LEVEL	1
LEARNINGOUTCOME	LO2 Students can follow the principles of sustainable development and environmental system management
SPECIFIC LEARNING OUTCOME	Students can explain the principles of management of environmental system
KEYWORDS	Human impact, solutions, innovation
INTRODUCTION	After identifying the major sustainability challenges,now you can learn how to face these issues minimizing as much as you can human impact.
HOW TO WORKWITH THIS MATERIAL	Read the text and follow the instructions
TIMING	approx. 4 hours

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1. Introduction

The environmental impact associated with any type of human activity represents the fundamental object on which to focus our attention when we want to talk on sustainable development. Everything can be done in a thousand of different ways but, among all the possibilities, we can certainly identify one that provides for a lesser impact. Being sustainable is this: it is a way of thinking, a way of being, a way to feel useful but above all it is the only way to act to ensure a future on earth for human beings.

We define the **management of environmental systems** as all procedures that we can use to minimize our impact.

2. Let's start: think in a sustainable way!

Find a sustainable solution to these situations: write on the right your answers.

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You have to visit a friend who is in the village near yours (4km). In which way you decide to go there?	_____ _____ _____
You are at the supermarket and you want to buy yourself something for a snack: what do you choose?	_____ _____ _____
Your parents have to buy a car. What would you recommend if they ask your opinion?	_____ _____ _____
You are you in charge of emptying the trash in your classroom. How do you do it?	_____ _____ _____

Compare your answers with your classmates or with the teacher.

3. Waste

3.1 Waste management: the first human challenge

Waste has always represented one of the major problems to find a solution since thebirth of the concept of sustainable development. The management of this problem can be summarized by the famous rule introduced in the 80s with the name of"**Rule of the 4 Rs**", so defined as the four keywords that summarize the mode of action all begin with the letter R. Furthermore, the four practices follow each other inorder from that more important to the one with less efficacy.

Let's see these rule! The Rule of the 4 Rs provides:

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REDUCE > REUSE > RECYCLING > RECOVERY (of energy)

1 - REDUCE: If the problem is waste, the first thing to do is to**act in order to prevent the problem**, **reducing its production**. Practically we can for example:

- Buy raw materials and products without or with reduced packaging.
- Consider the option of repairing items and tools before replacing them with new ones.
- At home, acquire suitable quantities of food products commensurate with familymembers, especially for those with a short term.
- Prefer biodegradable products (objects made of materials that dissolve in nature in ashort time without polluting).
- Use metal water bottles and thermos instead of buying plastic bottled water.
- Use cloth tissue instead of paper ones.
- Opt, whenever possible, for a digital book.

2 - REUSE: before considering some objects a waste, evaluate the possibility **of using them again for the same purpose or for different purposes**, extending their life as much as possible. Also evaluate the **creative reuse**: through creativity and a little dexterity, objects that have now completed their role for the purpose for which they were built, are used to create new objects. A classic example are the pallets which, suitably modified, can be transformed into functional tables or sofas.

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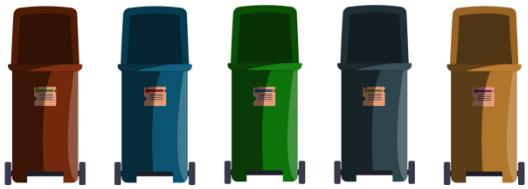
3- RECYCLING: If we can no longer reuse an object, we can **reuse the raw material it is made of to produce new things**. In fact, recycling means giving new life to raw materials. In order to be able to recycle it is, first, necessary to carry out a **separate collection of waste**, that is, a division of the waste according to the raw

materials of which they are composed. Each city has specific modes and bins of different colours for each material. In general paper, metals, plastic and glass are everywhere collected separated. Aluminium that we use now comes from 100% recycled aluminium. Today it is cheaper to procure this raw material from waste than to extract it from the minerals in which it is contained and the impact is minimum. Recycled plastic is often used to produce synthetic textile fibres from which technicalwinter sports clothing is made.



Paper is another classic example where recycling adds value to waste by producing new paper without cutting down trees. Another way to produce paper in a

sustainable way is also the one linked to **FSC brand**, in which to produce paper, cellulose is obtained from sustainably managed forests, by planting trees instead of those felled.

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ACTIVITY: Do you know how separate waste collection works in your school area?

Find all the information and create, working in team, a poster to hang up in your classroom with the right indications to make right waste collection! You can use www.canva.com

Recycling works if all those involved in separate collection do their job well: citizens firstof all!

4 - RECOVERY (ENERGY): if we cannot reuse or recycle, an alternative to landfill is to **use waste to produce electricity** using it as a fuel. This point provides for the sorting of waste and suitable waste is used in waste-to-energy plants. These realpower plants produce energy by burning waste.

Energy recovery, while being a valid alternative to landfill, leads to the formation of toxic and highly polluting solid and gaseous substances that must in turn be disposed of properly before being released into the environment.

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3.2 Activity: use the "4 Rs" rule to analyse the management of a water plastic bottle

Try to define in which way you can manage as a waste a water plastic bottle following the scheme proposed below. After that, compare your observations with your classmates.

REDUCE	REUSE	RECYCLE	RECOVERY

3.3 Composting: a solution to reduce the impact of household waste

If weanalyse the composition of household waste, more than 30% is made of organic waste, i.e. food waste and easily biodegradable plantresidues. An excellent solution for disposing of thiswaste is **composting**. In this way, the formation of gases and leachate in landfills is reduced and the impact of the greenhouse effect is lowered throughthe "confinement" of carbon in the soil.

Composting consists in the transformation of the organic waste produced at home or in restaurants into an excellent fertilizer rich in humus

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for the soil, called Compost. This can be used in the garden or in pots and helps improve the physical characteristics of the soil by reducing the use of chemical fertilizers and pesticides.

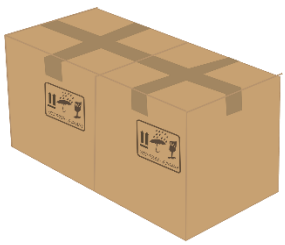
To obtain compost, all you have to do is to collect the suitable component of the organic waste produced in a hole in the garden or in a container, called a composter, with the base connected to the ground and wait a few months for transformation into compost.

The process is carried out by the **FBI**, that is, **F**ungi, **B**acteria and **I**nvertebrates (worms) that live in the soil. These decomposing organisms degrade and process organic matter, transforming everything into compost in a natural way.

We can divide waste in three big groups: **compost, recycle things and trash**, nonrecyclable waste. If you want to evaluate your ability to distinguish waste into these three types, **try this online game:** https://www.turtlediary.com/game/recycling- waste.html

3.4 Packaging: origin of more than half of our waste

Packaging is "material" used to wrap or protect goods used for enclosing or protecting products for distribution, storage, sale, and



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use. On it, we could find information to consumers such as contents of packaging, ingredients, quantity, date of manufacture and expiryand cost of product etc.

Packaging comes in different forms, in different sizes and uses different types of materials depending on the items or the products they are protecting. There are a number of benefits to packaging that push human beings to use them. They are barrier protection for the products from dust, water, other contamination, from physical dropping or shock.

The single use packaging is one the biggest environmental challenge. Plastic packaging is mostly single-use, especially in business-to-consumer product, and a majority of it is discarded the same year it is produced. Nearly 50 percent of the plastic waste generatedglobally in 2015 was plastic packaging. Much of this packaging, including polystyrene and other plastics, does not break down quickly and when they are disposed in landfills, they create long-term environmental problems. The production of packaging uses naturalresources including water, and electricity

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that has independent environmental impacts. **Think how can make sustainable packaging is very important to reduce waste.**

Have a look at these two videos and try to identify in which way we can manage packagingin a sustainable way. Put the keywords in the diagram, at the ends of the arrows.

https://www.youtube.com/watch?v=IfF7QO7F_p0

https://www.youtube.com/watch?v=Dy4aTT4Bnnk

Activity: Packaging: make it better!

Take a package of cookies or other food product you have at home. Analyze it according to the keywords that you have identified. Try to define ways in which the packaging can be improved.

Compare observations on your product with your classmates and with your teacher.

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4. Our weak point: dependence on fossil fuels

Another great challenge for sustainability is to reduce our dependence on fossil fuels quickly. In particular, we have seen that the two major sectors in which we need to make significant changes are **energy production and transport**. Let's see what human beings have done and what still needs to be done in these two areas.

4.1 Energy:

World energy production is directly linked to fossil fuels. Although we know that these types of resources will run out shortly, more than 75% of the world's energy is still obtained through the combustion of coal, oil derivatives and natural gas.

If you want to know some data for the whole world, Europe or your country, go to this site: https://energyeducation.ca/encyclopedia/Energy_production; at the end of the page you will find a graphic card where you can choose the reference year.

Promoting the production of energy starting from renewable sources represents animportant starting point on which human beings are working on. **Renewable sources of energy are any natural resource**

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that can replacethemselves quickly and dependably. They are abundant, sustainable, and environmentally friendly. These sources are:

- **Sunlight**: the solar photon flux can be converted to heat, electricity or chemical energy.

- **Wind**: the motion of air molecules can be harvested in wind turbines that spin the shaft of electric generators or in windmills.

- **Biomass**: organic materials can be used for cooking and heating, as well as to produce electricity and liquid transportation fuels.
- **Earth's internal heat**: can be used for heating and electricity production.
- **Water**: potential and kinetic energy of flowing water can be tapped to produce electricity or mechanical tasks.

We define **renewable or green,** the energy produced using these kinds of resources.

Renewable energy is important for many different reasons: it reduces global warming emissions, air and water pollution and the industry creates more employment opportunities and other economic benefits. Have a look at this video to know how we can use it: https://www.youtube.com/watch?v=Giek094C_l4

Another possibility to reduce the energy-related impact is to act by **decreasing energy consumption**. To do this, all of us must be willing to change our habits at home, at schooland at work.

In this case, we have an excellent ally: technology! Thanks to technology, year after year we invent machines that are increasingly complex butabove all more efficient

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to do the same things. For example, think of the energy savings linked to the introduction of LED lights instead of incandescent bulbs, or how much more thermally insulated are our homes than in the past thanks to new generation windows or insulating panels.

4.2 Teamwork: Energy Decalogue for a sustainable school

Work in team to find ten rules that everyone should follow at school to reduce unnecessaryenergy consumption.

You can draw up your Decalogue graphically with www.canva.com!

4.3 Activity: can 100% renewable energy power the world?

Let's reflect on this! Open this link: https://ed.ted.com/on/kelequqM, watch the video and then answer the questions.

4.4 Transport: Let's change our habits!

Transport represents another sector of high impact on the planet but in which we can act and make many sustainable choices. Mobility is linked to the use of fuels, the relative

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production of smog, fine dust and air pollution. Trying to act on transports and make mobility sustainable is thereforevery important.

Here there are some ways to reduce impact:

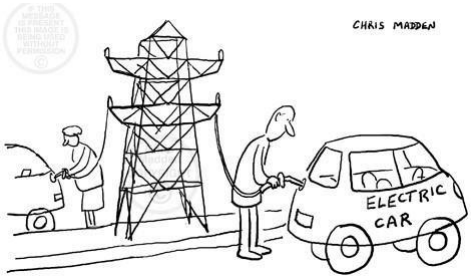
- **Use the bicycle or walk,** when it is possible: the bicycle is the symbol of sustainability. It does not pollute, allows you to avoid traffic and it is useful for our health. In particular, in large cities sustainable territorial planning and the implementation of an effective network of cycle paths have encouraged many people to prefer two wheels to cars. In addition, to allow commuters to use bicycles, the phenomenon of Bike Sharing has spread.

- **Bike Sharing** is a bicycle sharing service activated in many cities of Europe. Next to the bikes, you could find many other non-motorized transport systems. With a simple subscription service, bicycles can be used within urban areas. You can pick up and drop off your bike at any rest station or, if equipped with GPS, they could simply be left everywhere. In this case, the use of a simple App will indicate the right positions to otherpeople.
- **Use public transport and the train to the car**: When traveling, when possible, we can be more sustainable if we opt for the use of public transport such as buses, trolley buses and buses. The impact on the environment is in fact less compared to the use of the carfor the same

number of people. Furthermore, in large cities many public vehicles are electric and do not produce smog.

- **Promote the purchase of less polluting cars**: when someone wants to buy a car, a sustainable choice could be to consider one with low gases impact. It will be a good idea to shift from a diesel or petrol car to **methane** ones. In this last case it produces only water and carbon dioxide as exhaust gas. Another option it will be **hybrid car** with a double propulsion system, one of which is electric. Compared to cars belonging to an older generation,

these latter options have better performance, reduced operating costs, thanks to incentives and lower costs for refuelling, and the advantage of being much less polluting.



- **Car Sharing and Carpooling** are other two methods to reduce impact. As with bicycles, a car sharing system has been introduced in many cities, mostly electric and small vehicles, to solve the problem of pollution as well as the difficulty of finding parking. Carpooling involves sharing the car and the available seats between people who have to travel the same route. **Blablacar** is an excellent example of this. Unlike the previous method, the means of transport

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therefore belongs to private persons. Let's recap the things we said about sustainable mobility watching this video:

https://youtu.be/8Fj2ARn1WMY

4.5 Activity: eco mobility student for a week!

Use your smartphone or your computer to define the route you take every day to go and come back to school and identify the high-impact ways you move. Take information about alternatives to move and find a different solution to reach the school that produce less impact. Try to involve your classmates in the same reflections and all together for a week use the alternatives identified! At the end, developed through a brainstorming led by the teacher theexperience by sharing observations and emotions.

4.6 Activity: Eco mobility possibilities!

With your classmates, find information on all the ways to move in a sustainable way in your area: cycle paths, pedestrian paths, bus lines and stops, railway stations, bike-sharing stations etc. Try to **create a map of sustainable mobility** in your area with the help of the teacher.

5. Climate Change: what we can do?

Climate change is a complex process that cannot be stopped in its dynamics. If today we cancelled all our greenhouse gas emissions, it would still take

hundreds of years before the concentration curve of carbon dioxide and other greenhouse gases stabilizes, and it would take even longer for the temperature to stop to increase. What we can do is trying to limit or slow it down: **the goal is to contain concentration of carbon dioxide within the 450 ppm (parts per million) level** that it would allow heating to be kept within the 2° C threshold. We all have to take action to reach the goal. All the ways through which we can fight climate change can be divided in two kind of actions: **Mitigation and Adaptation.** With **Mitigation** we indicate the **strategies to work on the CAUSES of climate change**, with the aim of slowing down the trend of the phenomenon, of reducing or eliminating the factors that cause it. The main mitigation strategy is reduction emissions due to human activities (energy, industry, transport…). Even if they represent in theory a permanent and incisive solution, the mitigation actions are effective only in the long term. The **Kyoto Protocol** is therefore an example of a mitigation policy and the development of renewable sources and in general the improvement of energy efficiency are other types of choices made with a viewto mitigation.

Adaptation provides for **interventions on EFFECTS climate change** and tend to reduce vulnerability territorial, preventing their negative consequences and minimizing damage. It represents the set of actions, plans and interventions aimed at "preparing" the territory for the impacts due to the alteration of the climate, **for prevent possible damage and**

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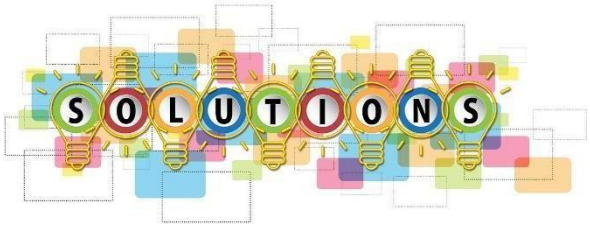
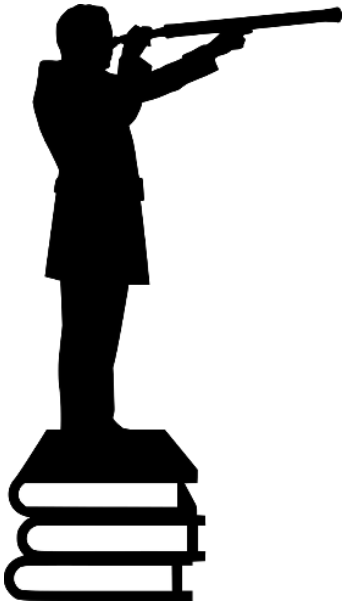


limit the extent of environmental consequences e socio-economic.

In order to implement adaptation actions, it is necessary to study the characteristics of theplaces (monitoring, simulations, scenarios), know the risks and evaluate the possible impacts. As they are linked to the peculiarities and vulnerability of the different territories, **they are local actions**. Even if they do not solve the problem at the origin, they are effective in the short term and represent a direct and immediate response to the consequences of climate change. This means that the results are more tangible and that the perception of improvement is immediate.

All the things we can do for mitigation of climate change are closely linked to the reduction of all those types of human impact that directly or indirectly lead to the increase of greenhouse gases. The six main human sectors on which action must be taken**: industry, agriculture and food, transport, energy, forests and land use.**



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Kyoto Protocol

If you want to know more about this important, what the protocol is you can see this video: https://www.youtube.com/watch?v=DFhuNKNDrLg

5.1 Activity: Mitigation or Adaptation?

Understanding the difference between the two strategies is important. What type of measure does each example below represent: adaptation or mitigation? Justify your answer.

	Mitigation	Adaptation
Designate more forests as protected areas.		
Improve roads, bridges and building design to resist weather damage.		
Protect homes and buildings from flooding.		
Invest in ways to absorb rainwater, like « green » roofs and porous driveways		
Promote water and energy conservation.		
Invest in or provide rebates for energy efficient fridges, furnaces, and appliances.		
Promote cycling, walking and taking transit as alternatives to driving.		

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Increase sources of renewable energy like wind and solar		
Improve industrial processes to use less energy and materials.		
Plant trees		

5.2 Activity: Climate Change, what you can?

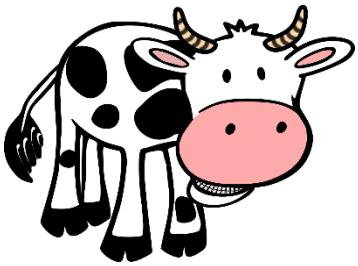
Make a list of things you can do during your day to work against climate change. If you want, compare your list with that of your classmates and think about both similar and different choices. Try to make a single common list that everyone could follow during school time!

6. Food impact solutions

For all living beings, food is necessary to live, but the quality, quantity and type of this food can greatly influence the state of health both of the environment. This means that **every day it is necessary to choose a diet that is sustainable for our planet**! Let's see together what we can do for reduce the impact connected with food.

- **Buy local products**: Buying local meansprivileging the short supply chain, thatis, reducing the steps between producers and consumers, eliminating intermediaries, with the advantages ofreducing environmental impacts and supporting farmers in our area and reducing weekly spending. Longer is the journey made by a food, greater is thepollution, energy consumption and greenhouse gas emission.
- **Eat seasonal produce:** In addition to the importance of a varied diet, seasonalityreduces the need for conservation and transport.

- **Cut down on your meat consumption:** because the meat we eat comes mainly fromintensive farming, meat consumption is the cause of veryserious environmental problems: climate change, pollution, water consumption, loss of biodiversity, deforestation and consumption of fossil resources. If youdon't want to give up on meat, reduces the number of times you eat it, consuming less and better quality and replacing the rest with otherprotein sources.



- **Reduce food waste:** The size of the waste has unacceptable numbers: 1/3 of worldproduction does not reach our bellies! **The main reason for this waste is carelessness**:

larger quantities are purchased than necessary and they are not stored properly. To reduce waste at home, we can prepare a shopping list, check the expiration dates at the time of purchase and make sure the refrigerator is working properly, for proper storage. When cooking, pay

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attention to the quantities; eat small portions because you can always have an encore!

- **Give preference to organic products:** Organic farming is an agricultural production system, both plant and animal, that seeks to reduce the environmental impact of production activities as much as possible, respecting ecological processes, resources (primarily soil and water) and biodiversity. Organic farming, by prohibiting the use of fertilizers and chemicals for plants, such as antibiotics and hormones for animals, significantly reduces the risk of water contamination and bioaccumulation of toxic substances in the food web.
- **Try not to buy products with too much packaging**: About 40% of the waste is made of packaging. The solution lies in the choice of bulk and **draft products** (consumers go to the points of sale equipped with a container and then they will fill thanks to the dispenser system) which aim to reduce the necessary containers or to allow them to be reused respectively.

- **Try to avoid ready-to-eat foods:** This type of food (which also includes sauces, frozen foods, coffee pods, refrigerated ready meals, cereal bars, fruit already cut in trays and light products) has very high impacts, mainly due to energy demands in the production and storage phases.

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- **Drink tap water:** Think about the impact of manufacturing and disposing of plastic containers and the pollution from transport operations. The best water to drink is not necessarily found in a bottle but it reaches consumers' homes through the taps!
- **Use the stove correctly**: the correct use of the stove can help not to "burn" resources! For example, when you use the oven, you can cook several trays together and avoid opening the oven all the time. Other precautions may be the use of the lid and the pressure cooker.

6.1 Activity: food break at school with minimal impact!

Try making a list of possible school breaksnacks that minimize food-related impact! Share your choices and observations with other classmates and the teacher and try to organize a "**zero impact**" snack break! Help yourself with this table.

Snack or food	Why does it have a low environmental impact?

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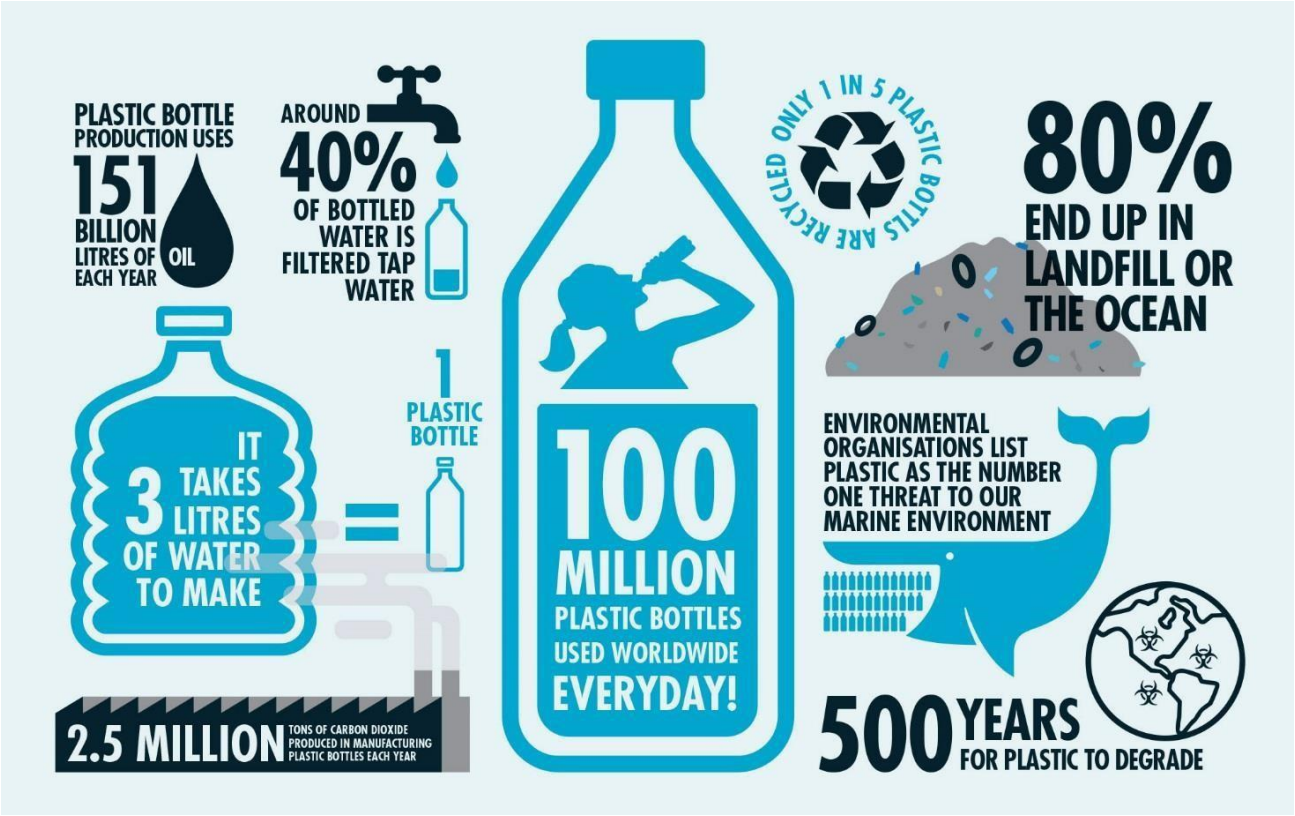
6.1 Let's reflect on water in plastic bottles.

Plastic bottled water is certainly an excellent example of how wrong choices can lead toa high impact on the environment. Let's try to understand things better through:

-Watch this video https://www.youtube.com/watch?v=Se12y9hSOM0&t=170s.

-Read the information in the figure.



Try to find:

- The types of impact related to plastic bottled water
- Possible concrete sustainable solutions to reduce this impact. In particular, think about what all the students in your school can do to do their part in solving the problem.

At the end, **compare your observations with those of your classmates through a teacher mediated debate.**

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7. The protection of Biodiversity

Biodiversity is another very important issue that has prompted human beings to define environmental management methods. Diversity in nature is indeed a value and as such, it must be protected as much as possible both by the state and by each of us. All these strategies are called **Conservation**.

The process of Conservation of biodiversity involves the **in-situ conservation**, where conserving and protecting the ecosystem will protect the entire biodiversity, and **ex-situ conservation**, which includes conservation measures when an organism is endangered. The main points to preserve biodiversity are:

- Protection against degradation and destruction of natural ecosystems; an important European initiative in this direction is **Habitats Directive** with the creation of "**Natura 2000**", a network of core breeding and resting sites for rare and threatened bird species and some exceptional natural habitats spread in Europe. In this website you can find all these areas: https://natura2000.eea.europa.eu/#
- **Maintain, restore, and increase ecological systems** promoting the implementation of better conservation practices; the rule of school in this point it is important!
- Identification and protection of endangered species
- Establishing **buffer zones** to prevent any alteration inthe balance of natural ecosystems
- Development Science, Technology and Research Tools for conserving biodiversity

- **Captive breeding and Gene banks**; in this case, if we

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are unable to provide for the salvation of endangered species today, we leave a science-bound hope for the future. What happens in Jurassic Park, the movie, is notso impossible!

Each of us has a fundamental role in protecting biodiversity in the areas where we live. Try to develop one of the following projects with your classmates to promote and safeguard biodiversity.

1.1 Group activity: tips to protect biodiversity!

Working in group, browse the attached file try to define some simple tips useful for allstudents to protect biodiversity in your school.

https://ec.europa.eu/environment/nature/info/pubs/docs/brochures/biodiversity_tips/ en.pdf

Expose your results to the other groups and to the teacher by creating a board orpresentation on the pc.

7.2 Activity: Build for Biodiversity!

Help to preserve biodiversity! Build birdhouses or insect shelters to put in your garden orschool! You can find information on how to build them in these links:

For bird's box:

https://www.welshwildlife.org/wpcontent/uploads/2011/10/Bird-Boxes.pdf
https://www.rspb.org.uk/globalassets/downloads/kids-schools/making-a-nestbox- activities.pdf
https://www.youtube.com/watch?v=IwJ8GYRluCk

For a bug's house:
https://www.merthyr.gov.uk/media/1236/how-to-build-a-bug-hotel.pdf
https://www.youtube.com/watch?v=Qpau_m2OCaE

8. Conclusion

The sustainable management of environmental systems and the impact linked to human activities are certainly the elements that we have to take care about. However, there are other fundamental concepts that contribute to achieving the common goal. Among these, must certainly be mentioned **education**, especially on the new generations, to respect the environment and sustainability, and the **example** that each one can give to other people.

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