alternative Bricks*** *- Wool and mud is excellent raw material to create bricks that are just as strong as traditional brick materials without using a kiln in its process, resulting in harmful emissions in the environment.*
- ***Sustainable Concrete*** *- Recyclable materials and plastics are an ideal substitute for traditional concrete and can significantly minimize carbon dioxide production.*

Plastic Construction Materials

Plastic is one of the significant destroyers of the environment or ecosystem. However, it can become a considerable strength when appropriately used in construction. One of the main goals of sustainable construction is to build longer lifespan buildings. The fact that plastic materials won't degrade for an extended time means it doesn't require much replacement or maintenance. Manufacturers can start incorporating plastics to produce durable and recycled construction materials.

The construction industry adopts sustainable practices. The sooner the global construction companies adopt these methods, the better the environment tenders all construction projects. We

can minimize the negative environmental impacts on the construction industry as we move into a more innovative, advanced world.

Source : *What Is Sustainable Construction? (construction21.org)*

PART 3 – GREEN BUILDING

Prepare an oral report of Green Building using a slideshow. You have to:

– define what is a Green Building.

– give the required criteria to consider a building as 'green'.

– give some advantages and drawbacks of those buildings.

– explain their possible use.

– illustrate your presentation with the example of an existing green building (or a project) in the world (location, use, characteristics, …)

- Your slideshow mustn't exceed 12 slides.
- Make each slide as 'light' as possible, only put the essential details, figures, etc. ; and choose a simple design.
- Your oral report should last around 3 minutes.

5.3 SUSTAINABLE ELECTRONICS AND DIGITIZATION

TARGETS.

Students learn about the sustainable material approach.

uses materials in the most efficient way by giving importance to using less.

Understands the importance of using resources sustainably to meet the needs of today and the future.

Learns how to donate and recycle used electronic devices.

INTRODUCTION:

https://www.youtube.com/watch?v=th0ZepC3V7Q

https://youtu.be/S2lmPIa1iWE

Students are asked to watch the webinar and video whose link is given, and attention is drawn to the subject by taking their opinions about the webinar.

Throughout history, people have not considered how abundant or scarce natural resources are, their impact on the planet, or what to do with waste. Humans have taken more from Earth, considering their immediate needs. They extracted raw materials for electronic products, made devices, used these devices until they were finished, and then threw them away. They repeated this cycle every time they created something new. When they realized that e-waste is dangerous and that they cannot be disposed of in the same way as other wastes, and that processing it would add a different cost, they chose the easy way and started exporting it to other parts of the world. However, there was nothing sustainable about this e-waste management plan.

In 1989 the Basel Convention was enshrined as a necessary response to the damage we do by exporting hazardous waste and introduced controls for the cross-border movement of waste. Eventually, we began to realize that there is real value in much of what we call e-waste, and the concept of electronic recycling as a way to both reduce waste and recover valuable materials has gained momentum.

Adding recycling as an option at the end of the electronics lifecycle changed the model from linear to circular, and at least some of the waste output became the starting materials for new devices.

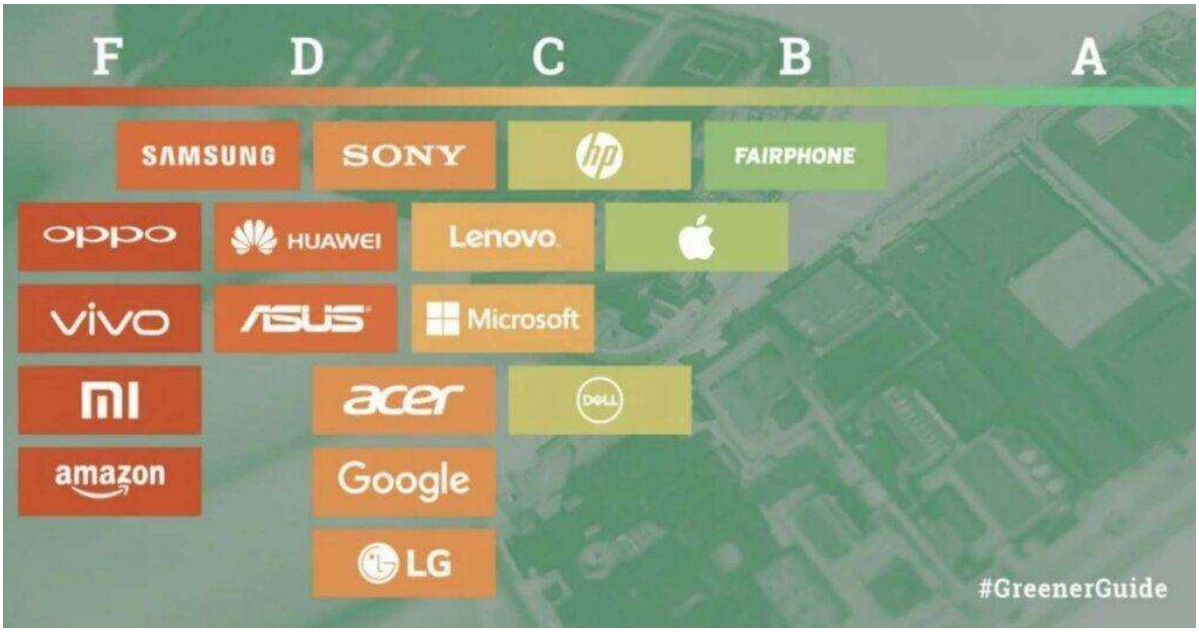
DEVELOPMENT

QUESTION: What is sustainable electronics?

Simply put, sustainable electronics are electronic devices made with sustainable practices and materials (e.g. your smartphone, TV, refrigerator (or freezer), tumble dryer, tablet, e-reader, and similar digital devices).

So how sustainable is your electronics? Is your smartphone sustainable?

In 2017, Greenpeace created a Green Electronics Directory that ranks the world's leading consumer electronics companies in terms of sustainability. They gave the top 17 companies a grade from F to A. Not a single company received an A. However, the report revealed that some companies made an effort. Fairphone, for example, got a respectable B! While there is currently no A+ rated smartphone company in the world, this report shows that it is possible to move towards sustainable practices while producing highly popular, innovative and modern devices. Apple got a B-.



By reducing the amount of materials used, increasing reuse, renewing and extending the life of products, and recycling electronic devices, sustainable electronics management can help reduce the amount of waste that needs to be managed locally and globally. Examining a product's entire life cycle can reveal new opportunities to reduce environmental impacts, conserve resources and reduce costs. Some electronics manufacturers have taken innovative approaches to ensure electronic products are sustainably sourced, designed and managed throughout their lifecycle.

QUESTION: What stages does a cyclical lifecycle of electronic products include?

Source Materials: Materials such as iron, gold, aluminum, palladium, platinum, lithium, copper, which play an important role in high-tech electronic products, are extracted from the soil, transported, processed, refined and included in the products. These activities use large amounts of energy and produce greenhouse gas emissions, pollute the environment and deplete our natural resources. Reducing materials can conserve natural resources, conserve energy and reduce pollution.

Product Design and Manufacturing

Designing and manufacturing electronics with the environment in mind is critical to developing more sustainable products. Resource reduction, also known as waste prevention, is important in design and manufacturing because electronics, which have less impact on human health and the environment, generally use less material, use more recycled materials, are more durable, and can be recycled.

Product Supply and Use

The first step to using electronics sustainably involves educating consumers on sustainable purchasing options. Manufacturers have a responsibility to create durable, long-lasting, reusable and recyclable products, but consumers also play an important role in maintaining their electronic devices.

Collecting

Electronic product collection organizations send products to recycling facilities to be reused, refurbished and resold, or to recycling facilities to be sorted, cleaned and converted into materials that can be reused in production.

Reuse and Renewal

Refurbished electronics are electronics that have been updated and repaired for resale. Reusing electronics extends product life and contributes to reducing raw material resources

Recycling

Recycling includes sorting, dismantling, mechanical separation and recovery of valuable materials. Recycling used electronic parts can introduce materials (eg gold, copper, glass, aluminum) that can be returned to the supply chain for reuse, reducing used raw materials and the need to dispose of used electronics.

Donating or recycling consumer electronics conserves our natural resources and prevents air and water pollution, as well as greenhouse gas emissions from the manufacture of raw materials.

In 2006, the US Geological Survey (USGS) estimated:

Recycling one million laptops saves energy equivalent to the electricity used by more than 3,500 US homes per year.

For every million mobile phones we recycle, 35,000 pounds of copper, 772 pounds of silver, 75 pounds of gold and 33 pounds of palladium can be recovered.

Evaluation

Check out the page below to donate and recycle electronic products.

https://www.epa.gov/recycle/electronics-donation-and-recycling

videos about the topic that could be watched: https://www.youtube.com/watch?v=dssPVrdSggs

https://www.youtube.com/watch?v=yM8LHJsMG3U

Students are asked to design waste electronic products.

5.4 SUSTAINABLE PLASTIC PRODUCTION

Topic 5: Sustainable Industry and Plastic Production

Lesson for Upper Secondary School

Objective:

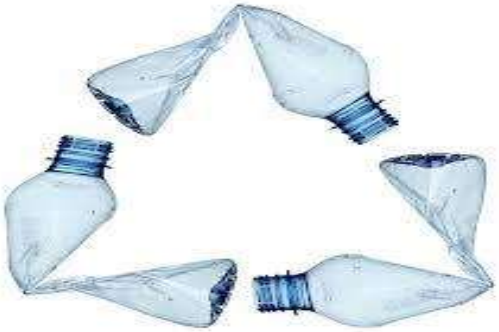
- Students will be able to understand the concept of sustainable industry and the importance of reducing plastic waste.
- Students will be able to identify sustainable practices in the plastic production industry.
- Students will be able to discuss the impact of plastic waste on the environment.

Materials:

- Videos on plastic production and recycling
- Articles on sustainable industry and plastic production

- Start the lesson by asking the students what they know about sustainable industry and plastic production.
- Present a brief overview of the lesson and its objectives.
- Show a short video on plastic recycling.

In recent years, there has been a growing awareness about the impact of industrial activities on the environment. Environmental policies have been put in place to regulate industrial operations and promote sustainable practices. Sustainable industry aims to reduce the negative environmental impact of industrial activities while ensuring economic growth and social development.



The ever-increasing amount of plastic, its impact on biodiversity and contribution to climate change, and how to deal with it in a circular economy perspective have been on the European Union's policy agenda for years. The COVID-19 pandemic has only increased the attention for plastic waste with images of masks in our seas, and large amounts of single-use protective gear. In the circular plastics economy report, published today, the European Environment Agency (EEA) analyses the need and potential for a shift to a circular and sustainable approach to our use of plastics.

Sustainable industry refers to industrial activities that are environmentally friendly, socially responsible, and economically viable. Sustainable industry seeks to minimize the negative impact of industrial activities on the environment and society while maximizing the benefits. Sustainable industry is based on the principles of sustainable development, which seeks to balance economic growth, social development, and environmental protection. adopt sustainable practices. For example, some environmental policies provide tax credits or subsidies for industries that adopt sustainable practices.

Plastic is a key material for innovation and for helping us reduce greenhouse gas emissions and tackle climate change. But any plastic waste in the environment is unacceptable. Plastics must be sustainable.

Video: Recycling plastics – Resource efficiency with an optimized sorting method

We are accelerating our contribution to the sustainable production and use of plastics, while ensuring they continue their positive contribution to healthy societies and growing economies. We need to increase our efforts to reduce plastic waste, promote reuse and collection and recycling of plastic waste, and accelerating the transition to a circular economy.

While our industry has an essential role to play, this transition is not one we can undertake alone. That is why working hand in hand with manufacturers, brand owners, consumers, recyclers and policymakers towards our shared goals is so important.

The plastics industry is already contributing towards Europe's climate ambitions. CO2 emissions are reduced by the use of plastics in most applications and are, for example, helping to decrease energy consumption and emissions in the building and construction and transport sectors.

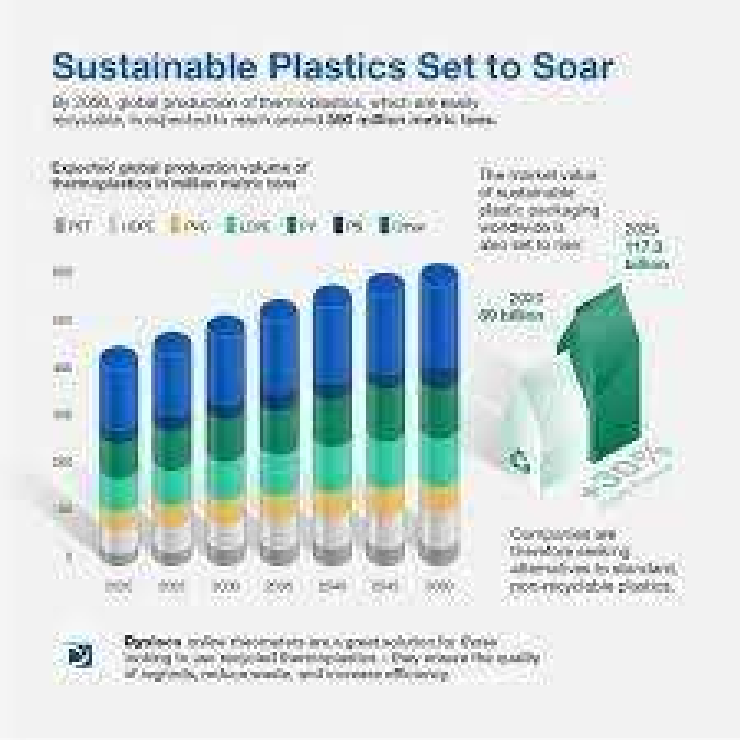
Plastics are also enabling the transition from fossil fuel to renewable energy through their use in wind turbines, solar panels and electric vehicles.

We are also improving the climate impact of all aspects of our operations, making our production processes more energy and resource-efficient, using more renewable energy and more alternative feedstock from waste and renewable resources, while also supporting carbon capture solutions and accelerating the transition to a circular economy.

https://plasticseurope.org/sustainability/

Public awareness of plastic pollution is driving increasing regulation to make industry more circular. At the same time, plastic is crucial to the net-zero transition as a key material in clean technology, such as renewable energy and electric vehicles.

In order to cut both waste and greenhouse-gas emissions, the plastics sector is reorganising its production and technology base, developing alternative raw materials and energy sources, and innovating in new technologies and investments.



What solutions are there? Divide the students into 5 groups and have them study different materials.

- **2 groups read article: Can plastics become more sustainable?**
- **1 group watches video: Why This May Be the Future of Plastic Recycling**

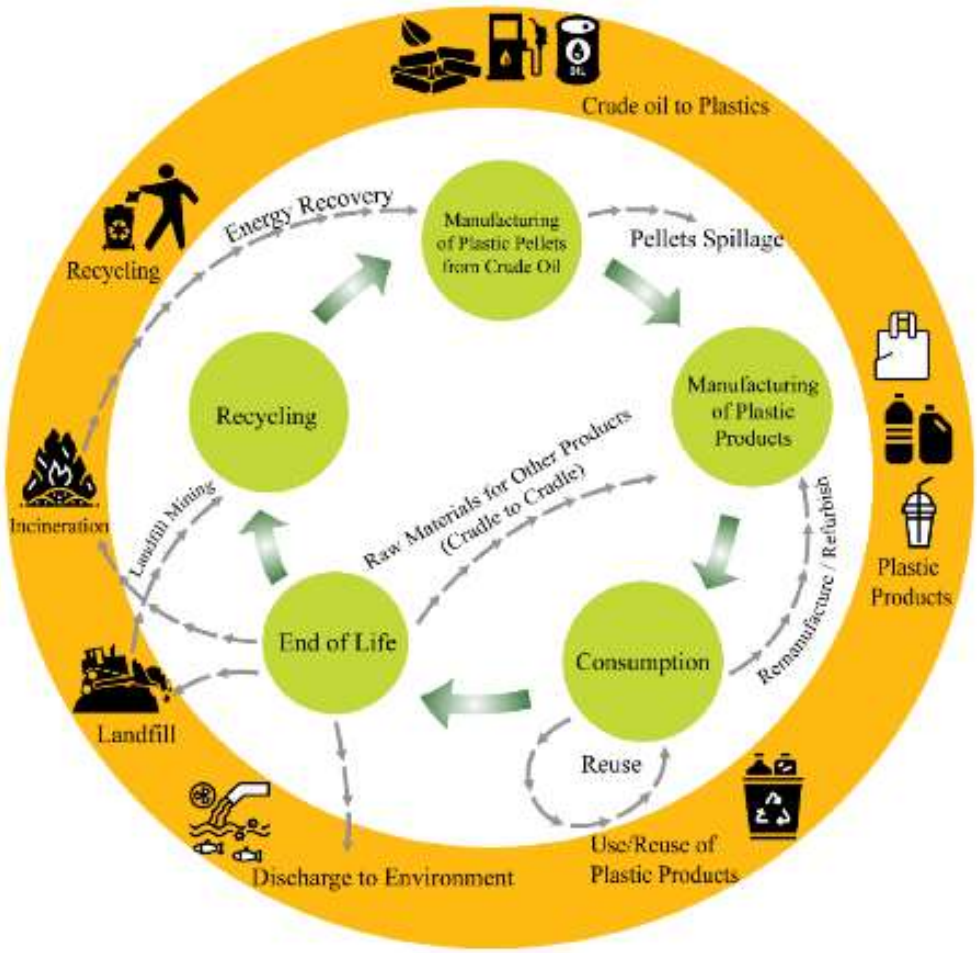
- **2 groups read the article: The future of plastic recycling**

Conclusion: Have each group present their findings and lead a class discussion on sustainable practices in plastic production.

Emphasize the importance of sustainable industry and encourage students to make conscious choices in their consumption of plastic products.

Assessment:

- Participation in small group discussions
- Quality of research and presentation



5.5 REUSABLE AND RECYCLABLE PACKAGING

SCHOOL: ITES Vitale Giordano, Bitonto – ITALY

Students: 2nd class (20 students)

Time required for the activity: 7 hours.

EXPECTED RESULTS

- Analyze data on packaging currently in use and the problems arising from it.
- Learn about the alternative materials to be used to design new packaging
- Acquire, interpret, and communicate information.
- Cooperate and participate in group activities by carrying out their duties.

PREREQUISITES

- Know the meaning of "circular economy".

METHODOLOGY

-Guided tour

-Group work: cooperative learning in classroom 3.0 (each student has his own iPad).

INTRODUCTION

European Union policies aim to achieve 100% sustainable packaging by 2030. But the choice to use eco-compatible, green, and circular packaging is not only a goal of the European strategy, from the Green Deal to the ecological transition of the PNRR, to promote environmental protection and ecological transition. Sustainability is in fact an economic driving force for companies, considering that, according to international statistics, 65% of young people prefer to buy products from brands that support environmental sustainability.

1) SEE THE VIDEO

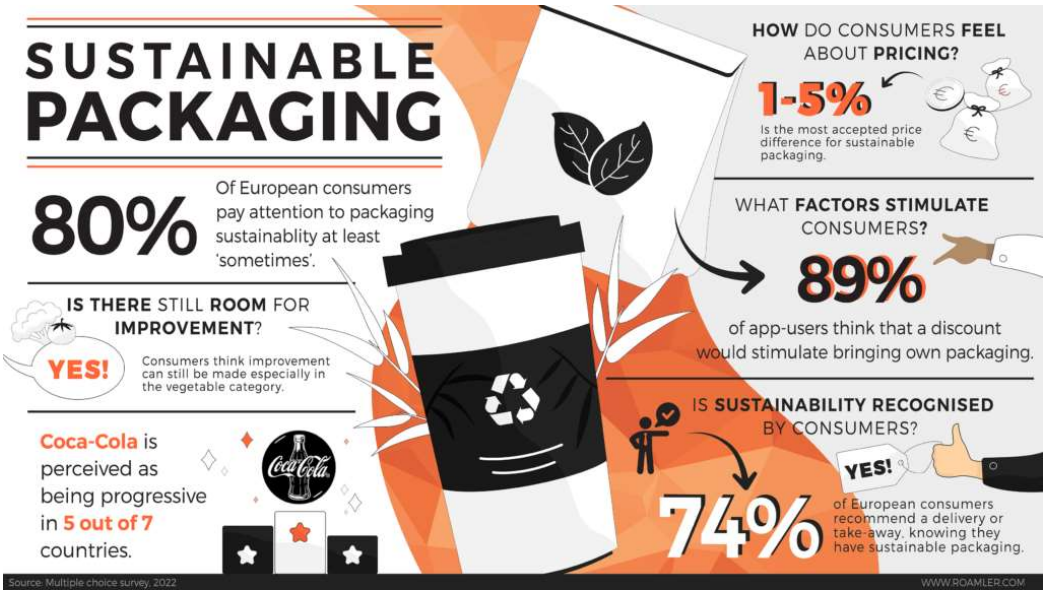
EU's Circular Economy Package in a Nutshell: New Packaging Legislation explained.

https://youtu.be/3avk7-XmBrY

2) Visit a supermarket and analyze the types of packaging, highlighting their characteristics of product protection, hygiene, sustainability. Divided into groups, students prepare presentations highlighting advantages and critical issues of the analyzed packaging.

3) Exploring the new European directive

https://environment.ec.europa.eu/topics/waste-and-recycling/packaging-waste_en



https://ec.europa.eu/commission/presscorner/detail/en/ip_22_7155

4) Work in cooperative groups: each group produces a presentation that will come

exposed to the rest of the class.

- Group A Classification of packaging

https://www.emballagecartier.com/en/article/primary-secondary-and-tertiary-packaging-whats-the-difference/

https://www.mecalux.it/blog/types-of-primary-secondary-tertiary-packaging

- Group B New materials for alternative packaging.

https://ilfattoalimentare.it/packaging-popcorn.html

https://www.phyuture.com/post/imballaggi-naturali-al-100-here-the-alternative-to-polystyrene

https://www.agrodolce.it/2020/01/21/5-packaging-alternativi-alla-plastica-da-adottare-subito/

- Group C_ Logistics: redesigning packaging.

https://it.linkedin.com/pulse/how-to-reduce-packaging-costs-and-make-delivery-deiana

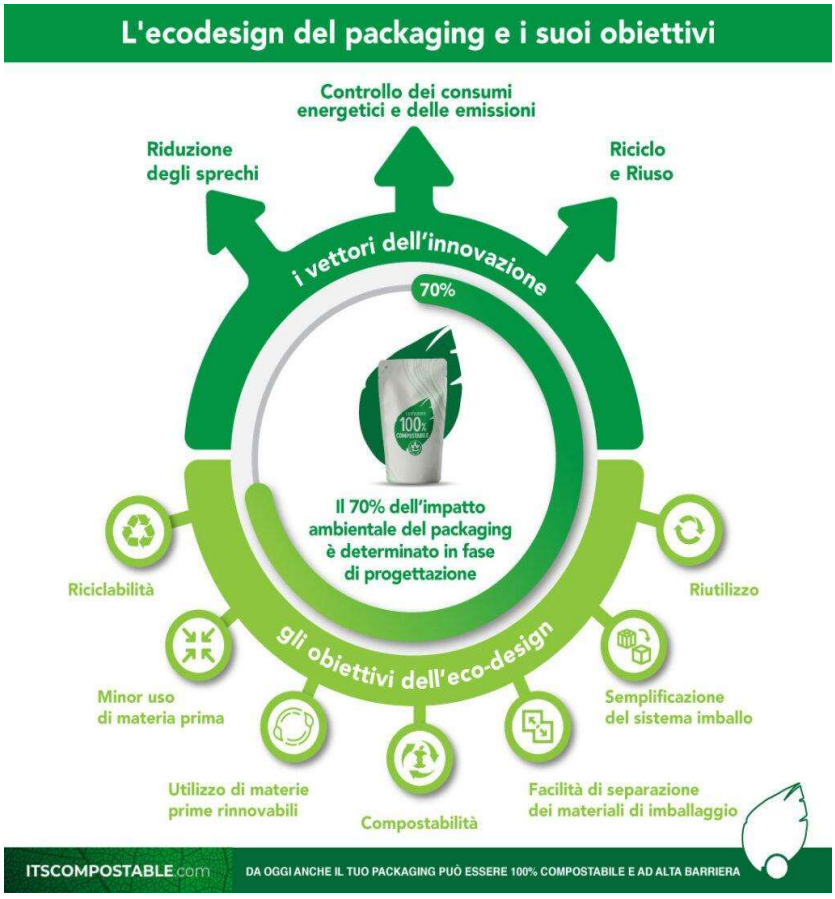
- Group D_ e-commerce and packaging (examples)

Amazon https://www.logisticamente.it/Articles/14965/amazon-riduce-gli-imaggiaggi-grazie-al-machine-learning/

IKEA https://packagingspeaksgreen.com/en/materials/ikea-reduces-the-use-of-plastic

Apple https://techprincess.it/apple-iphone-packaging-sustainable/

5) Based on the sharing of the results of the work carried out, the students will elaborate a list of characteristics of the packaging of the future in the circular economy.



6) The evaluation of the pupils will be done with specific evaluation rubrics, for individual and group activities.

VI. CLEAN ENERGY

6.1 STANDARDS FOR CLEAN ENERGY

Main Activity

- Divide the students into small groups and assign each group a different form of clean energy and have them read about different standards for clean energy. Try and fit their assigned energy into the standards.
- Each group should prepare a short **CLEAN ENERGY STANDARDS FOR CLEAN ENERGY**

Objective: To introduce students to the different standards and different forms of clean energy.

- Begin by asking the students what they know about clean energy and why it is important. Write their findings on the board.
- Introduce the topic of standards for clean energy and explain that they are necessary to ensure that the energy we produce and consume is sustainable and meets specific criteria.
- Ask students if they have heard of any standards or certifications related to clean energy.

Clean energy refers to any form of energy that has a low or zero impact on the environment compared to traditional sources of energy such as fossil fuels. The transition to clean energy is essential for reducing greenhouse gas emissions and mitigating the negative impacts of climate change. Standards for clean energy are necessary to ensure that the energy we produce and consume is sustainable and meets specific criteria.

Though details vary all clean electricity standards share the same primary goal: replacing electricity from dirty fossil fuels with zero-emission electricity from renewables and other sources.

How? By requiring utilities to produce a certain percentage of their electricity using clean energy sources like wind and solar by a target date. For example, a country that heavily uses coal or natural gas today could aim to produce at least 50% of their electricity using renewables by 2030, and then 100% by 2050.

In 2019 the EU overhauled its energy policy framework to help us move away from fossil fuels towards cleaner energy - and, more specifically, to deliver on the EU's Paris Agreement commitments for reducing greenhouse gas emissions.

The new rules will bring considerable benefits for consumers, the environment, and for the economy. By coordinating these changes at EU level, the legislation also underlines EU leadership in tackling global warming and makes an important contribution to the EU's long-term strategy of achieving carbon neutrality (net-zero emissions) by 2050.

https://energy.ec.europa.eu/topics/renewable-energy_en

Iceland is a country that has been a leader in clean energy production and use. The country's geology and geography provide a unique opportunity to generate electricity and heat from renewable sources. In this article, we will explore the standards of clean energy in Iceland.

1. Geothermal Energy Iceland is known for its abundant geothermal energy resources, which provide the country with about 87% of its primary energy needs. The utilization of geothermal energy in Iceland is governed by a set of regulations and standards that ensure

its safe and sustainable use. The Ministry of Environment and Natural Resources is responsible for managing and regulating the country's geothermal resources.

2. Renewable Energy Targets Iceland has set a target to become carbon neutral by 2040. To achieve this, the country has set ambitious targets for the production and use of renewable energy. Iceland aims to generate 100% of its electricity from renewable sources by 2030 and to increase the share of renewable energy in its primary energy mix to 75% by 2030.
3. Hydroelectric Power Hydroelectric power is another important source of clean energy in Iceland, accounting for about 13% of the country's electricity production. The country's hydroelectric power plants are regulated by the National Energy Authority, which sets safety and environmental standards for their operation.
4. Carbon Capture and Storage Iceland is also exploring the use of carbon capture and storage (CCS) technology to reduce greenhouse gas emissions from its power plants. The CarbFix project, which is a collaboration between the Icelandic government and several private companies, aims to capture and store carbon dioxide emissions from the Hellisheidi geothermal power plant.
5. Energy Efficiency Standards Iceland has implemented energy efficiency standards for buildings and appliances. The country has adopted the European Union's energy efficiency labeling system for appliances, which provides consumers with information on the energy efficiency of different products. Iceland also requires new buildings to meet energy efficiency standards, and the country has developed a system of energy audits to help companies identify areas for improvement in their energy use.

- presentation to the class explaining their standard or certification, including any examples of companies or organizations that use it.

Class Discussion After each group has presented, lead a discussion on the different forms of clean energy. Ask students to identify similarities and differences between them, and how they contribute to environmental sustainability.

- Encourage students to think critically about the standards and certifications, and whether they are effective in promoting clean energy.

Conclusion

- Show videos on renewable energy or energy efficiency, such as wind or solar power, or the benefits of using energy-efficient appliances or lighting.
- Have students reflect on what they learned during the lesson and how they can apply it in their own lives to promote clean energy and reduce their carbon footprint.

Assessment:

- Evaluate students based on their participation in group work and class discussion, as well as their ability to explain their assignment clearly and accurately.

Extension Activities:

- Research further forms of clean energy and see how well they fit the standards.
- Organize a field trip to a renewable energy facility (geothermal and/or hydroelectric plant), to see first-hand how clean energy and sustainability are put into practice.

https://www.youtube.com/watch?v=jJpCB5Puubs (Breakthroughs in Clean Energy to Watch in 2023)

https://www.youtube.com/watch?v=I3uzFUaT-h8 Þreföldun orku frá jarðhita á fimm árum

https://www.youtube.com/watch?v=BC0zKj-IKNM Jarðhiti á Íslandi

https://www.youtube.com/watch?v=ij6h97f3wt4 Iceland Geothermal Energy

https://www.youtube.com/watch?v=xy9nj94xvKA How do wind turbines work?

https://www.youtube.com/watch?v=GzQmo_Wd2Sw Solar power 101

https://www.youtube.com/watch?v=nCrTsWtPVIY Cheap, renewable energy

6.2 POTENTIAL OF WINDS ENERGY

Grade: Secondary students

DESIRED RESULTS
Established Goals (Standards, Performance Indicators, Learning Goals): **1** Knowledge about the potential of wind energy, such as clean energy. 2.Integration of the topic in order to fully comprehend. 3.Expanding knowledge and consolidating skills on the topic.

Understandings:	**Essential Question:**
1 Understand the potential of wind energy. 2. Understand the advantages of using wind energy.	Why should the potential of wind energy be exploited?
Students will know: 1. What wind energy is. 2. How wind energy works. 3. They are familiar with the benefits of wind energy. 4. They are aware of the disadvantages	**Students will be able to do:** 1.Recognize the wind energy and the mechanisms for its generation and use. 2. List the advantages of wind energy. 3. List the disadvantages of wind energy.

of wind energy.	

EVIDENCE/ASSESSMENTS:

Performance Task:

Representative task - the form of presentation of the project result at the end – Presentation maket

Goal:

To know the potential opportunities for the production and use of wind energy. To understand the advantages and disadvantages of wind energy.

Role:

The class is divided into 5 groups. Each member of a particular group has a role that goes with specific tasks. Each group will fill in its worksheet, which will help to gather the necessary information for the production of individual elements for the assembly of a wind turbine mock-up.

Product:

Wind turbine mock-up. LEGO or other plastic/paper materials

Other Evidence/Assessments:

1. Worksheet
2. Mobile device and Internet
3. Talk on "Wind energy opportunities"
4. Cooperative learning

LEARNING PLAN

Learning Activities:

1. Getting to know the project
2. Divide the class into groups and define the role in the group

3. Give away a worksheet

4. Students are divided into groups, working with the materials they have received to complete their worksheet. Upon completion of the cooperative work, the results will be presented, discussed and supplemented if necessary. At the end there will be a short talk on "Wind Energy Capabilities"

5. Presentation of the final product

Introduction to the topic:

In the world of renewable energies, wind energy undoubtedly stands out. It uses so-called wind turbines to transform the energy that wind has into electricity.

Wind turbines are very complex devices that need preliminary study to be profitable and efficient. In addition, there are several types of wind turbines and wind energy.

Do you want to know everything related to wind turbines?

For the purposes of the project, the class is divided into 5 working groups.

First group

Students receive a link to follow.

https://www.youtube.com/watch?v=Wz7nRzohq4E

It takes them to a short video: watch and learn about the types of renewable energy sources. Questions in the worksheet:

1. What are the sources of renewable energy?

2. What are the benefits of introducing energy efficiency measures?

Second group

Wind Energy

Students are introduced to the information they are given to explore.

https://www.youtube.com/watch?v=revdR1rOqPY

Answer the questions on the worksheet.

Question:

1.What is the wind?

2.What does the wind speed depend on?

3.What is a turbine?

Elements of a wind turbine

https://www.renovablesverdes.com/bg/%D0%B2%D1%8F%D1%82%D1%8A%D1%80%D0%BD%D0%B0-%D1%82%D1%83%D1%80%D0%B1%D0%B8%D0%BD%D0%B0/#Elementos_de_una_turbina_eolica

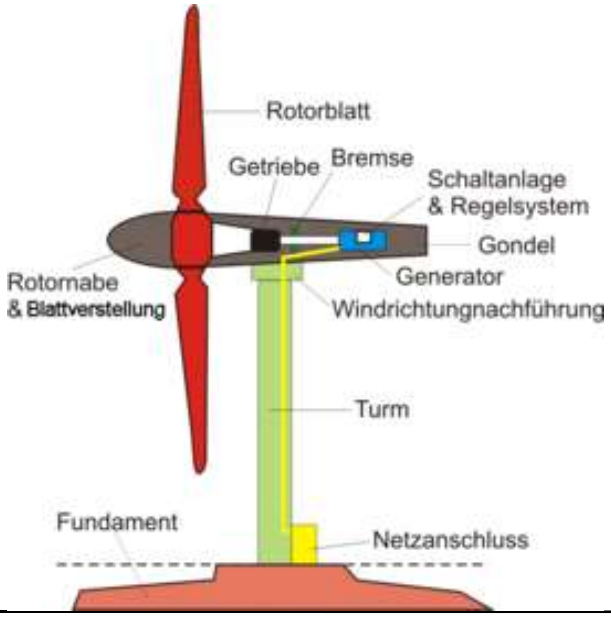
1.List the elements of the wind turbine.

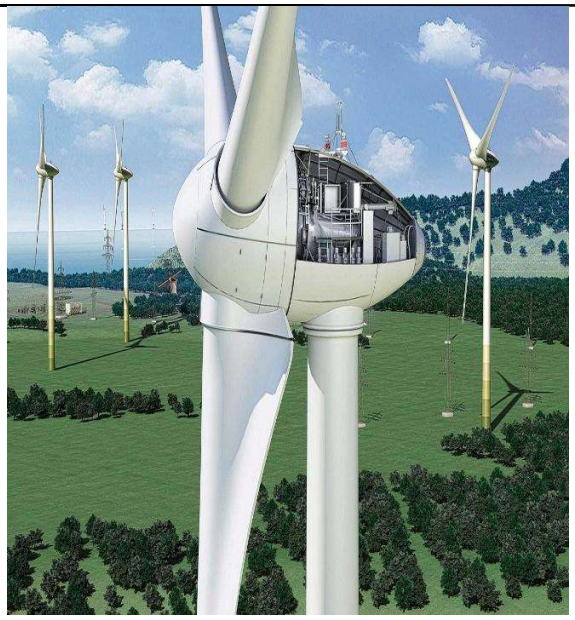
2.Describe the functions they perform.

Third group

How the wind turbine works?

https://apee.bg/%D0%BA%D0%B0%D0%BA-%D1%80%D0%B0%D0%B1%D0%BE%D1%82%D0%B8-%D0%B2%D1%8F%D1%82%D1%8A%D1%80%D0%BD%D0%B0%D1%82%D0%B0-%D1%82%D1%83%D1%80%D0%B1%D0%B8%D0%BD%D0%B0/





Schematic of the wind turbine device

Characteristics of wind turbine/ Operation

https://www.renovablesverdes.com/bg/%D0%B2%D1%8F%D1%82%D1%8A%D1%80%D0%BD%D0%B8-%D1%82%D1%83%D1%80%D0%B1%D0%B8%D0%BD%D0%B8/#Caracteristicas_de_un_aerogenerador

1.List and describe the operations for the production of electrical energy from the energy of the wind.

2.What is the name of the operation to transfer the received electrical energy to the network? Describe the process.

Fourth Group

Types of Wind Turbines

https://www.renovablesverdes.com/bg/%D0%B2%D1%8F%D1%82%D1%8A%D1%80

%D0%BD%D0%B8-%D1%82%D1%83%D1%80%D0%B1%D0%B8%D0%BD%D0%B8/#Caracteristicas_de_un_aerogenerador

Vertical axis wind turbine

Horizontal axis wind turbine

After studying the material, students answer the questions on the worksheet.

Questions:

1.What types of wind turbines are there according to the axis of the rotor? Make a brief description.

2.What are the types of wind turbines according to the supply power? Please describe them.

Group Five

Advantages and challenges of wind energy

https://www.energy.gov/eere/wind/advantages-and-challenges-wind-energy

1. What are the advantages of wind energy?
2. What are the shortages of wind energy?
3. Why do we have to use wind energy now?

Model of the wind turbine example https://www.youtube.com/watch?v=So_eJveUNjE

6.3 INTERCONNECT ENERGY SYSTEMS

SCHOOL: ITES Vitale Giordano, Bitonto – ITALY

Students: 2nd class (20 students)

Time required for the activity: 5 hours

EXPECTED OUTCOMES.

- Know the interconnected energy systems and know their role and operation

- Acquire, interpret, and communicate information.

- Cooperate and participate in group activities by carrying out their tasks.

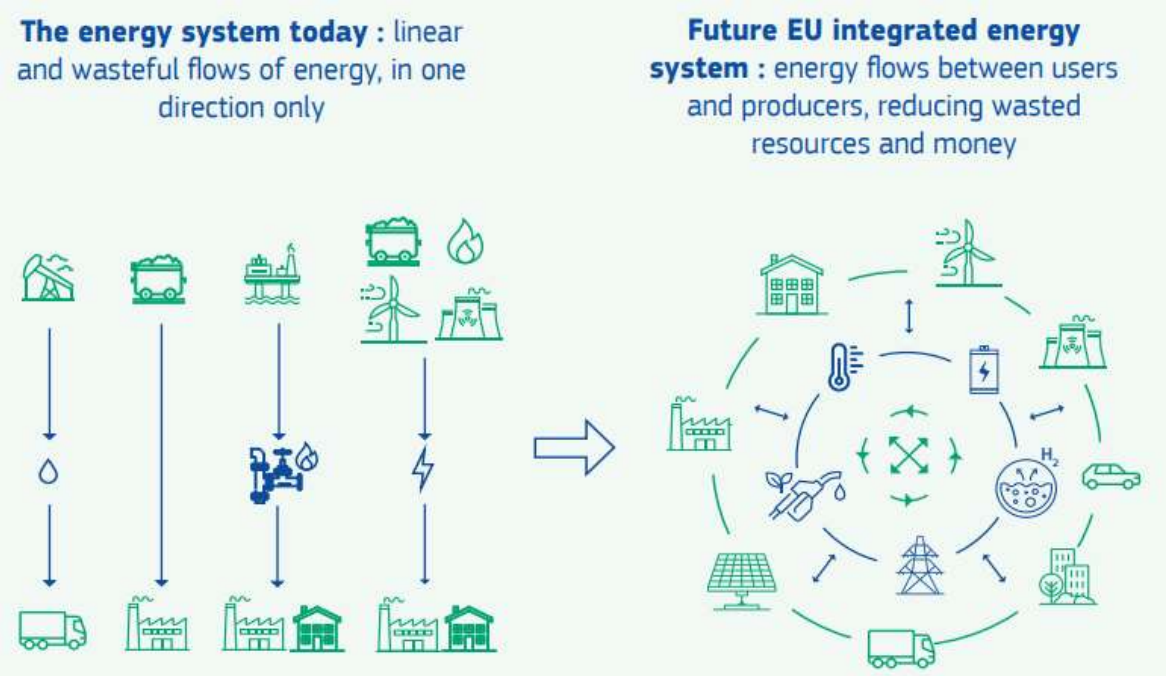
PREREQUISITES

- Knowledge of renewable and nonrenewable energy sources

METHODOLOGY

-Group work: cooperative learning in classroom 3.0 (each student has his/her own iPad).

-Web search



1. INTRODUCTION

Interconnection of energy systems serves to achieve a unified view of available energy carriers and is the basis for optimal management of the entire energy system.

It is necessary, therefore, to carry out a strong interconnection of energy systems, technologically characterized by their own energy carrier, both at the level of large-scale energy production and transmission and at the level of utilization and self-production.

Interconnection allows:

- an increase in renewable sources and a reduction in climate-altering emissions for the same energy use,

- greater security of energy availability for the end user

- greater capacity for demand management.

2. DOCUMENTING INTERCONNECTED ENERGY SYSTEMS

To better understand what interconnected energy systems are, students, gathered in cooperative groups, view the video, read the article, and later discuss the content.

What are interconnectors?

https://youtu.be/8VU5GjA6Q2Y

Renewable Energy Communities. A revolution toward sustainability

https://www.infosostenibile.it/notizia/comunita-energetiche-rinnovabili-una-rivoluzione-verso-la-sostenibilita

3. WEB RESEARCH

Divided into 5 cooperative groups, students search the web for information and insights on interconnected energy systems: Below are some links from reliable official sources

- Greater interconnection of the European electricity system

https://eur-lex.europa.eu/IT/legal-content/summary/greater-interconnection-of-europe-s-electricity-system.html

- Italy, the EU and an integrated sustainable development for energy in the Mediterranean area

https://www.enea.it/it/seguici/documenti/le-proposte/Mediterraneo.pdf

- Distributing energy at the right time: a new challenge for digital energy

https://asvis.it/notizie/929-2356/distribuire-energia-al-momento-giusto-una-nuova-sfida-per-il-digitale-energetico#

- Interconnecting: data solutions for the energy sector

https://digital-strategy.ec.europa.eu/en/news/interconnect-data-solutions-energy-sector

4. CASE ANALYSIS.

Example of an interconnected system: "Interconnected power grids in the Mediterranean region, the progress of the TEASIMED project" (Article from "Canale Energia" (https://www.canaleenergia.com)

The Association of Mediterranean Transmission System Operators (Med-TSO) has published the latest data on power generation in the region.

"The TEASIMED project, launched in 2020 by Med-TSO, aims to develop an interconnected and resilient power grid in the Mediterranean.

The latest analysis covered seven countries-Jordan, Turkey, Egypt, Morocco, Tunisia, Algeria, and Libya.

The area's generation capacity for 2022 is estimated to be 115 GW, and 128 GW in 2027.

The objective of the TEASIMED (Towards an efficient, adequate, sustainable and interconnected Mediterranean power system) project is to develop electricity infrastructure in the Mediterranean and to promote the integration and coordinated operation of networks. The initiative is coordinated by the association of Mediterranean transmission system operators, Med-TSO. Which recently published two seasonal reports (Summer Outlook 2022 and Winter Outlook 2022/2023) and, on February 22, also released forecasts for the near future (Mid-term Outlook 2025 & 2027).

The adequacy assessments

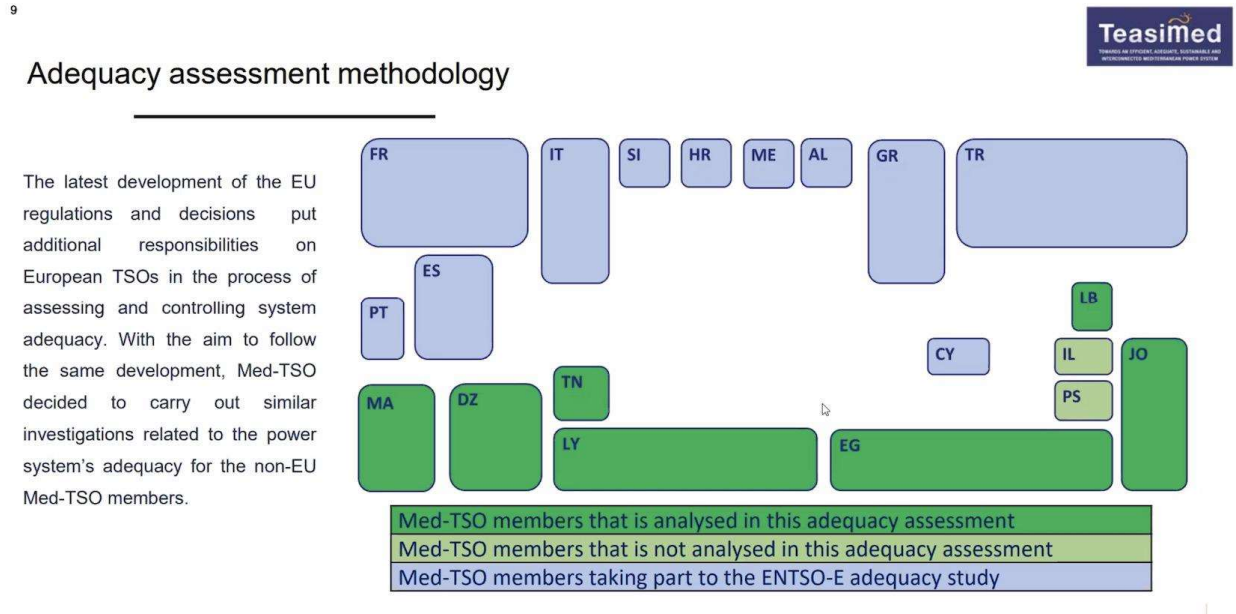
"We started drafting adequacy assessments, i.e., before the energy crisis, and we want to publish them on a regular basis. They represent an increasingly important tool with a view to increasing security of supply in the Mediterranean region." These are the words of Angelo Ferrante, secretary general of the Med-TSO.

The purpose of these assessments, explained project manager Simone Biondi, is to examine the countries in the region to see if they have sufficient capacity to handle peak energy demand, and how the interconnection of networks can make up for any shortfalls. To do this, climate data must be cross-referenced with data regarding unforeseen service disruptions so that a model can be built that can be used to analyze future scenarios.

The data for winter 2022-2023.

Ahmed El Shami, Power System Advisor at Med-TSO, showed some graphs for winter 2022-2023. Among the seven countries analyzed, Jordan and Turkey stand out with the lowest weekly consumption, while Egypt has the highest consumption. Demand is steady in Morocco and Tunisia, not so in Algeria and Libya.

Overall, the area's generating capacity for 2022 is estimated at 115 GW, of which 102 GW is in thermal units. Hydropower is present only in Algeria, Egypt, Morocco, and Lebanon. The countries that contribute most with wind and solar to the energy mix are Jordan and Morocco, whose plan is to increase the share of renewables in the electricity mix to 52 percent by 2030. The share of variable renewable energy (VRE) generation in the region is slightly above 8 percent, which is still too low. At the level of adequacy, significant problems are found in Lebanon, Libya and Morocco."



5. FINAL PRODUCT AND EVALUATION

Each group prepares a presentation that they show to the rest of the class.

Evaluation is done with specific evaluation rubrics.

6.4 INNOVATIVE TECHNOLOGIES AND MODERN INFRASTRUCTURE

CONTENT

1. INTRODUCTION
2. PRODUCTION AND WORK DOCUMENTS
3. SKILLS WORKED
4. GOALS TO REACH

1- INTRODUCTION

As a recap on renewable energy and its meaning, read this article and answer the following questions:

Renewable energy – powering a safer future | United Nations

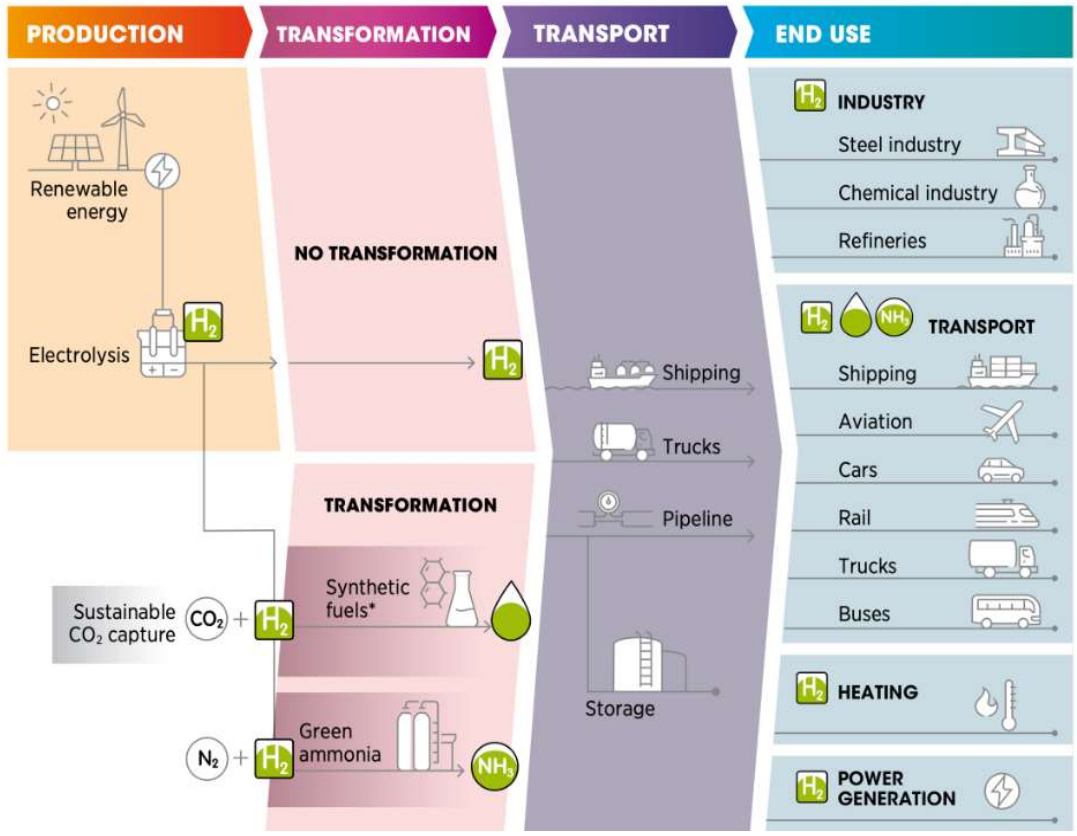
- Give four renewable energies that you know. How do they work?
- How is it important to use renewable energy today? Explain.

2- PRODUCTION and WORK DOCUMENTS

The class is divided in four groups. Each group will produce a mind map according to the questions given.

Group 1 – clean hydrogen in industrial innovation

Hydrogen is the most abundant material in the universe and produces close to zero greenhouse gas emissions when burnt.



Source : Green hydrogen production, conversion and end uses across the energy system Image IRENA

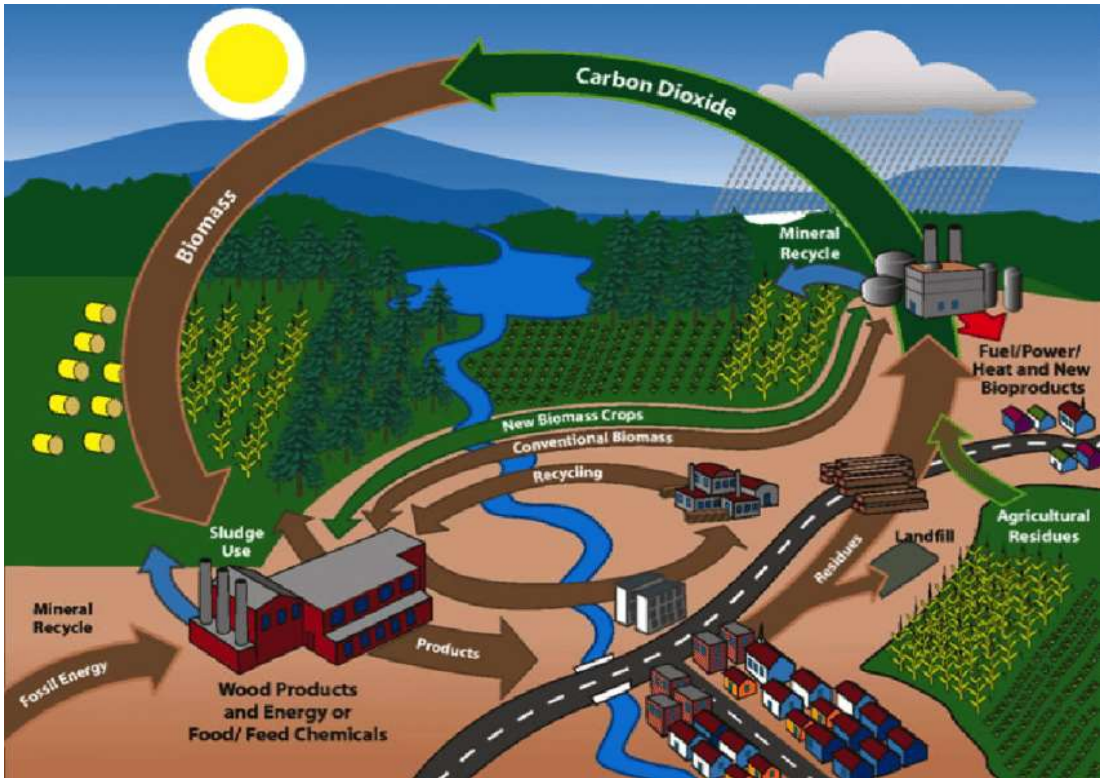
After doing some research on the internet, answer these questions through a mind map:

- What is clean hydrogen?
- Can green hydrogen be used in industrial processes?

Present your mind map to your classmates.

<u>Group 2 – bioenergy</u>

Energy derived from biomass or biofuel has the potential to generate far more of the power used by human society than it does today.



Source: 1. illustrates a large bioenergy system showing many of the key... | Download Scientific Diagram (researchgate.net)

After doing some research on the internet, answer these questions through a mind map:

- What is bioenergy and how does it work?
- What is the future of bioenergy?

Present your mind map to your classmates.

Group 3 – charging battery innovation

The development and production of batteries is essential for the clean energy transition as they are a key enabling technology for low-emission mobility, as well as for stationary energy storage. The transport sector is still responsible for 25% of global CO_2 emissions.

After doing some research on the internet, answer these questions through a mind map:

- What battery innovations could change the world?

- What are the most recent inventions in electric car charging?

Present your mind map to your classmates.

Group 4 – floating wind power

In order to understand the process, watch this video:

https://youtu.be/iMwcAstXyLM

After doing some research on the internet, answer these questions through a mind map:

- What is floating wind power?
- How do floating farms work?
- What are their advantages?

Present your mind map to your classmates.

3- SKILLS WORKED

- Reading and analysis of documents
- Work on the synthesis of documents
- Creation of a mind map
- Organization of the argumentation
- Oral presentation

4- GOALS TO REACH

- Understanding that innovation is part of a global energy optimization dynamic.
- Understanding that optimizing the energy needs involves several areas.

6.5 BOOST ENERGY EFFICIENCY AND ECO-DESIGN OF PRODUCTS

OBJECTIVES:

Students will learn about energy efficiency and renewable energy terms.

They will learn about the environmental benefits of efficient energy use.

They will learn about the concept of eco-design.

They will develop learning skills by designing and making ecological products.

INTRODUCTION SECTION

The lesson begins with a question, "Can you imagine spending three days without any energy sources?". Students are given 15 minutes to think and express their thoughts in a composition. After that, compositions are read aloud.

https://padlet.com/meltemgeveli/b-y-leyici-padlet-im-xmewwh48f8brl0ay

QUESTION: What is energy efficiency and how can it be achieved?

Energy efficiency is the use of less energy to perform the same task or achieve the same result. The decreasing availability of energy resources has made efficient energy use a necessity. Efforts to save energy include creating homes and buildings that are more energy-efficient, using less energy to heat, cool, and operate electronic devices, and establishing energy-efficient production facilities. Energy efficiency is also a crucial component in achieving net-zero carbon dioxide emissions through decarbonization.

DEVELOPMENT

QUESTION: What are the benefits of energy efficiency?

Energy efficiency provides cost savings, increases the resilience and reliability of the electricity grid, and provides environmental, societal, and health benefits.

At home, you can save on energy bills by making energy-efficient and weather-appropriate upgrades such as adding insulation that reduces energy usage and increases comfort, using LED lighting, and installing a heat pump.

https://www.energy.gov/eere/energy-efficiency#:~:text=Energy%20efficiency%20is%20the%20use,less%20energy%20to%20produce%20goods.

QUESTION: What is the relationship between clean energy, green energy, renewable energy, and energy efficiency?

Clean energy can be defined as energy obtained from renewable and zero-emission sources such as bioenergy, solar energy, geothermal energy, hydropower, ocean energy, wind energy, etc. It refers to a series of environmentally friendly energy options that are mostly derived from renewable, low-emission sources.

Today, countries are embracing clean energy technologies and infrastructure, investing in renewable energy sources, and prioritizing energy efficiency practices to accelerate the transition to an affordable, reliable, and sustainable energy system. Clean energy is one of the most effective ways to combat climate change.

Clean energy can be defined as energy obtained from renewable and zero-emission sources that do not pollute the air, cause greenhouse gas emissions, or harm nature. On the other hand, green energy is energy that is obtained from natural sources. Meanwhile, renewable energy can be defined as energy produced from sources that are continuously renewed and never depleted.

Source;

https://www.bestforenergy.org/temizenerjii1845#:~:text=Temiz%20enerji%2C%20yenilenebilir%20ve%20s%C4%B1f%C4%B1r,dostu%20enerji%20se%C3%A7enekleri%20dizisini%20ifade

The Clean Energy Package for All Europeans was adopted in 2019 and included decisions to help decarbonize the EU's energy system in line with the goals of the European Green Deal.

ACTIVITY;

VIDEOS ABOUT CLEAN ENERGY ARE WATCHED

Why Clean Energy?https://youtu.be/U8HfJX6DZ88

Clean Energy in the World and in Turkey: https://youtu.be/1V9jJe8mWK8

The Clean Energy Transition:https://youtu.be/dffw4Aj1ZQ0

Renewable Energy:https://youtu.be/1kUE0BZtTRc

Seven Types of Renewable Energy:**https://youtu.be/44Wp3WE1AHs**

GREEN ENERGY :https://youtu.be/Ms--0d7Oh0s

Energy Efficient Buildings | CleanPower:https://youtu.be/ys07tEScaSo

How do solar panels work? https://youtu.be/xKxrkht7CpY

How do Wind Turbines work?https://youtu.be/qSWm_nprfqE

Energy Conservation:https://youtu.be/KlG0xk93J-E

Create A Model For School Project (Working Model)Watering using Solar Power

Our students can watch these videos and use them in their own activities.

https://youtu.be/EMU9VSweJzc

Question: What is eco-design and why is it needed?

The increasing world population and the rapid depletion of the resources needed by the population due to consumption and various disasters have become a problem that limits the living conditions of all living things. Humans are taking action against this important problem and the use of environmentally friendly products and services is becoming more widespread every day, and regulations related to this issue are becoming increasingly important.

Eco-design is an approach aimed at designing a product while taking into account its environmental impacts throughout its life cycle. When we talk about the life cycle of a product, we generally refer to the processes of supply, production, use, and disposal. Eco-design has adopted criteria such as resource efficiency, environmentally preferred materials, efficiency in use, design for disassembly and recycling, durability and longevity.

QUESTION: Why is the design phase important?

ANSWER: Approximately 80% of the environmental impacts associated with a product can be determined during the design phase. Additionally, thinking towards the source of the problem can result in time, cost, and energy savings.

In the past, the environmental impacts of products were not considered during the design phase. The typical criteria considered in product design were functionality, quality, price, ergonomics, aesthetics, and reliability. The relationship between products and the environment during their life cycle was not examined, raw material acquisition and use stages were not questioned, and post-use was not addressed.

The first steps in eco-design were taken in the late 1980s in the United States and Europe, in parallel with the environmental movement. In the early 1990s, following a study in eight different sectors in the Netherlands, including furniture, automotive, and packaging, Delft University of Technology published the first eco-design guide, named "Pro-mise." Throughout

this process, numerous regulations emerged, ranging from waste management to water pollution, carbon emissions, and fuel efficiency. In the 2000s, the issue of climate change brought the importance of energy efficiency to the forefront. In order to reduce energy-related CO2 emissions and contribute to sustainable development, the EU, which aims to meet its energy efficiency goals and respond to rising demand worldwide, published the Eco-Design directive in 2009.

Eco-design requires guide strategies to reduce the environmental impact that can arise from a newly designed product or the redesign of an existing product. When determining these strategies, it is crucial to consider sustainability aspects ranging from the primary function of the product to the impact of the service it provides.

Source:https://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:285:0010:0035:en:PDF

		No	Eco-design strategies
PRODUCT	USAGE	1	Providing information about resource consumption during the use phase
		2	Material labeling - instructions/descriptions for disposal of the product
	END-OF-LIFE	3	Ease of disassembly - easy separation of product parts
		4	Adding instructions/descriptions for users on how to dispose of the product
	LIFE SPAN	5	Ease of maintenance and repair
		6	Ease of performance improvement
		7	*Environmentally friendly surface design*
		8	*Integration of operations*
		9	Standardization of parts

EQUIPMENT	USAGE	10	Avoidance/reduction of toxic materials
		11	Minimization of materials during usage
		12	Reduction of input materials
		13	Reduction of material diversity and number of parts
		14	Use of refurbished parts
		15	Use of low-energy materials
		16	Use of recyclable materials
		17	Use of recycled materials
		18	Use of renewable materials
	END-OF-LIFE	19	Minimization of waste and emissions to the environment
		20	Waste recycling/reuse
	PACKAGING	21	Optimization of packaging weight/volume
		22	Use of reusable packaging
ENERGY	USAGE	23	Minimization of energy consumption during usage
		24	*Reduction of energy consumption during production*
		25	Use of renewable energy sources

Assessment: Students present their researched eco-design products.

Verpackungszentrum Graz

VPZ (Verpackungszentrum) Graz is a wholesale packaging company founded in 1989. In order to make an effective contribution to the future, VPZ specializes in biogenic packaging and has invested in Research & Development projects for biogenic materials since 1992.

Currently, VPZ is involved in three research projects in collaboration with Graz University of Technology. These projects focus on the production of foam from seaweed for packaging, the development of polymers from agricultural waste, and the production of biopolymers from natural fibers for packaging.

Elvis & Kresse

Elvis & Kresse creates a range of lifestyle accessories by utilizing materials that would otherwise go to landfill. Their first priority product category uses decommissioned fire hoses from UK Fire Brigades. Many of the materials are sourced from old office furniture fabrics, torn sail cloths, and discarded parachute fabrics. The company has a strong environmental philosophy that is woven into their business practices, and all of their packaging is made from recycled materials, including tea sacks, tea bag papers, coffee sacks, air traffic control tapes, shoe boxes, old newspapers, and used express mail bags.

Ecover offers a wide range of cleaning and laundry products, all based on pioneering and eco-friendly principles. Their sustainability vision takes into account the ecological, economic, and social aspects from the source of raw materials to the complete biodegradation of final products.

Gourd packaging

This prototype concept demonstrates how packaging can be made from renewable materials such as gourds. Gourds are a type of fruit that were traditionally used as containers, but they have been adapted for use in the modern cosmetics industry by growing them in rectangular molds for easier transportation. They are grown in molds, harvested, and dried. Gourds are suitable for use in bath oils, soap bars, and bath salts.

Boxes made from citrus peels

The shells are soaked in water for a few hours, then pressed onto a mold to form the shape of the box. The molds are left to dry in the sun for the next three days, then removed and polished. The box remains sturdy for years and the scent lasts for 3 to 4 years. The fragrance can be renewed with a drop of orange or lemon essential oil.

For more information: http://www.c2cn.eu/gph/verpackungszentrum-graz

http://www.c2cn.eu/gph/elvis-kresse

http://www.c2cn.eu/gph/ecover-ecological-cleaning-products-green-packaging

http://ecodesign.Ibooro.ec.uk/index.php?section=129&currentsubsection

http://www.bethgehamburg.de

http://www.re-f-use.com/view_product.php?id=5006&action=next

Student Work Video :

https://youtu.be/LhHZZEE31tk

VII. SUSTAINABLE AGRICULTURE

7.1 MEANING AND IMPORTANCE OF SUSTAINABLE AGRICULTURE

Grade: High school

DESIRED RESULTS
Established Goals (Standards, Performance Indicators, Learning Goals): **1.** They know the essence of the concept of sustainable agriculture. 2.Know the EU's policies in the field of sustainable agriculture. 3.Integration of the topic in order to fully comprehend. 4.Expanding knowledge and strengthening skills on the topic.

Understandings:	**Essential Question:**
1. Understand the basic ideas and principles of sustainable agriculture. 2. Understand the importance of sustainable agriculture in protecting the environment and maintaining ecological balance.	What is sustainable agriculture?
Students will know: 1. They know what sustainable agriculture is. 2. They know the concept of sustainable agriculture.	**Students will be able to do:** 1 Recognize sustainable agriculture from conventional farming methods. 2. List activities related to sustainable agriculture that contribute to the protection of the environment and biodiversity.

EVIDENCE/ASSESSMENTS: Доказателства

Performance Task:

Representative task - the form of presentation of the project result at the end – Presentation

Goal: The main objective of this lesson is for students to learn about the concept of sustainable agriculture, to understand its importance and importance, as well as to get acquainted with European Union (EU) policies in the field of sustainable agriculture.

Role:

The class is divided into 4 groups. Each member of a particular group has a role that goes with specific tasks. Each group will complete its worksheet, which will help to gather the necessary information for good practice for sustainable agriculture.

Product:

Detailed description of a good practice for sustainable agriculture.

Other Evidence/Assessments:

1. Worksheet
2. Mobile device and Internet
3. Talk on "Basic principles of sustainable agriculture"
4. Cooperative learning

LEARNING PLAN

Learning Activities:

1. Getting to know the project
2. Divide the class into groups and define the role in the group
3. Give away a worksheet
4. Students are divided into groups, working with the materials they have received to complete their worksheet. Upon completion of the cooperative work, the results will be presented, discussed and supplemented if necessary. At the end there will be a short talk on "Basic Principles of Sustainable Agriculture"
5. Presentation of the final product

Part One

Introduction to the subject:

Sustainable agriculture is an important topic that concerns food security and the conservation of natural resources for future generations. One way to develop sustainable agriculture is by adopting policies and stimulating people involved in agriculture. The topic of the lesson is presented and the concept of "sustainable agriculture" is clarified.

Part Two

Sustainable agriculture in the EU

For the purpose of the project, the class is divided into 4 working groups.

First group

https://www.consilium.europa.eu/bg/policies/cap-introduction/

1.What is the Common Agricultural Policy (CAP)?

2.Why is support for EU farms important?

3.How does the CAP work?

Group Two

Environmental Sustainability

https://agriculture.ec.europa.eu/sustainability/environmental-sustainability_bg

After getting acquainted with the information from the link, students write down the

answers in their worksheet to the following questions:

1.What are the main objectives for environmental sustainability in the Common Agricultural Policy (CAP) reflected in the European Green Deal?

2.What are the measures that promote ecological farming and impose environmental protection rules?

3.What are the activities that unlock the potential of agriculture to combat climate change?
4.What are the natural resource conservation activities essential for agriculture?

5.How does the CAP help to improve ecological diversity?

6.How does the CAP help reduce the use of pesticides, fertilisers and antibiotics in EU agriculture?

Third group

Social sustainability

https://agriculture.ec.europa.eu/sustainability/socially-sustainable-cap_bg

1. With what actions does the CAP promote agriculture to meet society's needs for the production of safe and sustainable food?
2. How does the CAP help to increase sustainability in agricultural communities?

Group Four

Economic Sustainability

https://agriculture.ec.europa.eu/sustainability/economic-sustainability_bg

1. With the help of what can the CAP achieve economic sustainability in the sphere of agricultural tourism?
2. Do changes in the environment have economic consequences? If your answer is yes, give an example.
3. What economic measures and practices can be applied to sustainable agriculture?

7.2 SOCIAL SUSTAINABILITY

SCHOOL: ITES Vitale Giordano, Bitonto - ITALY

Students: 2nd class (20 students)

Time required for the activity: 5 hours

EXPECTED RESULTS

- To raise awareness of social, agricultural and food sustainability issues in order to adopt healthy lifestyles, developing the ability to make informed choices.

OBJECTIVES

- Understand social sustainability issues in relation to the first 5 goals of the 2030 Agenda
- Reflect on the importance of taking responsibility in relation to global issues
- To develop problem solving skills through group dynamics To reflect on the need to take personal action on social sustainability issues.

PREREQUISITES

- Know the meaning of 'sustainable development'.
- Know the aims of the 2030 Agenda.

METHODOLOGY

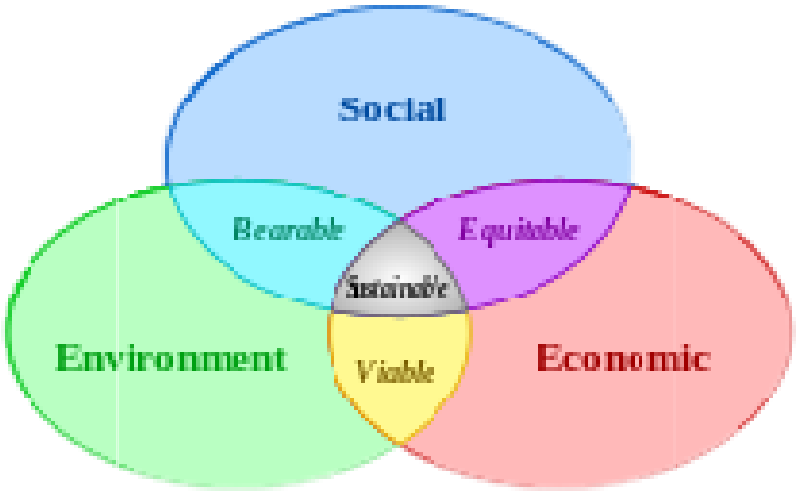
- Group work: cooperative learning in classroom 3.0 (each student has his or her own iPad).

INTRODUCTION

A) Sustainable development

Sustainable development consists of three basic dimensions: economic, environmental and social.

- Economic dimension: is understood as the ability to generate income and employment to sustain the population;
- Social dimension: it consists of the capacity to guarantee conditions of human well-being (security, health, education, democracy, participation, justice) equally distributed without any discrimination (gender, social class, age, disability, etc.);
- - Environmental dimension: coincides with the capacity to maintain d reproducibility of natural resources.



What is social sustainability?

The concept of sustainable development has three thematic pillars: environmental, economic and social. However, the latter has only recently been considered in an integrated manner with sustainability. The reason lies in the fact that the profound realisation of the principles of social sustainability implies profound changes in the power relations between people and in our economic system. On the other hand, the concept of social sustainability also derives from the well-known definition of sustainable development elaborated in the Brundtland Report (also known as the 'Our Common Future' Report) of 1987: 'Development that meets the needs of the present generation without compromising the ability of future generations to do the same'.

Indeed, economic and environmental issues have a very close link with social ones. Just think of some current social sustainability issues and how they are linked to economic and environmental imbalances. For example, in the so-called developing countries, the effects of climate change imply survival problems for populations due to food insecurity or rising seas that eliminate liveable territory. Dramatic situations that drive individuals belonging to these populations to forced migration. In a different way, in so-called developed countries, social sustainability issues are linked to growing inequality between generations and the fight against poverty or racial and gender discrimination.

The 2030 Agenda, signed in 2015 by 193 UN countries, including Italy, is based on five key concepts, represented by five 'P's:

1) People

2) Prosperity

3) Peace

4) Partnership

5) Planet.

All 17 goals cut across the themes of the 5 pillars.

B) The Agenda and society

Among the priorities of the 2030 Agenda are the social goals, which form the foundation on which the entire sustainable development agenda rests. Poverty (Goal 1), hunger (Goal 2), health (Goal 3), education (Goal 4) and gender equality (Goal 5) are in fact the key issues for achieving real 'global well-being'. Not by chance, they are the first five goals of the Agenda. The social dimension is the litmus test of human development. In fact, the degree of well-being of a community, be it large or small, is not only an economic issue, but involves the affirmation of rights in the areas of food security, health, culture, and gender equality**.**

READING THE DOCUMENTS:

- **Agriculture and rural development. La PAC e la sostenibilità sociale nell'UE**
  https://agriculture.ec.europa.eu/sustainability/socially-sustainable-cap_it#capandsocialsustainability
- **Social Development for Sustainable Development**
  https://www.un.org/development/desa/dspd/2030agenda-sdgs.html#:~:text=2030%20Agenda%20seeks%20to%20strengthen,national%2C%20regional%20and%20global%20levels.
- **The Sustainable Development Goals Report 2022**
  https://unstats.un.org/sdgs/report/2022/The-Sustainable-Development-Goals-Report-2022.pdf

WORK IN GROUPS: students work in cooperative groups. At the end, each group reports on their work and prepares 1 summary infographic, poster format, made with Canva. The posters will then be used to create a small exhibition in the school hall.

Group A_GOAL 1: Poverty

Video:

https://youtu.be/kkDWf8gC2wk

Goal 1: End poverty in all its forms everywhere

https://www.un.org/sustainabledevelopment/poverty/

Group B_GOAL 2: Hunger

Video:

https://youtu.be/zv_Lr_rs9Ew

Goal 2: Zero Hunger

https://www.un.org/sustainabledevelopment/hunger/

Group C_ GOAL 3: Health

Video:

https://youtu.be/yZOwyi9Ekxs

Goal 3: Ensure healthy lives and promote well-being for all at all ages

https://www.un.org/sustainabledevelopment/health/

Group D_ GOAL 4: Education

Video:

https://youtu.be/3athxBxZPxg

Goal 4: Providing quality education

https://www.un.org/sustainabledevelopment/education/

Group E_GOAL 5: Gender equality

Video:

https://youtu.be/K6AHSbNMfck

Goal 5: Achieve gender equality and empower all women and girls

https://www.un.org/sustainabledevelopment/gender-equality/

At the end of the activities, all students will review the document http://www.youneedtoknow.ch

("170 small gestures to change the world") and create a list of small gestures of social sustainability to be disseminated among the school's students.

7.3 ENVIRONMENTAL STABILITY

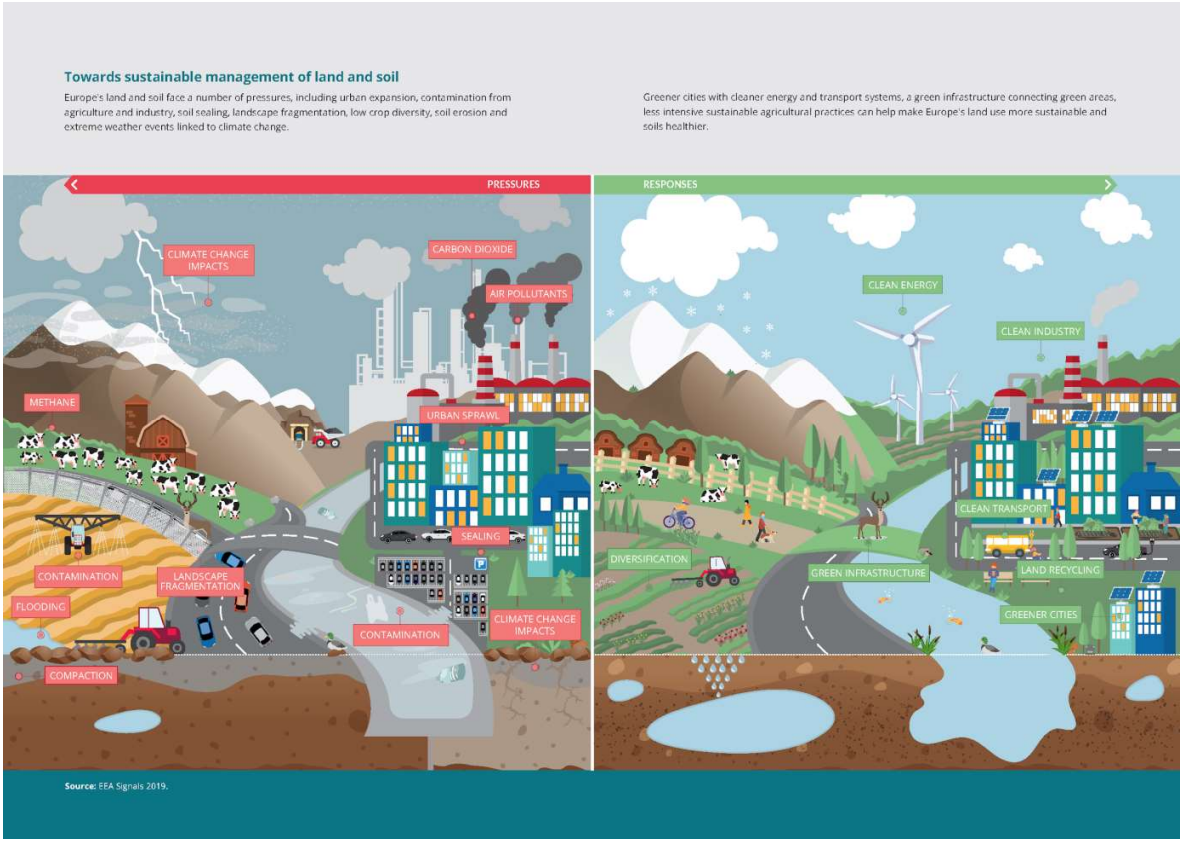
SCHOOL: ADİLE MERMERCİ ANATOLIAN HIGH SCHOOL- TURKEY

Achievements:

They learn the environmental effects of agricultural methods applied by countries with different levels of development.

They learn the aims and environmental effects of sustainable agriculture.

They learn sustainable farming methods.



Source: https://www.eea.europa.eu/signals/signals-2019-content-list/infographics/towards-sustainable-management-of-land/view

INTRODUCTION

The class is divided into two groups; The first group discusses the agricultural methods applied in the underdeveloped countries, the second group discusses the agricultural methods applied in the developed countries and their environmental effects.

Students watch this video.https://youtu.be/WoKO9KSKxzY

Todd Mayhew–Sustainable Agriculture Production

Agriculture, the practice of raising plants and animals, has a history dating back thousands of years. From the beginning of hunter/gatherer societies to the major changes in manufacturing brought about by the industrial revolution, agriculture has continued to be a critical part of human survival.

But for many, many years we have been operating based on industrial agriculture. Industrial agriculture prioritizes large-scale factories and uses agricultural practices that degrade our water, soil, air and environment as a whole.

Recognizing the negative effects of agricultural production is critical to minimizing undesirable Environmental consequences.

Agriculture can cause soil degradation and ecosystem degradation. However, in many countries agriculture is also the leading source of pollution. The livestock sector alone contributes to 18% of all greenhouse gas production worldwide. In addition, toxic chemicals used on farms are pollutants; Pesticides and fertilizers can poison the surrounding air, soil and water, and their effects persist for generations.

Some farmers use gasoline-powered machines; or they burn their fields to prepare for planting a new crop. Both of these farming practices contribute to greenhouse gas emissions.

Growing plants or keeping livestock requires a lot of water. Today, 69% of the planet's fresh water is used for agriculture. Fresh water is a limited resource and more creative water conservation measures or
Without innovative irrigation methods, agriculture will continue to consume excessive amounts of water while disrupting freshwater systems around the world.

PROGRESS

QUESTION: So how can we make agriculture more environmentally friendly?

By making it sustainable.

The following videos on the subject are watched.https://www.youtube.com/watch?v=iloAQmroRK0&list=PLWlltQ6Oy0zpgxVhd2vZqTDvVXpPhSVd0

What is Sustainable Agriculture? Episode 1: A Whole-Farm Approach to Sustainability

https://www.youtube.com/watch?v=PrQ_wu67ItM&list=PLWlltQ6Oy0zpgxVhd2vZqTDvVXpPhSVd0&index=2

What is Sustainable Agriculture? Episode 2: Cover Crops and Soil Health

https://www.youtube.com/watch?v=eCPkMWzkgvc&list=PLWlltQ6Oy0zpgxVhd2vZqTDvVXpPhSVd0&index=3

What is Sustainable Agriculture? Episode 3: Conservation Tillage and Soil Health

https://www.youtube.com/watch?v=6896Nwydzg0&list=PLWlltQ6Oy0zpgxVhd2vZqTDvVXpPhSVd0&index=4

What is Sustainable Agriculture? Episode 4: Social Sustainability

https://www.youtube.com/watch?v=iWJek3LuE6c&list=PLWlltQ6Oy0zpgxVhd2vZqTDvVXpPhSVd0&index=5

What is Sustainable Agriculture? Episode 5: Ecological Pest Management

https://www.youtube.com/watch?v=sZeKNWNSM3I&list=PLWlltQ6Oy0zpgxVhd2vZqTDvVXpPhSVd0&index=6

What is Sustainable Agriculture? Episode 6: Sustainable Grazing

What is Sustainable Agriculture?

Sustainability is based on the principle that we must meet the needs of the present without adversely affecting the ability of future generations to meet their own needs. Agricultural sustainability takes this one step further: good management of natural systems and resources to reduce damage and improve environmental stability.

Sustainable agriculture is the rejection of the industrial approach to food production and the integration of environmental health, economic profitability and social equity.

For agriculture to be truly sustainable, it must include the following principles:

People's needs: to provide nutrient-rich food for farmers, farm families, communities, to help protect public health, but also to improve quality of life in rural areas.

Profit: A farming operation must be profitable, otherwise it will go out of business quickly.

Planet and environment: agricultural practices must be ecologically sound, promoting healthy biodiversity and judicious management of natural resources.

Sustainable agriculture seeks to help the environment by:

Maintaining healthy soil

To manage water wisely, to prevent pollution of lakes and rivers,

Reducing food waste

Minimizing air, water and climate pollution

Promoting biodiversity

Improving the quality of life for farm families and communities

Maintaining soil fertility naturally by recycling nutrients on the farm

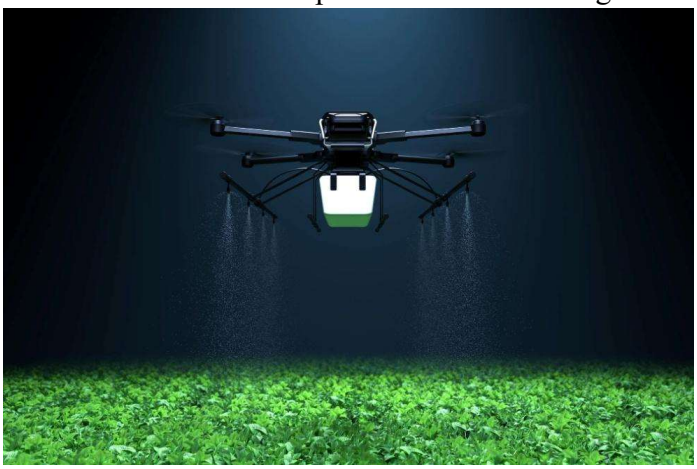
Promoting energy efficiency in agricultural activities

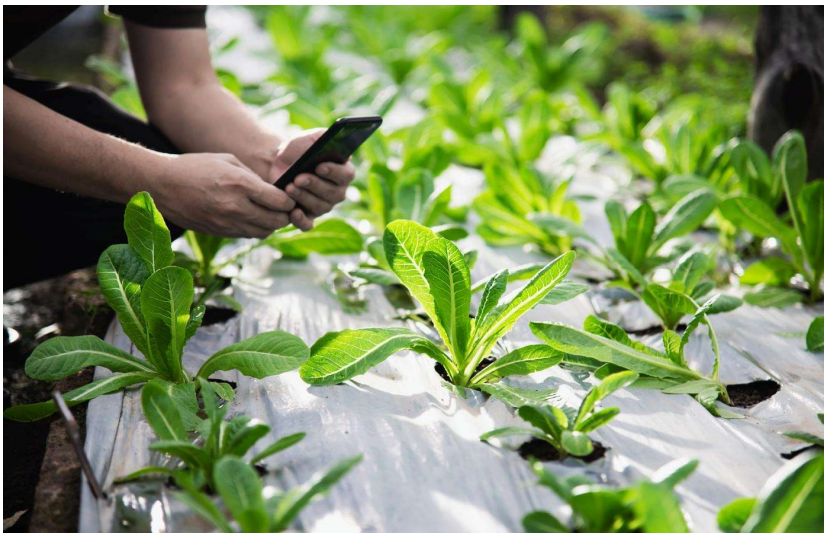
Reducing air pollutants and greenhouse gas emissions

Creating habitats for pollinators and beneficial insects

Ensuring the welfare of farm animals, as well as providing space to respectfully coexist with native wildlife.

As we navigate today's critical climate crisis, it is our responsibility to put ethical, green farming practices to work. Examples of sustainable agriculture include:
permaculture
biodynamic agriculture
hydroponic and aquaponic
urban agriculture
agroforestry
polycultures
Crop rotation
natural animal breeding
natural pest management
heirloom growth
EVALUATION
Students research examples of sustainable agriculture and prepare a presentation about it.





7.4 ECONOMIC STABILITY

CONTENT

1- Introduction

Agriculture “refers to all work aimed at the production of plants and animals useful” to humans “for food, health care, clothing or to help them in their various activities” (Raymond, 2018). Agriculture includes animal husbandry.

Healthy, sustainable and inclusive food systems help achieve global development goals.

- The development of agriculture makes it possible to put an end to extreme poverty, to strengthen the distribution of wealth and to feed the 9.7 billion people that the planet will have in 2050. Compared to other sectors, the growth of the Agriculture has two to four times more effective effects on increasing the income of the poorest populations.
- Agriculture is a key driver of economic growth: in 2018, it accounted for 4% of global gross domestic product (GDP) and, in some least developed developing countries, its share can exceed 25% of GDP.

Several factors threaten agriculture's ability to drive growth, reduce poverty and improve food security. The proliferation of conflicts, the acceleration of climate change increases malnutrition (10% of the world's population in 2020), pollution.

Several areas of reflection are now proposed: fighting against food waste, the exploitation of resources such as water, forests are urgent areas of reflection. Changes in agricultural production systems, land allocation in order to create the conditions to reduce poverty and achieve green, resilient and inclusive development.

2- Presentation to students

Read and write a definition of terms:

- "economic development: http://geoconfluences.ens-lyon.fr/glossaire/developpement-economique
- “resilient: http://geoconfluences.ens-lyon.fr/glossaire/resilience
- “inclusive“: http://geoconfluences.ens-lyon.fr/glossaire/developpement-economique

3- Work documents

GROUP 1: Different transformation proposals on the FAO website (Food and Agriculture Organization of the United Nations: https://www.fao.org/search/fr/?cx=018170620143701104933%3Aqq82jsfba7w&q=transformation +food+systems&cof=FORID%3A9

GROUP 2: Eating in Nuuk (Greenland), between traditional practices, food transition and security of supply

http://geoconfluences.ens-lyon.fr/information-scientific/dossiers-regionaux/Arctic/articles-scientific/food-groenland

4- Final products

GROUP 1

In the form of a mind map, identify the answers to the following question: What can be done to transform global food systems?

GROUP 2

In the form of a mind map, identify the answers to the following question: From the example given, what are the characteristics and advantages of a green, resilient and inclusive development?

GROUPS 1 + 2

On the basis of the documents provided, from the mental maps, your research and personal reflections, write an oral presentation

5- Skills developed

- Reading and analysis of documents
- Work and synthesis of documents
- Create a mind map
- Make assumptions and organize the argument
- Oral expression

6- Goals to reach

- Understand the complexity of the actors and issues to address the issue.
- Achieving a necessary balance between agricultural production, consumption of global societies and environmental needs
- Understand that achieving this balance requires international and global cooperation and the implementation of compromises.

7.5MODERNIZING AGRICULTURE

Introduction

As the world faces the pressing challenges of climate change and environmental degradation, sustainable and modern agriculture emerges as a pivotal solution towards a greener future. Europe, at the forefront of this global shift, has placed sustainability at the heart of its agenda with the European Green Deal. This ambitious framework aims to transform the European Union (EU) into a climate-neutral continent by 2050, revolutionizing various sectors, including agriculture. By combining innovative technologies, ecological practices, and policy reforms, sustainable and modern agriculture holds the potential to secure food production while minimizing its environmental footprint.

1. Enhancing Resource Efficiency: Sustainable agriculture emphasizes optimizing resource utilization while reducing waste. The European Green Deal fosters the adoption of precision farming techniques, leveraging advancements in digital technologies and data analytics. Smart farming solutions, such as precision irrigation, automated pest management, and drone-assisted monitoring, enable farmers to make informed decisions, conserving water, energy, and fertilizers. By maximizing resource efficiency, agriculture can minimize its impact on natural resources and contribute to a circular economy.

2. Promoting Biodiversity and Ecosystem Health: Preserving biodiversity and ensuring the health of ecosystems are integral components of sustainable agriculture. The European Green Deal aims to promote agroecological practices that enhance biodiversity and restore degraded landscapes. By reducing chemical inputs, implementing crop rotation, and creating ecological focus areas, farmers can nurture beneficial insects, improve soil health, and support pollinators. These efforts not only bolster resilience against climate change but also foster sustainable food production systems.

3. Reducing Emissions and Enhancing Carbon Sequestration: Agriculture is a significant contributor to greenhouse gas emissions. However, sustainable practices can mitigate these emissions and contribute to carbon sequestration. The European Green Deal encourages farmers to adopt climate-smart techniques such as agroforestry, cover

cropping, and organic farming. These practices promote carbon sequestration in agricultural soils and reduce reliance on synthetic fertilizers, thereby curbing emissions and improving overall soil health.

4. Strengthening Local and Organic Food Systems: The European Green Deal emphasizes the development of local and organic food systems. By supporting shorter supply chains and promoting organic farming, the EU aims to reduce the environmental impact of food production, enhance food security, and foster sustainable rural development. These initiatives encourage consumers to make informed choices, supporting local farmers and reducing the carbon footprint associated with long-distance food transportation.

5. Iceland: Iceland is commonly thought of as a land ill-suited to agriculture and for centuries the main emphasis has been on meat and dairy. Raising sheep (the traditional mainstay for generation of Icelandic farmers), and cattle make up the majority of livestock while pigs and poultry are also raised. Iceland is self-sufficient in the production of meat, dairy products, and eggs. Despite the richness of the volcanic soil on the island, only 1% of the land can be used for traditional agriculture. And yet, Iceland produces over half of all the vegetable produce consumed in the country each year, and it does so with 100% renewable energy. How is this case? Icelandic farmers rely on greenhouse farming, which is heated and powered by readily available geothermal energy. They grow 100% organic vegetables, meaning there is no use of chemicals or pesticides during the growth process. The farmers will even introduce insects into their greenhouses to manage pests naturally. This creativity has shown that green agricultural practices can be applied anywhere in the world.

Ensuring Resilience and Adaptation: Climate change poses significant challenges to agricultural productivity. Sustainable and modern agriculture can enhance resilience and adaptation capacities. The European Green Deal supports the development and implementation of climate services, providing farmers with accurate and timely information on weather patterns, pests, and diseases. By utilizing climate-resilient crop varieties, diversifying agricultural systems, and integrating agroforestry, European farmers can better adapt to changing climatic conditions.

Since only 1% of Iceland's land is suitable for agriculture, farmers have had to get creative over the years. According to the National Energy Authority of Iceland, "heating greenhouses using geothermal energy began in Iceland in 1924." These greenhouses have created a boom of success for the Icelandic agriculture industry, providing locals with fresh, sustainable produce such as tomatoes, bell peppers, cucumbers, bananas, and more. While the main focus of these greenhouses is on vegetables, they also produce many flowers, herbs, and other plants, covering a wide range of Iceland's agricultural needs.

Teaching methods:

There are several approaches to the teaching of this topic.

- Divide into groups and have each group study a particular topic such as growing of vegetables, growing meat more sustainably, the effects of using pesticides and chemicals in agriculture etc.

- Visit an agricultural education unit and some farms that emphasise sustainability.
- Have the students present a topic they choose or write articles, create a video or a podcast or design a poster.

Conclusion:

Sustainable and modern agriculture, in alignment with the European Green Deal, is a vital step towards a greener and more resilient future. By embracing innovative technologies, ecological practices, and policy reforms, Europe can transform its agricultural sector into a sustainable powerhouse, ensuring food security, reducing environmental impact, and contributing to global climate goals. The transition to sustainable agriculture requires collaboration among policymakers, farmers, researchers, and consumers to build a resilient, inclusive, and environmentally conscious food system for generations to come.

The Environmental Performance Index (EPI) ranks all countries in regards to "which countries are doing best against the array of environmental pressures that every nation faces," and the 2018 EPI puts Iceland in 11th place, making it a world leader in environmental protection. With their green agriculture industry continuing to grow and flourish, they may soon be making their way further up that list. Even in what seems like a challenging environment, Iceland upholds green standards and makes sustainability a priority. As global warming and food scarcity pose serious threats to the world, Iceland's successful green agriculture movement illustrates the massive potential of sustainable farming across the world.

VIII. FROM FARM TO FORK

8.1 STRATEGY FROM FARM TO FORK

Grade: Secondary school students – UPPER COURSE

DESIRED RESULTS
Objectives set (standards, performance indicators, learning objectives): Purpose of the lesson: The aim of this lesson is to introduce students to the concept of "From farm to fork") as part of European Union (EU) policies related to the sustainability and quality of food products. Students will understand the importance of responsible production of ecologically clean food and will be encouraged to develop projects for group work related to this topic

Understanding: 20 min.	**Essential question: 10min.**
1. EU policies for a sustainable food chain A. Explain how the European Union (EU) works to ensure sustainability and quality in the food chain. B. Present the main EU policies related to the food chain: 1. The EU's 'Farm to Fork' strategy and its objectives. 2. Food safety regulations and standards. 3. Programmes for the promotion of sustainable agriculture and organic farming. 4. Investments in research and innovation in	1. What do you think "From farm to fork" means? 2. Why is it important to know what happens to food from the moment of production to consumption? 3. Do you have an appetite for change?

agriculture and food industry.	
Students will know: 1. The concept of sustainability in EU crop and animal production. 2. What are the sustainability and quality criteria in the food chain. 3. They will be familiar with the objectives, the actions of the concept of sustainable production of agricultural products. III. Significance of a sustainable food chain (15 minutes) A. Discuss with students the advantages and challenges of a sustainable food chain. B. Provide data and facts to support the importance of sustainable food production and consumption of quality products: 1. Reduce the use of pesticides and chemicals in agriculture. 2. Strengthening environmental protection and biodiversity. 3. Improving the health and well-being of consumers.	**Students will be able to do:** 1. They explain the concept of "From farm to fork" and the importance of the sustainable food chain for our daily lives. 2. Identify key aspects of a sustainable food chain, including health and food safety, environmental impact and social responsibility. 3. Discuss European Union policies related to the sustainable food chain and their contribution to the protection of the environment and biodiversity. 4. Identify the benefits of a sustainable food chain and the role of local producers in achieving sustainability. 5. They recognise the interconnectedness between the sustainable food chain and environmental sustainability, including impacts on soil, water and climate.

EVIDENCE/ESTIMATES:

Task to be carried out**:**

Projects for work in groups (15 minutes)

A. Divide students into groups of 4-5 people.

B. Each group should select one sustainable food chain project to be implemented.

C. Project themes:

1. Creating an information campaign to support sustainable agriculture in our country.

2. Food Production Survey: Presentation of data and statistics on food production, methods of sustainable agriculture, changes in agriculture and policies aimed at protecting the environment. The project may include the development of a regenerative farming plan or the promotion of organic farming.

4. Promoting sustainable food supply: Research on methods to optimise transport routes, reduce waste and carbon footprint in the food supply chain. The project may include the development of a promotion plan for local producers and the promotion of the use of public transport or bicycles for delivery.

5. Food consumption: Research into the problems associated with food waste, the impact of food surplus on the environment and opportunities to reduce food release. The project may include the development of a campaign to inform and educate people about the proper storage and use of food products.

6. Building partnerships: Exploring opportunities to collaborate with grassroots organisations, schools, farmers and food suppliers to promote a sustainable food system. The project may include planning events such as farmers' markets, lectures and workshops to exchange knowledge and experience.

Other materials and activities/evaluations:

1. Mobile device and Internet
2. Talk on "From farm to fork."
3. Cooperative training
4. Game "Sustainability and Products" - Make a list of different food products, including healthy and environmentally friendly options, as well as products that are affected by environmental problems. Divide students into groups and give them the list of products. Each team must justify their choice of sustainable and unsustainable products and offer alternatives to reduce the negative impact on the environment.

TRAINING PLAN

Learning activities:

1. Familiarity with the project.
2. Divide the class into groups and determine the role in the group.
3. Presentation of the final products.

Introduction to the topic:

https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy_en#documents

https://www.consilium.europa.eu/bg/policies/from-farm-to-fork/

https://food.ec.europa.eu/plants/pesticides/sustainable-use-pesticides/farm-fork-targets-progress_en

"From farm to fork" is an expression that describes the overall path of food products from their production on farms to their consumption by us, consumers. This includes all stages of the food chain, including plant and animal breeding, production, processing, transport, distribution

and final sale of food.

The main idea behind From Farm to Fork is to ensure transparency, sustainability and quality at every level of the food chain. This includes ensuring food safety, protecting the environment, promoting healthy diets and supporting fair and sustainable practices in agriculture and the food industry.

As consumers, we need to be informed about the origin of food, how it is grown and processed, and the effects it has on our health and the environment. The "Farm to Fork" principle gives us the opportunity to make informed decisions about our food and contribute to the sustainable development of the food system.

It is important to know what happens to food from the moment of production to consumption for several reasons:

1. Health and safety: Knowing how food is grown, produced and processed helps us make informed decisions about food quality and safety, so we can avoid foods that may be contaminated with pesticides, chemicals, bacteria or other harmful substances. Also, information about allergens or potential risks allows us to protect ourselves from possible health problems.

2. Environmental sustainability: Food production and delivery have a major impact on the environment. Knowledge of the origin and cultivation of food allows us to support sustainable and environmentally friendly practices in agriculture. For example, if we know that a product is from organic farming or produced in a sustainable way, we can choose such foods and contribute to the conservation of natural resources and biodiversity.

3. Ethical and social aspects: Food chain information helps us to be aware of the social and ethical aspects of production. For example, whether food is produced with respect for workers' rights, whether local communities are supported or whether sustainable methods of animal husbandry are used. Such information helps us choose products that meet our values and benefit society as a whole.

Ultimately, knowledge of the food chain enables us to be informed and responsible consumers who adopt informed decisions and support sustainable practices in the food system.

8.2 SUSTAINABLE FOOD PRODUCTION

PRODUCTION SCHOOL: ADİLE MERMERCİ ANATOLİAN HİGH SCHOOL- TURKEY

achivements:

Being sustainable is not enough; To future-proof our food system, we must also work to improve soil health and increase biodiversity.

Education and training are the key to accelerating the transition to sustainable agriculture.

Understands the importance of providing transparency and traceability

INTRODUCTION

Which of the following do you think is more frightening?

The fact that 2 billion people are deprived of adequate food and one in every two people is malnourished?

The expectation that the world population will reach 10 billion by 2050?

The fact that we need to produce more than half of what we have today to feed the growing population?

the fact that producing more is impossible, or all of them?

unfortunately you need to say all of them!

At least 70% more food production will be needed to meet the demand of the 9.7 billion population projected for 2050. At the same time, when we consider risks such as agricultural areas, limited water resources, and climate change, it is clear that innovative solutions will be needed. Here, it comes to the fore how important it is to develop agricultural production solutions that are especially resistant to climate change risks. This shows that sustainable agriculture and sustainable food production is an important need of our age.

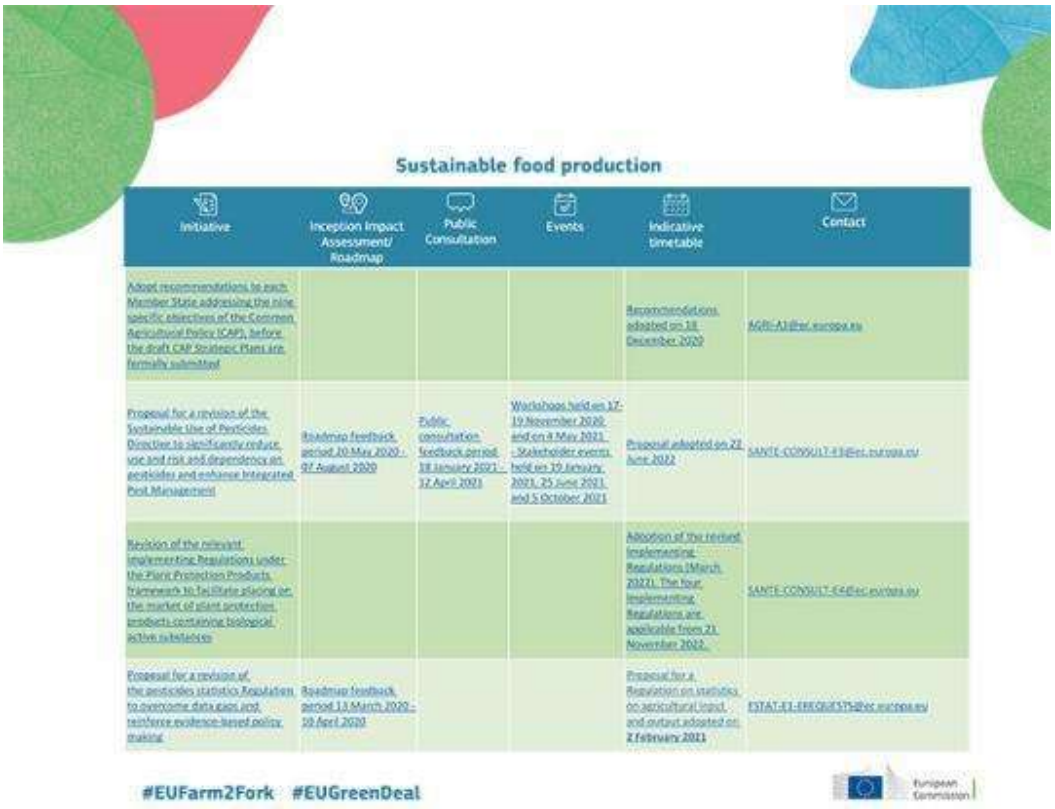
DEVELOPMENT

The Farm to Fork Strategy, which is becoming increasingly popular today, aims to reduce the environmental and climate impact of primary production while providing fair economic returns for farmers, fishermen and aquaculture producers.

The strategy aims to significantly reduce the use and risk of chemical pesticides, fertilizer use and antimicrobial sales, as well as increasing organic farming farmland.

It also aims to improve animal welfare by promoting livestock, protecting plant health and promoting the adoption of new green business models, circular bio-based economy and the shift to sustainable fish and seafood production.

The strategy envisages the following actions to ensure sustainable food production:



https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy/sustainable-food-production_en

Watch the following videos on the subject:

https://audiovisual.ec.europa.eu/en/event/66052

Proposing a legislative framework for sustainable food systems (FSFS) is one of the key initiatives of the Farm to Fork Strategy.

As announced in the Strategy, it will be adopted by the Commission by the end of 2023.

Its aim is to accelerate and facilitate the transition to sustainable food systems. In addition, promoting policy coherence at EU and national level, strengthening mainstream sustainability in all food-related policies and strengthening the resilience of food systems will be the main objective. The proposal will be accepted after extensive consultation and impact assessment.

for more information:

https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy/legislative-framework_en

The Farm to Fork Strategy aims to accelerate our transition to a sustainable food system:

- have a neutral or positive environmental impact
- help mitigate climate change and adapt to its effects
- reversing biodiversity loss
- ensure food security, nutrition and public health by ensuring that everyone has access to adequate, safe, nutritious and sustainable food
- Maintaining the affordability of food while delivering fairer economic returns by improving the competitiveness of the EU supply sector and promoting fair trade

QUESTION; How can we accelerate the transition to sustainable agriculture?

Because of the scale and complexity of the challenge, there is no single solution to accelerate the transition to sustainable agriculture. Collaboration is essential and there are several elements that can be implemented to improve the sustainability of farming.

Here are 5 key ways that can accelerate the transition to sustainable agriculture:

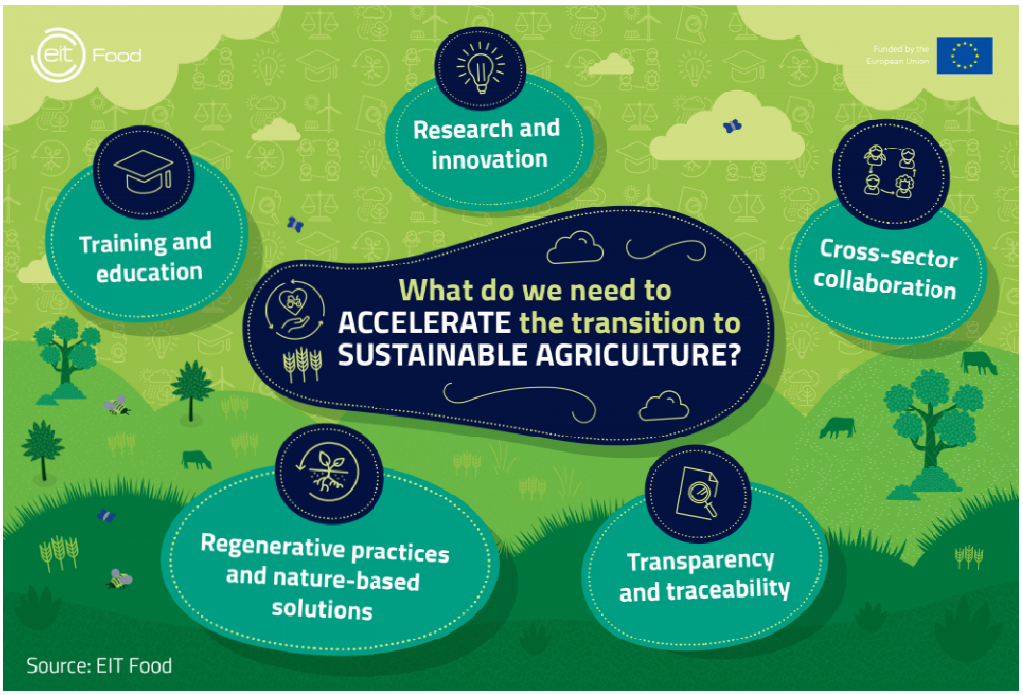
I. Benefit from research and innovation

II. Apply regenerative practices and nature-based solutions

III. Provide farm-to-table education and training

IV. Increase transparency and traceability

V. Promote cross-industry collaboration



Resources available on the subject

1-Sustainable Agriculture - The pioneering technologies of our future

https://youtu.be/-kUNlvgytK8

2- Test Farms - validate your agrifood innovation with farmers

https://youtu.be/V8UAc_ui3LE

3- Regenerative Agriculture is a Hopeful Solution to Climate Change

https://youtu.be/gmYc6ScSW7I

4-https://agriculture.ec.europa.eu/data-and-analysis/farm-structures-and-economics/fadn_en

5-https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy_en

EVALUATION

Sustainable agriculture and food are interconnected. However, the resulting food waste is against the principle of sustainability. Especially in our country, bread is the most easily accessible food. Therefore, it is seen that bread waste reaches very serious amounts. In addition, it is an important problem that foods such as vegetables and fruits that are sold in kilograms are taken in excess of the need and thrown away as a result of not knowing how to protect them. In order to prevent this; First of all, the habit of making a shopping list should be gained, the preservation conditions of the foods should be known, the amount of food should not be cooked more than the amount to be consumed, the difference between the recommended consumption date and the expiry date should be known. (The recommended consumption date is related to the quality of the food and means that the food will preserve all its properties when stored under suitable conditions until that date. The expiry date is related to the food safety and means that it will be harmful to human health if consumed after that date.) effort should be made to avoid it.

Students are given one week, during which time they are asked to observe food waste in their homes and produce solutions against it.

In order to evaluate stale bread, they are asked to develop recipes and shoot them as videos.

https://youtu.be/M21VQLrKB5M

8.3 SUSTAINABLE FOOD PROCESSING AND DISTRIBUTION

SCHOOL: ITES Vitale Giordano, Bitonto - ITALY

Students: 2nd class (20 students)

Time required for the activity: 6 hours

EXPECTED RESULTS

- raising awareness of agricultural and food sustainability issues to adopt healthy lifestyles, developing the ability to make informed choices
- promoting the adoption of the Mediterranean Diet and Short Chain Products;
- informing the school population about healthy and sustainable consumption.

OBJECTIVES

- Understanding the sustainability issues of the agro-food industry in the processing and distribution of products
- To reflect on the importance of taking responsibility for global issues.
- Developing problem solving skills through group dynamics Reflecting on the need to reduce carbon and water footprints on the Planet

PREREQUISITES

- To know the meaning of 'circular economy'.

METHODOLOGY

- Group work: cooperative learning in classroom 3.0 (each student has his or her own iPad).

INTRODUCTION

The EU Farm to Fork strategy for sustainable food is a key component of the European Green Deal. European food is famous for being safe, nutritious and of high quality. It should now also become the global standard for sustainability.

"The Farm to Fork strategy is at the heart of the European Green Deal, which aims to make food systems fair, healthy and environmentally friendly. (...)

We need to redesign our food systems, which today are responsible for almost a third of global greenhouse gas emissions, consume large amounts of natural resources, cause loss of biodiversity and negative health impacts (due to both under- and over-nutrition), and do not allow for fair economic returns and livelihoods for all actors, especially primary producers.
Setting our food systems on a sustainable path also brings new opportunities for food value chain actors. New technologies and scientific discoveries, combined with growing public awareness and demand for sustainable food, will bring benefits to all stakeholders.
The Farm to Fork strategy aims to accelerate our transition to a sustainable food system that should:
- have a neutral or positive environmental impact
- help mitigate climate change and adapt to its impacts
- reverse the loss of biodiversity
- ensure food security, nutrition and public health, ensuring that everyone has access to sufficient, safe, nutritious and sustainable
food - preserve the affordability of food' (from 'Farm to Fork strategy', EU)

SEE THE VIDEO

- **"EU Producer-to-Consumer Strategy**

https://youtu.be/1tXseroYYFs

READ DOCUMENTS:

- **"Farm to Fork strategy (for a fair, healthy and environmentally friendly food system)".**

https://ec.europa.eu/food/farm2fork_en

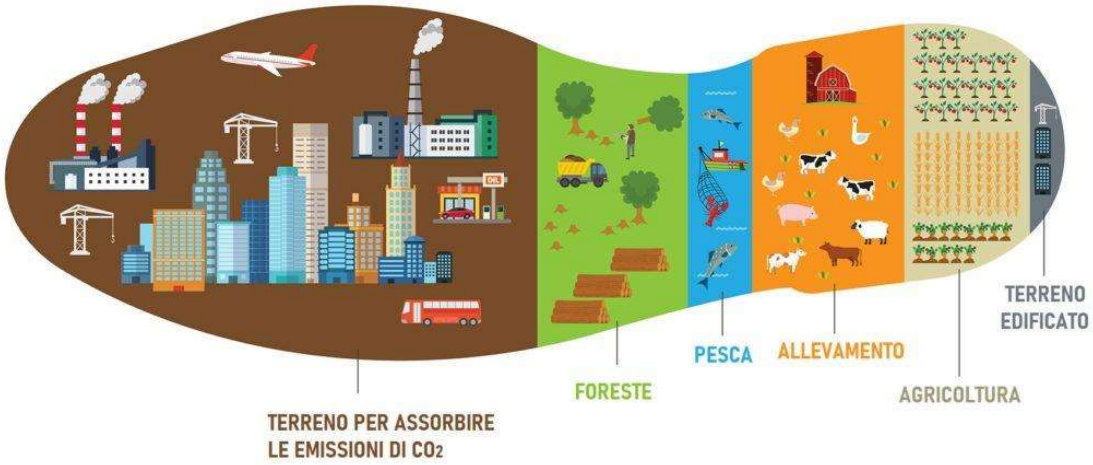
- **"FOUR WAYS TO MAKE FOOD PROCESSING MORE SUSTAINABLE".**

https://www.bureauveritas.it/insight/quattro-modi-rendere-sostenibile-la-trasformazione-dei-prodotti-alimentari

WORK IN GROUPS: students work in cooperative groups. At the end, each group reports on their work and prepares 1 summary infographic, poster format, made with Canva. The posters will then be used to create a small exhibition in the school hall.

Group 1: THE CARBON FOOTPRINT

Students research on the web what 'carbon footprint' means, explore the topic further and identify examples to present to their peers.



- **ENVIRONMENTAL FOOTPRINTS AND FOODSTUFFS**

https://www.isprambiente.gov.it/it/attivita/certificazioni/files/ipp/documenti/le-impronte-ambientali-e-i-prodotti-alimentari

- **MY FOOTPRINT**

https://www.wwf.ch/it/vivere-sostenibile/la-mia-impronta-alimentazione

- **Would carbon food labels change the way you shop?**

https://ig.ft.com/carbon-food-labelling/

Group 2: ECO FRIENDLY PACKAGING

Students research information and the latest EU guidance on food packaging, explore the topic in depth and identify examples to present to their peers to explain the current situation.

- **Reduction, reuse, recycling: the new EU Packaging Regulation**

https://www.alternativasostenibile.it/articolo/riduzione-riutilizzo-riciclo-il-nuovo-regolamento-ue-sugli-imballaggi

- **Organic packaging: the sustainable, edible and biodegradable packaging**

https://www.green.it/imballaggi-organici/

Group 3: REDUCE WASTE

The students research the current situation and also learn more about new apps for using food close to its expiry date and making surplus meals available to restaurants. In the end, they define a list of good practices to follow in everyday life to reduce food waste.

- **Food waste reduction targets**

https://food.ec.europa.eu/safety/food-waste/eu-actions-against-food-waste/food-waste-reduction-targets_it

- **Too Good To Go supports EU proposal to reduce food waste**

https://www.repubblica.it/economia/rapporti/osserva-italia/osservacibo/2023/07/06/news/too_good_to_go_supporta_la_proposta_dellue_per_ridurre_gli_sprechi_alimentari-406885978/

Group 4: SHORT ROW FOODS

Students research the definition and characteristics of 0 km and short supply chain food products. They identify the main products in their region with these characteristics.

Zero km and short chain food products

https://temi.camera.it/leg18/provvedimento/prodotti-agroalimentari-a-km-zero-e-a-filiera-corta_d.html

This is Slow Food

https://youtu.be/wRZXnYdcpNM

About us (Slow Food)

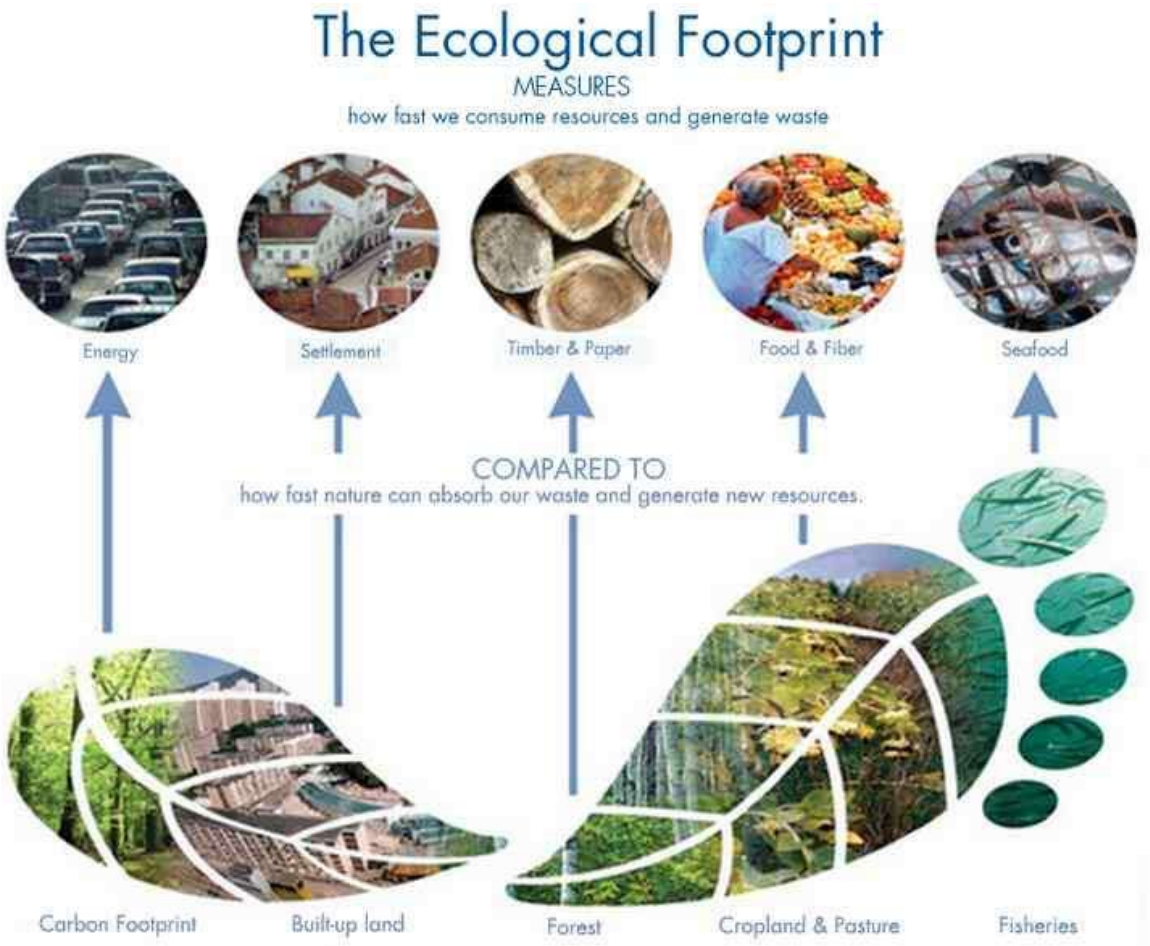
https://www.slowfood.it/chi-siamo/che-cose-slow-food/

The Slowfood Presidia

https://www.fondazioneslowfood.com/it/cosa-facciamo/i-presidi/

At the end of the activity, all students will calculate their ecological footprint using the calculator and display the result in the exhibition set up in the school hall:

https://www.wwf.ch/it/vivere-sostenibile/calcolatore-dell-impronta-ecologica


The Ecological Footprint
MEASURES
how fast we consume resources and generate waste
Energy
Settlement
Timber & Paper
Food & Fiber
Seafood
COMPARED TO
how fast nature can absorb our waste and generate new resources.
Carbon Footprint
Built-up land
Forest
Cropland & Pasture
Fisheries

8.4 SUSTAINABLE FOOD CONSUMPTION

CONTENT

- Introduction
- Student preparation
- Work documents
- Production
- Skills worked - Goals to reach

INTRODUCTION

From farm to fork

The Farm to Fork (F2F) strategy will enable the transition to a sustainable food system in the European Union (EU) that safeguards food security and guarantees access to healthy diets from a healthy planet. The F2F strategy is special because it is the first time that EU food policy has a general strategy, encompassing all stages of the food system and putting consumers and producers at the centre. As European agriculture currently accounts for 10.3% of EU greenhouse gases, the F2F strategy is key to delivering the EU Green Deal. European farmers, fishermen and aquaculturists are seen as key players in the transition to a fairer and more sustainable food system. To support them, new funding streams and eco-schemes will be put in place to adopt more sustainable practices, under the common agricultural policy and the common fisheries policy.

The strategy includes 27 concrete actions with targets to transform the EU food system by 2030, including

- 50% reduction in pesticide use and risk
- a reduction of at least 20% in the use of fertilizers - including animal manure
- a 50% reduction in sales of antimicrobials used for farm animals and aquaculture
- reach 25% of agricultural land in organic farming, the current level of which is 8%
- However, the strategy does not endorse a certain harmonized EU mandatory front-of-package labeling (FOPL) model within two years. Going forward, an impact assessment for front-end labeling and nutrient profile models will be launched to identify the best model.

Source: https://ec.europa.eu/food/sites/food/files/safety/docs/f2f_action-plan_2020_strategy-info_en.pdf

STUDENT PREPARATION

- Definition of expression:

  Sustainable food

  https://fr.wikipedia.org/wiki/Sustainable_food

  Equitable

  https://www.larousse.fr/dictionnaires/francais/%C3%A9quitable/

WORK DOCUMENTS

GROUP 1

Sustainable Food and Agriculture

https://www.fao.org/3/I9900en/i9900en.pdf

GROUP 2

Sustainable food: the main issues

https://www.hellocarbo.com/blog/reduire/alimentation-durable/

PRODUCTION

Group 1: In the form of a mind map, identify the answers to the following question: Why is sustainability for food and agriculture so important?

Group 2: In the form of a mental map, identify the answers to the following question: on which pillars is sustainable food based ?

Groups 1 + 2

On the basis of the documents provided, from the mental maps, your research and personal reflections, write an oral presentation

SKILLS WORKED - GOALS TO REACH

- Reading and analysis of documents
- Work on document synthesis
- Making a mind map
- Organization of argumentation expression
- Oral

8.5 FOOD LOSS AND WASTE PREVENTION

Introduction:

The Farm to Fork (F2F) strategy is a crucial part of the European Green Deal, an ambitious action plan aimed at transforming the European Union's food system to be more sustainable, healthy, and fair. Central to this strategy is the need to tackle food loss and waste, which have significant environmental, economic, and social impacts.

Objective:

The objective of this lesson plan is to introduce students and readers to the concept of the Farm to Fork strategy, understand the magnitude of food loss and waste, and explore how countries in Europe are combating this issue with reference to the European Green Deal.

Lesson Plan:

1. Introduction to Farm to Fork Strategy and Food Loss/Waste (15 minutes)
    a. Define the Farm to Fork strategy and its importance in achieving sustainability goals.

b. Explain the concept of food loss and waste, differentiating between the two.

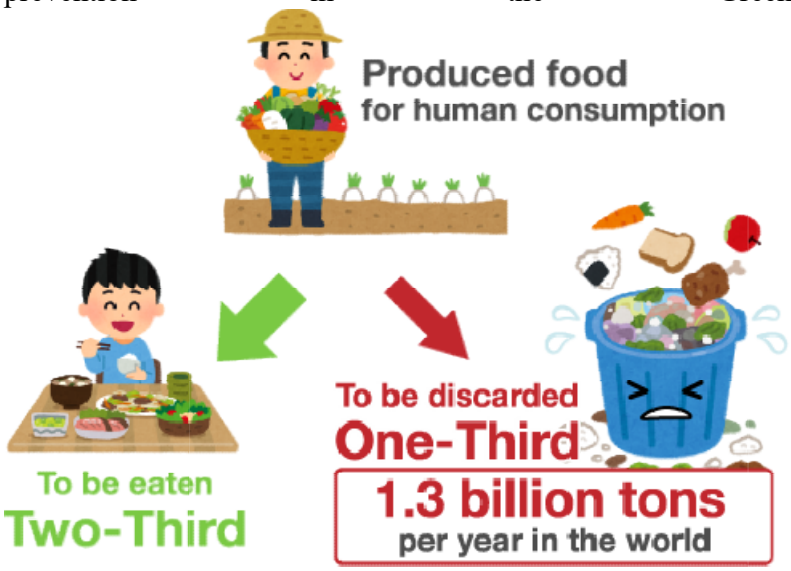
c. Highlight the environmental, economic, and social implications of food loss and waste.

2. Understanding the European Green Deal (20 minutes)

a. Briefly introduce the European Green Deal, its goals, and its significance for the EU's sustainability efforts.

b. Discuss how the Farm to Fork strategy fits into the broader framework of the European Green Deal.

c. Explore specific policy measures and targets related to food loss and waste prevention in the Green Deal.



3. Exploring Food Loss and Waste Prevention Strategies (25 minutes)

a. Investigate various causes of food loss and waste at different stages of the food supply chain (e.g., production, distribution, consumption).

b. Present innovative approaches and technologies used to minimize food loss and waste.

c. Discuss the role of consumers in reducing food waste and the importance of responsible consumption.

4. Iceland's Contribution to Food Loss and Waste Prevention (20 minutes)

a. Provide an overview of Iceland's sustainability initiatives and efforts to reduce food waste.

b. Examine specific programs, policies, and partnerships in Iceland that have been successful in combating food loss and waste.

c. Discuss the challenges faced by Iceland and how they have overcome them.

5. Interactive Activity: Designing Local Solutions (30 minutes)

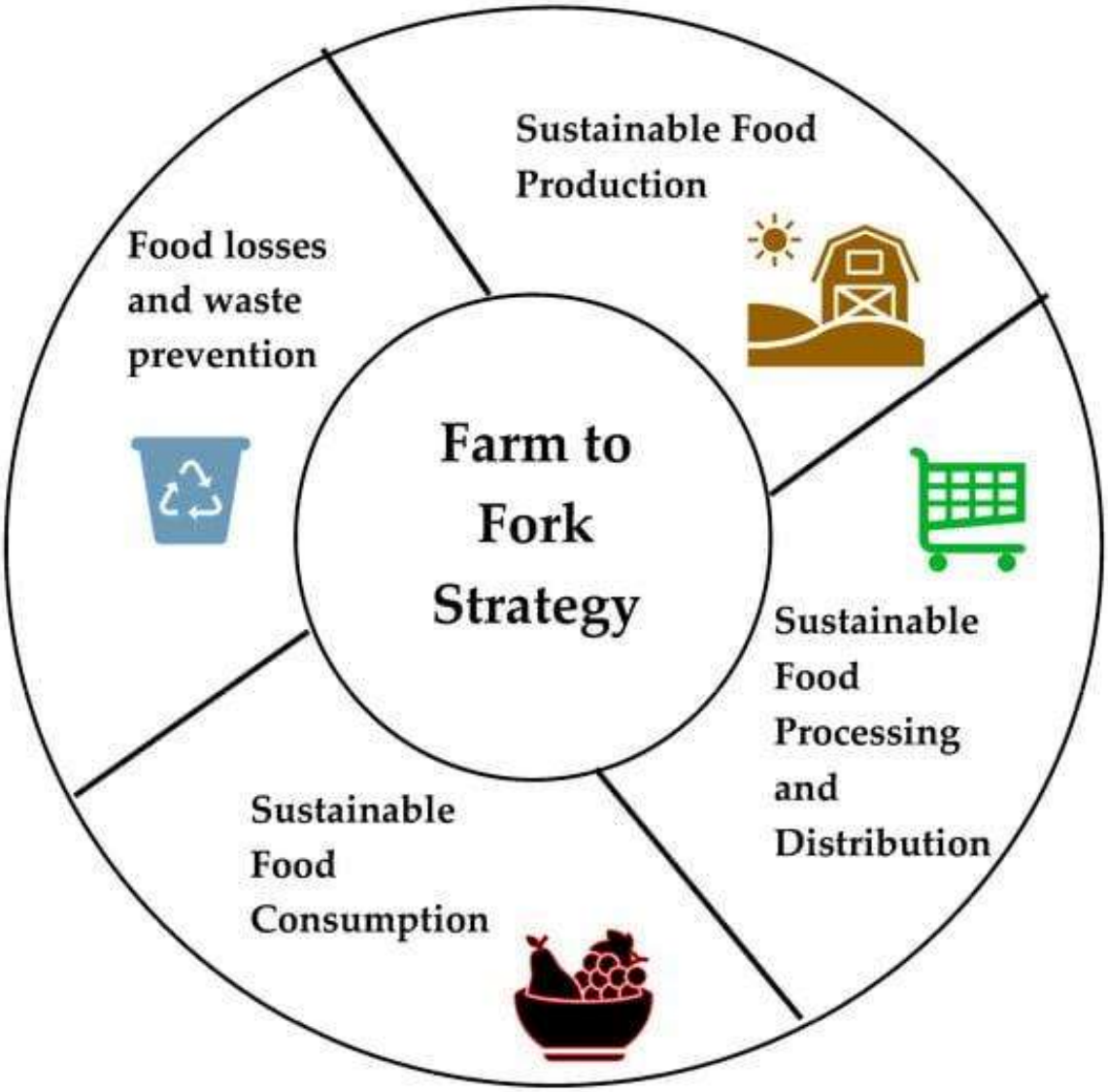
a. Divide students into groups and assign them specific roles (e.g., farmers, retailers, consumers).

b. Instruct each group to brainstorm and propose practical solutions to prevent food loss and waste in their respective roles.

c. Have each group present their ideas and discuss the potential impact of these solutions.

Conclusion:

In conclusion, the Farm to Fork strategy, with a focus on food loss and waste prevention, plays a vital role in achieving the sustainability objectives outlined in the European Green Deal. By adopting sustainable practices, we can work towards creating a more resource-efficient and resilient food system. This lesson plan provides students and readers with the knowledge and inspiration to contribute to a more sustainable future in their own communities.



https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy_en

https://www.arepoquality.eu/politics/farm-to-fork-strategy/

https://www.efta.int/EEA/news/EEA-EFTA-Comment-Farm-Fork-Strategy-522691

IX. BIODIVERSITY

9.1 BIODIVERSITY AND RICH LANDSCAPES

SCHOOL: ADILE MERMERCI ANATOLIAN HIGH SCHOOL - TURKEY

Achievements:

1. Learns the concept of biodiversity.

2. Explains the factors influencing the formation and decrease of biodiversity.

3. Understands the consequences of decreasing biodiversity.

INTRODUCTION:

The first student lives in a high plateau in the Black Sea Region, while the second student lives in Istanbul. The places they live in have different natural and human characteristics.

a- Show the effects of these different characteristics on the number and species of living beings on the concept map, using the given example.

b- Think about the species of living beings in your environment and write down the factors that influence whether there are few or many species of living beings.

c- Define the concept of biodiversity.

DEVELOPMENT

Living organisms exist in three different environments. These are the atmosphere (the air sphere), lithosphere (the rock sphere), and hydrosphere (the water sphere). Living beings inhabit areas within these three domains, up to a maximum depth of 10 meters in the lithosphere, up to

200 meters in the hydrosphere, and up to an altitude of 120 meters in the atmosphere. Beyond these distances, living beings are rarely encountered.

Biodiversity refers to the entirety of genes, species, ecosystems, and ecological events related to living beings in a region. Biodiversity is a fundamental element of maintaining the continuity of life and is composed of all the diverse living organisms on Earth. It is estimated that the number of species of living beings varies between 15 million and 100 million. The group of living beings with the highest number of species is insects, while the group with the fewest species is vertebrates (such as reptiles, birds, and mammals).

What is Biodiversity?

What is Biodiversity?

Biodiversity, which refers to the diversity and distribution of living organisms, is related to geographical conditions. The fact that geographical conditions are not the same everywhere on Earth has led to different regions being home to different living beings. Places with high biodiversity include tropical rainforests, coral islands and reefs, continental shelves, swamps, and major river estuaries. While various organisms can be found in the deep sea and ocean floors, marine life in saltwater environments generally thrives in the continental shelf region.

Question: What are the factors that affect biodiversity and its distribution?

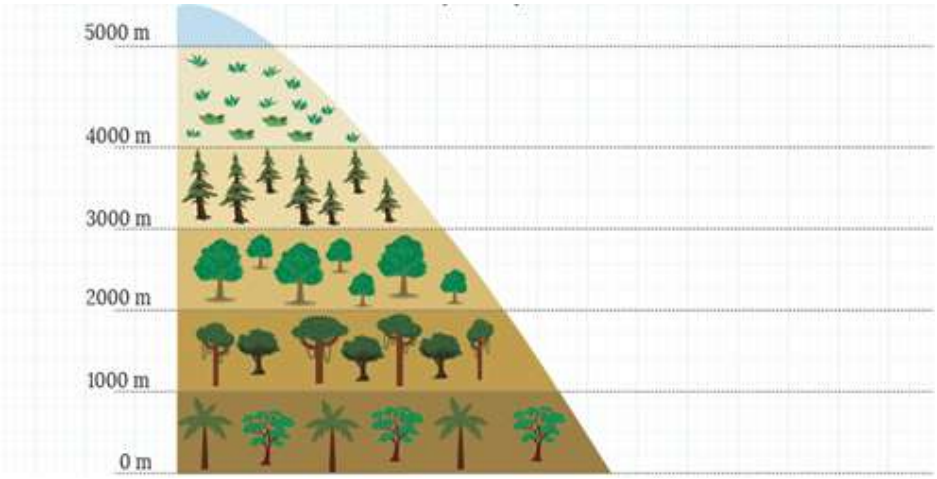
1- Physical Factors (climate, landforms, water bodies, soil structure)

2- Paleogeographic factors (continental drift, climate change)

3- Biological factors (human activities, other organisms)

Biodiversity varies depending on changes in temperature and rainfall. For example, in the equatorial climate zone, which experiences warm and humid conditions throughout the year, rainforests and various animal communities that inhabit these forests have emerged. High temperatures and low rainfall have a negative impact on the lives of living beings, as can be seen in areas with deserts. Biodiversity is also low in polar and tundra climates, where temperatures and rainfall are low.

The decrease in temperature with increasing altitude and the increase in rainfall up to a certain point allow for the diversification of plant and animal species along a mountainside. Therefore, as elevation increases, plants form different zones.



Certainly, here is the translation of the provided text into English:

Another factor that increases biodiversity is the variation in climate over short distances in regions with rugged topography and the emergence of various climate types. Generally, rugged regions have richer plant and animal species compared to regions with flat terrain. Precipitation levels increase along the coastal areas where mountains are high and parallel to the coast but decrease in the interior regions. This phenomenon has led to higher biodiversity on the seaward slopes of mountains compared to the inland areas. Additionally, species with a high demand for sunlight inhabit the sunward slopes of mountains, while species requiring less light are found on other slopes.

Water is of great importance to aquatic life. Although it varies from one organism to another, all living beings have water in their structures. Therefore, there is high biodiversity in areas with water sources and their surroundings. In places where usable water sources are insufficient (deserts, polar regions, etc.), biodiversity is quite low.

Soil significantly affects plants, while it holds a separate importance for animal species. Some species, such as worms, ants, moles, snakes, and various microorganisms, spend their entire lives or part of their lives within the soil. Grazing animals, on the other hand, prefer areas with fertile soil and dense vegetation.

Throughout the history of the Earth, paleogeographic conditions have also influenced biodiversity. The separation and merging of continents have led to the dispersal and isolation of plant and animal species on Earth. Changing climatic conditions have caused some species to migrate in search of new habitats, while others have seen their ranges shrink, and some have faced extinction. During the Quaternary Period, most species migrated towards warmer regions due to glaciation. Changes in sea levels have resulted in the closure or opening of areas that serve as transition zones for plant and animal species living on land and in the oceans. Today, due to global warming and climate change, it is possible to say that some species, such as pandas, polar bears, blue whales, and African elephants, may disappear, while others may migrate to areas with more favorable conditions for their survival.

Question: What are the effects of humans on biodiversity?

There are several human-induced factors that threaten biological diversity. These include:

Rapid population growth, expansion of urban areas, emissions of gases, liquids, and solid waste from industrial facilities, air pollution and acid rain, the use of chemical fertilizers and pesticides in agriculture, deforestation, overgrazing of grasslands and steppes, excessive and unregulated hunting, construction of dams, accelerated erosion, road construction, and so on.

Especially, the adverse effects caused by human activities lead to the extinction of many species and harm ecosystems. According to the results of research, it is stated that the loss of species has increased between 1,000 to 10,000 times compared to the past.

Assesment

Three groups are formed in the classroom. Using the table below, the groups conduct a study related to the Amazon Basin.

Amazon River Basin		2002		2020	
		Srface Area (km^2)	%	Surface Area (km^2)	%
Including rain forests	Green areas	4.828.220,10	70,3	4.430.505,00	64,5
	Deforastated areas	631.261,10	9,2	1.0289.76,20	15
	Area with No Forest Cover	866.180,90	12,6	866.180,90	12,6
The areas except rain forests		543.337,90	7,9	543.337,90	7,9
Total		6.869.000,00	100	6.869.000,00	100

Table 1: Changes Occurring in the Tropical Rainforest Area in the Amazon River Basin Between 2002-2020

1st Group: Prepares survey questions and conducts interviews. They create survey questions taking into account the following key sentences. The conducted surveys are recorded with photos and videos.

* The tropical rainforests, which are the lungs of the Earth, are disappearing.

* Biodiversity is decreasing in tropical rainforests.

* Humans are responsible for sustainable biodiversity.

* Measures to protect biodiversity.

2nd Group: Prepares posters and slogans. The poster is prepared considering the following questions.

* What are the causes of the destruction in tropical rainforests?

* What are the effects of spatial losses occurring in tropical rainforests on biodiversity?

* What measures should be taken to save tropical rainforests and biodiversity?

3rd Group: Creates a public service announcement video emphasizing the effects of spatial reduction in rainforests.

1st Person: A farm owner in the Amazon Basin

2nd Person: Brazilian Minister of Economy

3rd Person: A doctor emphasizing the impact of extinct species on human health

4th Person: An activist working to preserve the natural environment

The work conducted is displayed on school bulletin boards.

Useful resources

How To Save Our Forests and Rewild Our Planet

https://youtu.be/Ig9Tfc_hNsE?feature=shared

How to Save Our Planet

https://youtu.be/0Puv0Pss33M?feature=shared

Animals of Amazon 4K - Animals That Call The Jungle Home

https://youtu.be/s7DbVTkaXn0?feature=shared

https://archive.epa.gov/greenacres/web/pdf/wo_2004b.pdf

https://www.epa.ie/publications/research/biodiversity/STRIVE_87_web.pdf

https://www.youtube.com/watch?v=7tgNamjTRkk

https://www.youtube.com/watch?v=sycGoTrA2Ac

9.2 HALTING AND REVERSING THE DECLINE OF POLLUTERS

CONTENT

INTRODUCTION

Stopping and reversing the effects of pollutants

For the first time in 30 years, legislation has been introduced to tackle the catastrophic loss of wildlife in the EU. Legally binding targets for all member states to restore wildlife on land, in rivers and at sea have been announced, alongside a crackdown on chemical pesticides.
Following UN negotiations on halting and reversing biodiversity loss, targets published by the European Commission include reversing the decline of pollinator populations and restoring 20% of land and seas by 2030, with all ecosystems to be restored by 2050. The commission also proposed a target to halve the use of chemical pesticides by 2030 and eradicate their use near schools, hospitals and playgrounds.
Frans Timmermans, the commission's executive vice president, said the laws were a step forward in the fight against "imminent ecocide" threatening the planet. Around €100bn (£85bn) will be available for spending on biodiversity, including ecosystem restoration. The 2030 goal to reduce pesticide use will give farmers time to find alternatives.

Source : EU plan to halve use of pesticides in 'milestone' legislation to restore ecosystems | Pesticides | The Guardian

STUDENT PREREQUISITES

- Definition of the expression:

  Biodiversity

  What is biodiversity? | Biodiversity - All alive (biodiversite.gouv.fr)

Ecosystem

Ecosystem - Wikipedia (wikipedia.org)

WORK DOCUMENTS

GROUP 1

European directives on habitat

The Habitats Directive (europa.eu)

GROUP 2

Return to biodiversity by 2030

EU plan to halve use of pesticides in 'milestone' legislation to restore ecosystems | Pesticides | The Guardian

PRODUCTION

Group 1: In the form of a mental map, identify the answers to the following question: What are the major advances in the 1992 text on the protection of biodiversity?

Group 2: In the form of a mental map, identify the answers to the following question: What are the European Union's objectives in 2022 to reverse the effects of pollution?

GROUPS 1 + 2

Based on the documents provided, from the mind maps, your research and personal reflections, write an oral presentation. Highlight the objectives of European laws and texts aimed at renewing biodiversity.

WORKED SKILLS

- Reading and analyzing documents
- Work on document synthesis
- Creating a mind map
- Organization of argumentation expression
- Oral

9.3 REDUCING THE USE AND HARMFULNESS OF PESTICIDES

Title: Biodiversity and Pesticides: Protecting Our Environment

Level: High School

Duration: 3 class periods (45 minutes each)

Objectives:

1. Understand the concept of biodiversity and its importance in ecosystems.
2. Explore the environmental issues associated with pesticide use.
3. Analyze the European Union's environmental plan related to pesticide reduction.
4. Propose solutions to reduce pesticide use and its harmful effects on biodiversity.

Video: What is biodiversity?

Lesson 1: Understanding Biodiversity (45 minutes)

Introduction:

- Start with a brief discussion on what biodiversity means and its significance in maintaining ecosystems. Brainstorming, writing on board etc.

Activity 1: Biodiversity in Local Ecosystems

1. Divide students into small groups.
2. Assign each group a local ecosystem (e.g., wooded area, pond, garden, beach).
3. Ask them to make a list of species they can find in that ecosystem and discuss the interdependence of these species.
4. Have each group present their findings.

Discussion:

- Engage the class in a discussion about the importance of biodiversity in maintaining a balanced ecosystem.

Lesson 2: Pesticides and their environmental impact (45 minutes)

Introduction

- Present information on the use of pesticides in agriculture and the potential environmental impacts.

Activity 2: Case Study – Pesticides and Biodiversity

1. Share case studies highlighting the negative effects of pesticides on biodiversity.
2. Ask students to discuss the consequences of pesticide use on a specific ecosystem.
3. Discuss the concept of bioaccumulation and biomagnification in relation to pesticides.

Video: Silent Death: Europe's big pesticide problem and biodiversity crisis

Discussion

- Discussion on the ethical considerations of pesticide use and its impact on biodiversity.

Lesson 3: The EU environmental plan on pesticides (45 minutes)

Introduction:

- The European Union's environmental plan related to pesticide reduction and its objectives.

https://agriculture.ec.europa.eu/sustainability/environmental-sustainability/low-input-farming/pesticides_en

Environmental plan

1. Provide students with handouts containing key points of the EU environmental plan
2. In small groups, have students analyze and discuss the objectives and strategies mentioned in the plan.
3. Encourage students to think critically about the feasibility of these goals.

Discussion

- Lead a class discussion on the significance of international efforts to reduce pesticide use and its implications for biodiversity.

Lesson 4: Proposing solutions (45 minutes)

Activity 4: Brainstorming solutions

1. Divide students into groups and ask them to brainstorm potential solutions to reduce pesticide use and minimize its harmful effects on biodiversity.
2. Encourage creativity and feasibility in their proposals.

Activity 5: Presenting Solutions

1. Have each group present their proposed solutions to the class.
2. Encourage feedback and discussion.

Conclusion

- Summarize the key points from the proposed solutions and emphasize the importance of individual and collective actions in protecting biodiversity.

Homework/Assignment:

- Assign a research project where students investigate local initiatives or organizations working to reduce pesticide use and support biodiversity. They should also explore the role of organic farming and integrated pest management.

Assessment

- Evaluate student understanding through participation in discussions and presentations, as well as their research project on local initiatives.

By focusing on biodiversity and the reduction of pesticide use in alignment with the EU environmental plan, students will gain a deeper understanding of the importance of biodiversity and the need to protect it by adopting sustainable agricultural practices.

9.4 PLANTING TREES

Grade: Secondary students

DESIRED RESULTS	
Established Goals (Standards, Performance Indicators, Learning Goals): **1** Knowledge about the European commission goal to plant 3 billion trees. 2.Integration of the topic in order to fully comprehend. 3.Expanding knowledge and consolidating skills on the topic.	
Understandings: **1.** Understand the new EU forest strategy for 2030 1. Understand the new guidelines to support tree planting actions and to protect old-growth forests. 2. Understand the advantages of forest strategy	**Essential Question:** Why the planting trees are so important part of the Green Deal?
Students will know: 1. What Forest strategy is. 2. How Forest strategy works. 3. They are familiar with the benefits of planting trees.	**Students will be able to do:** 1.Discuss on the importance of trees and biodiversity

4. They are aware of the biodiversity.	

EVIDENCE/ASSESSMENTS:

Performance Task:

Goal:

To understand the advantages and disadvantages of planting trees and reflection of trees on climate change.

Role:

The class is divided into 5 groups. Each member of a particular group has a role that goes with specific tasks.

Product:

PBL Activity - "Trees for Tomorrow"

Other Evidence/Assessments:

1. Worksheet
2. Mobile device and Internet
3. Cooperative learning

LEARNING PLAN

INTRODUCTION and discussion

Planting trees is incredibly important for several reasons, and it plays a crucial role in maintaining a healthy environment and combating various global challenges. Here are some key reasons why planting trees is essential:

Carbon Sequestration: Trees absorb carbon dioxide (CO2) from the atmosphere through a process called photosynthesis. This helps reduce the concentration of greenhouse gases in the atmosphere, mitigating climate change and its associated effects.

Climate Change Mitigation: By absorbing CO2 and releasing oxygen, trees help regulate the Earth's climate. Forests act as carbon sinks, capturing and storing carbon, thus reducing global warming and its impacts.

Biodiversity Support: Trees provide habitats for a wide variety of plants, animals, and microorganisms. Forests are among the most biologically diverse ecosystems on Earth, and they play a vital role in preserving biodiversity.

Air Quality Improvement: Trees filter out pollutants and particulate matter from the air, improving air quality. They help reduce the risk of respiratory diseases and promote overall human health.

Erosion Prevention: Tree roots help bind soil, preventing erosion and landslides. This is particularly important in areas with vulnerable soil conditions.

Water Resource Management: Trees play a crucial role in regulating the water cycle. They absorb rainwater, reduce surface runoff, and release water gradually, preventing floods and ensuring a stable supply of freshwater.

Aesthetic and Psychological Benefits: Trees contribute to the beauty of landscapes and urban areas, enhancing the quality of life. They also have a calming and stress-reducing effect on human well-being.

Economic Value: Trees have economic value in terms of timber, non-timber forest products, and recreational opportunities, contributing to local economies and livelihoods.

Energy Conservation: Properly placed trees can provide shade and reduce cooling and heating costs for buildings, making them more energy-efficient.

Cultural and Spiritual Significance: Trees often hold cultural and spiritual importance in various societies and religions. They can be symbols of life, growth, and renewal.

Habitat for Indigenous and Local Communities: Forests and trees are integral to the livelihoods and cultural practices of many indigenous and local communities around the world.

Environmental Education: Tree planting and forest conservation offer opportunities for environmental education, raising awareness about environmental issues and the importance of sustainability.

Given these multiple benefits, tree planting and forest conservation efforts are critical in the face of environmental challenges such as climate change, deforestation, and habitat loss. It is essential to recognize the significance of trees in maintaining ecological balance and to actively engage in tree planting and conservation initiatives to ensure a more sustainable and healthier planet.

GROUP WORK

European Green Deal Connection (20 minutes)

Materials:

1. New EU forest strategy for 2030. To improve the quantity and quality of EU forests

https://environment.ec.europa.eu/strategy/forest-strategy_en

2. 3 Billion Trees Pledge

https://environment.ec.europa.eu/strategy/biodiversity-strategy-2030/3-billion-trees_en

3. EU forests: Commission adopts new guidelines to support tree planting actions and to protect old-growth forests

https://environment.ec.europa.eu/news/eu-forests-commission-adopts-new-guidelines-support-tree-planting-actions-and-protect-old-growth-2023-03-21_en

Have students discuss the connection between their tree planting knowledge and the European Green Deal.

Ask them to identify specific ways in which tree planting contributes to the goals of the European Green Deal.

FINAL PRODUCT:

Local Tree Planting Project

Find and provide information about a local tree planting project or partner with a local environmental organization.

Challenge students to come up with a plan to actively participate in the tree planting initiative.

Discuss logistics, fundraising, and coordination.

PRESENTATION AND REFLECTION

Have each group present their research findings and how they plan to contribute to the local tree planting project.

Encourage reflection on what they've learned about the importance of tree planting and its role in the European Green Deal.

EXTENSION ACTIVITY:

Assign students to write a short essay or create a poster highlighting the importance of tree planting in addressing environmental challenges and its alignment with the European Green Deal.

ASSESSEMENT:

Evaluate students based on their participation in group activities, the quality of their presentations, and their understanding of the importance of tree planting and its relationship to the European Green Deal.

This PBL lesson provides students with the knowledge and practical experience to connect tree planting with the broader environmental goals of the European Green Deal while actively contributing to local sustainability efforts.

9.5 WILDLIFE AND SPECIES AT RISK

SCHOOL: ITES Vitale Giordano, Bitonto - ITALY

Students: 2nd class (20 students)

Time required for activity: 7 hours

EXPECTED RESULTS

- To know the risk factors for biodiversity in each area.

- To play an active role in the protection of animal and plant biodiversity.

- To acquire, interpret and communicate information.

- To cooperate and participate in group activities by carrying out tasks.

PREREQUISITES

- To know and/or deepen the concept of biodiversity

- To know the structure of an ecosystem.

METHODOLOGY

-Group work: cooperative learning in classroom 3.0 (each student has his or her own iPad).

-Web search

-INTRODUCTION

- What is biodiversity?

Biodiversity describes the billions of unique living organisms that inhabit the Earth and the interactions between them. These organisms are essential elements of our life but are under constant threat. The main pressures on biodiversity are changes in land use (e.g., deforestation, intensive monoculture, urbanization), direct exploitation such as hunting and overfishing, climate change, pollution, and invasive alien species.

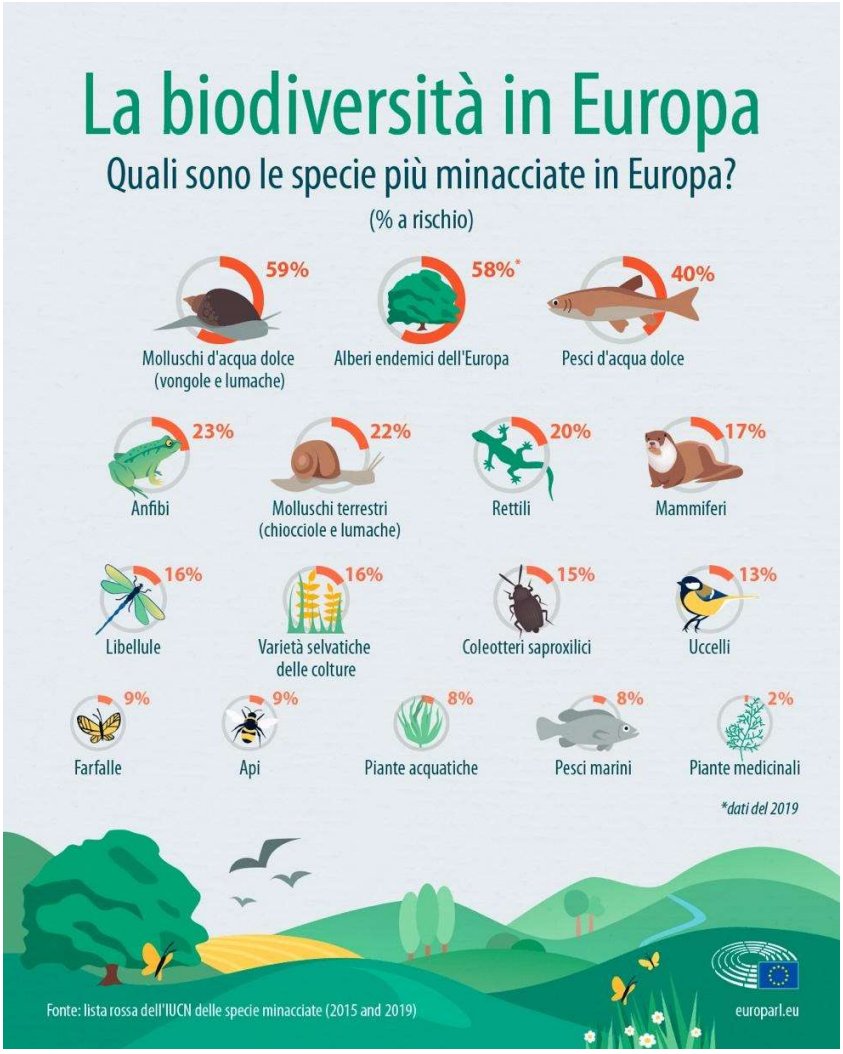
Preserving biodiversity is crucial not only for its intrinsic value but also because it ensures, for example, clean air, fresh water, good soil quality and crop pollination. It helps us combat and adapt to climate change, as well as helping to reduce the impact of natural hazards. Its decline therefore has fundamental consequences for society, the economy and human health.

The European Nature Information System (EUNIS) provides key data on species, habitat types and designated sites.

For more information, see BISE (European Biodiversity Information System). (https://biodiversity.europa.eu)

Of the eight million living species that exist on Earth, one million are endangered.

According to the IUCN (Implementation and Finance Contributions for Nature) about 1700 species out of a total of about 15000 are considered endangered. In particular, the most endangered are snails, clams, fish and about one fifth of amphibians and reptiles are endangered. More than half of Europe's endemic trees, including the horse chestnut, Heberdenia excelsa and rowan, are threatened. Among mammals, those most at risk are the Arctic fox, the European mink, the Mediterranean monk seal, the North Atlantic right whale and the polar bear. Pollinators are also endangered: one in ten species of bees and butterflies is threatened with extinction.



- VIDEO

See the video 'Biodiversity: restoring nature' on the homepage

- https://www.europarl.europa.eu/news/it/headlines/society/20200519STO79424/biodiversita-i-dati-sulle-specie-a-rischio-in-europa-infografica

-WEB RESEARCH and PRESENTATION PRODUCTION (4 hours)

Divided into 4 co-operative groups, students search the web for information and insights on the following topics.

GROUP 1: BIODIVERSITY

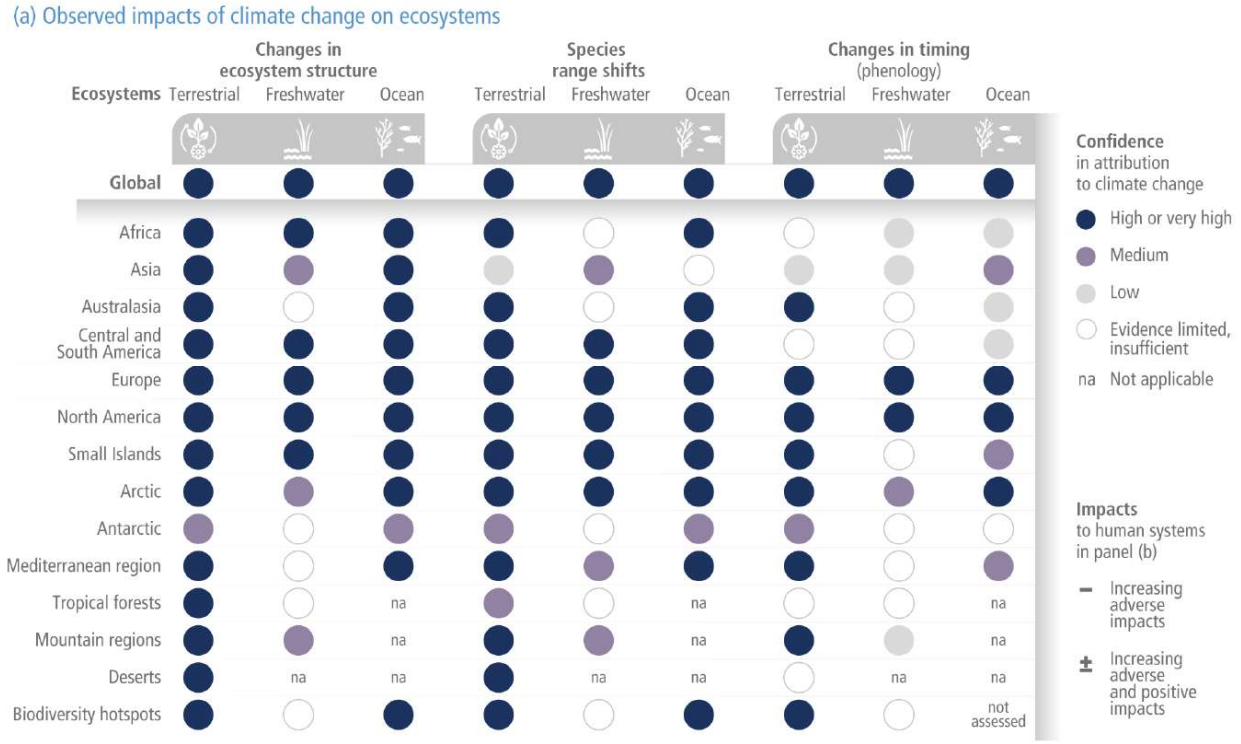
Why is biodiversity important? How much biodiversity do we have in the world? How much are we losing?

- https://www.isprambiente.gov.it/it/attivita/biodiversita/le-domande-piu-frequenti-sulla-biodiversita/cose-la-biodiversita
- https://www.iucn.org/regions

GROUP 2: CLIMATE CHANGE AND BIODIVERSITY LOSS

What are the main threats to biodiversity? The role of man.

- https://www.isprambiente.gov.it/it/attivita/biodiversita/le-domande-piu-frequenti-sulla-biodiversita/quali-sono-le-relazioni-tra-biodiversita-e-cambiamenti-climatici
- https://www.focus.it/ambiente/ecologia/cambiamento-climatico-giornata-mondiale-della-terra-crisi-biodiversita-affrontare-insieme
- https://ilbolive.unipd.it/it/news/ipcc-limpatto-cambiamenti-climatici-sulla



GROUP 3: WILD ANIMALS AND PLANTS THREATENED WITH EXTINCTION IN EUROPE

What are they? What are the causes?

- https://www.europarl.europa.eu/news/it/headlines/society/20200519STO79424/biodiversita-i-dati-sulle-specie-a-rischio-in-europa-infografica

- https://www.euronews.com/green/2023/06/07/we-must-end-this-war-on-nature-europes-most-endangered-species-to-protect-on-world-wildlif

GROUP 4: WILD ANIMALS AND PLANTS THREATENED WITH EXTINCTION IN ITALY:

What are they? What are the causes?

- https://www.wwf.it/specie-e-habitat/specie/
- https://www.repubblica.it/green-and-blue/2022/03/03/news/animali_fauna_selvatica_italia_a_rischio_di_estinzione-339941066/

FINAL DEBATE (1 hour)

At the end of the group work, all students come together to present their research findings with PPT or Keynote presentations.

Students discuss among themselves and answer the questions.

- How can the loss of biodiversity be remedied?

- What measures should national governments take?

- What behaviors should everyone take to protect flora and fauna?

FINAL PRODUCT (2 hours)

Students develop a concise infographic to be disseminated in the school via the official social, the website and posters on school premises.

EVALUATION

Evaluation of the work (group work, production of presentations and infographics) is done using specific evaluation rubrics.

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