



## Module 5: The Air I Breathe: Green Areas and Playgrounds in my School

### Introduction

Imagine a world of green around you. Visualize that you find yourself in the middle of a large forest. Close your eyes, breath deeply and feel the purity and clarity of the air that enters your lungs. Think about how, as you inhale and exhale air, you are actually introducing life and energy to your body.

Now open your eyes and observe what surrounds you. Are there plants, gardens, or trees close by? Or, instead, do you see walls, buildings, cars, large signs, and in general, asphalt and concrete? Now concentrate your attention on the aroma of the air. Do you detect any odors in particular like dust, cleaners, or smog? The majority of the time, they are imperceptible because we don't pay attention or we are accustomed to them, but in reality, the air that we breathe in the cities is not as pure as we would like to think. With this module, we will discover the possibilities for being an agent of change in a topic that literally, is of vital importance: improving the quality of the air in your environment.

### Objectives

By the end of this module, the teacher will be able to:

- Identify the basic concepts related to climate change.
- Analyze environmental services that the atmosphere provides.
- Understand the interaction between human beings and their atmosphere, and the implications.
- Understand the positive effect that a green area has on the environment.
- Learn to differentiate between manicured green areas and a wildlife habitat.
- Design a garden for your school as a hands-on project for cleaning the air.

### Themes

1. *Our Atmosphere*
2. *How it protects us and what affects it: contamination, greenhouse effect, ozone layer, climate change*
3. *Green areas and playgrounds in my school*
4. *Air quality*
5. *A world of interactions*
6. *Biodiversity: adaptations, local precedents*
7. *Children and the nature deficit*

8. *A world of challenges and opportunities*
9. *Green areas: environmental services*
10. *Deforestation and implications.*
11. *Reforestation.*
12. *Habitats, what they are and how they work*
13. *Native species*
14. *School habitats*
15. *Steps to create a sustainable green area*

### **1. Our atmosphere**

The air that all living beings share is an invisible layer that surrounds the Earth and which we call atmosphere. Just as the ocean is full of water, the atmosphere is full of air. Without air, life would not exist on Earth.

Like all other animals, we need oxygen to live. The food we eat, in combination with the oxygen in the air, produce the energy needed to live and extra carbon dioxide. With each breath, we inhale oxygen and exhale carbon dioxide. The carbon dioxide produced by animals (including man), is used by plants. Plants use energy from the sun to combine nutrients, water, and carbon dioxide and produce sugar and other molecules. During this process, which is called photosynthesis, plants continually produce oxygen that can be used by animals.

So, as plants and animals, we depend on each other to live. Animals produce the carbon dioxide

necessary for plants and plants produce the oxygen necessary for animals. This is to say, oxygen and carbon dioxide are the gases in the air that interconnect all plants and animals. Because of this, it is essential that an appropriate balance is maintained between both oxygen and carbon dioxide.

### **1.1 How does it protect us and what affects it?**

The Earth's atmosphere is primordial to life for many reasons. In addition to containing the necessary gases for animals and plants to live, it is also indispensable for protecting life on Earth, absorbing ultra-violet solar radiation in the ozone layer, reducing the differences in temperature between day and day, and acting as a shield to protect us against meteorites. Each one of the five atmospheric layers plays a different role.

The troposphere is the layer of air closest to the Earth. Climate, as in, wind and rain, occur here. Wind and rising air help remove contaminants from (streets, cities, and industrial zones. Rain contributes to diluting the contaminants in the atmosphere. Furthermore, water molecules in the air maintain the excess of trapped heat close to the surface of the Earth. This phenomenon is what keeps the surface of the Earth from freezing, which would make it impossible to maintain living beings.



The stratosphere, which is found above the troposphere, contains the ozone layer. The ozone (O<sub>3</sub>), is a type of special oxygen molecule. In the upper atmosphere, it protects plants and animals from excess harm due to ultraviolet radiation from the sun. In recent years, the amount of ozone in some parts of this layer has diminished due to the presence of contaminants, among them chlorofluorocarbons (CFCs), which, upon ascending toward the higher atmosphere, act as a catalyst for the destruction of the ozone faster than it can regenerate it, producing what we know as holes in the ozone layer. The knowledge that each one of these contaminating substances potentially causes depletion of the ozone, was discovered by Mexican Chemical Engineer Mario Molina, Nobel Prize Winner in Chemistry, 1995.

The ionosphere contains charged atoms and molecules that protect us from cosmic rays and from harmful radiation produced by the sun. Here you can also find the mesosphere and the thermosphere.

It is very important that we understand the atmosphere and how it helps protect our lives on Earth. This knowledge will help us repair and possibly even prevent potential problems. We can also find ozone (O<sub>3</sub>) in the lowest zone of the atmosphere, the troposphere. The ozone, in this case, also comes from contaminating compounds produced

by human activity. However, this can become a problem, since in sufficient concentration, it can provoke considerable harm to human health and vegetation.

## 1.2 The Greenhouse Effect

Solar light, which reaches the surface of the Earth and heats it, causes the earth to emit infrared rays (thermal waves) that, unlike the sun's rays, are absorbed by the atmosphere. The increase in the concentration or amount of carbon dioxide or other gases from the greenhouse effect in the air causes the Earth's temperature to rise more than we'd like. This effect of the increase in temperature caused by atmospheric gases is what we know as the Greenhouse Effect.

Modern industry and technology have, without a doubt, improved our lives, but at the same time, have caused the amount of carbon dioxide in our atmosphere to rise dramatically due to the presence of fossil fuels. Upon combustion, it causes the carbon in these to mix with the oxygen in the air to convert them into carbon dioxide (CO<sub>2</sub>). A rise in carbon dioxide in the air can induce the greenhouse effect. Other greenhouse gases include chlorofluorocarbons (CFC's) used in refrigeration and air conditioning, nitrous oxide (NO<sub>x</sub>), caused by contamination, and methane (CH<sub>4</sub>) produced by livestock and other chemical processes.



### 1.3 Global Warming

According to the Intergovernmental Panel of Climate Change, “the majority of the increases observed in the median temperatures worldwide since the middle of the 20th century are probably due to the observed rise in the concentration of anthropogenic Greenhouse Gases.”

This means that human activity, in the last century and the beginning of this one, has modified the atmosphere’s characteristics to a degree that no one had seen before. This could cause a rise in the sea level caused by the melting of the polar ice caps, causing inundations in inhabited coastal areas and modifying their profile.

Furthermore, this warming of the Earth’s surface can also change climate patterns, producing more violent storms like hurricanes and tornadoes. In turn, some areas of the Earth would get hotter and more arid, preventing the production of crops, which translates to a reduction in the availability of food at a global level.

### 1.4 Atmospheric Contamination

Contamination is caused by the release of chemical substances into the atmosphere that aren’t normally found. Many sources of contamination exist in the air, not only human but also natural. Forest fires, volcanic eruptions, and soil erosion are examples of natural sources of air contamination. Rain,

wind, and gravity are in charge of naturally cleaning the air of these contaminants, but with the rise in the use of fossil fuels and industrial activity, contaminants have been added to the air more quickly and in a higher concentration than natural forces are capable of removing them.

Contamination causes health problems for humans and animals, is detrimental to the vegetation and reduces food crops. It deteriorates buildings, and other objects. Air contamination generates foul odors and makes everything that surrounds us look dirty. On the other hand, humidity in the air absorbs sulfur dioxide and nitrous oxides contained in the smoke from burning fossil fuels. These substances acidify air molecules that are carried up into the atmosphere and later fall to the surface of the earth in the form of rain, snow, or fog. This is what is known as acid rain. When it is absorbed by the earth, it can release heavy metals that mix with water for human consumption. Air contamination is a phenomenon with global consequences, since some concentrated contaminants in the atmosphere are displaced by winds from the place they originated to locations far away, including other continents, before settling down.



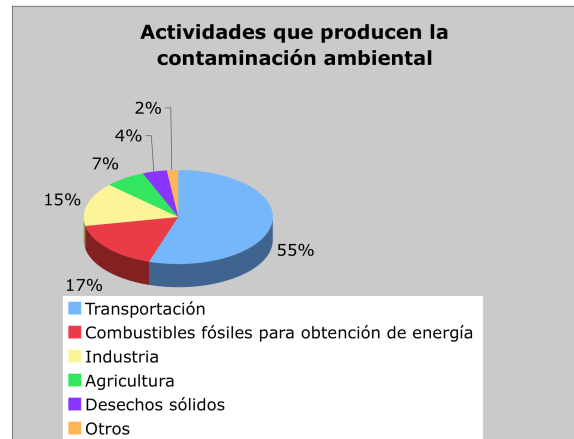
CONTAMINANT	HEALTH RISKS	SOURCE
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Sulfur dioxide (SO <sub>2</sub> )	Gas that causes irritation and inflammation to conjunctival and respiratory mucus membranes. Produces acid in the air.	Burning fossil fuels that contain sulfur in their composition.
Nitrogen oxide (NO <sub>x</sub> )	In high concentrations, it produces problems with olfactory perception, respiratory trouble, sharp respiratory pains, and pulmonary edema.	Excessive traffic, energy production plants, industrial and cultivation processes, bacterial decomposition and forest fires.
Particulate Material (PM <sub>10</sub> y PM <sub>2.5</sub> ) classified according to their size	Among the smaller particles, they penetrate the lungs with possible toxic effects. Linked to cancer and cardiac problems.	Mix of solid and liquid materials due to natural processes such as pollinization or anthropogenic sources from combustion to the fertilization and use of insecticides in the countryside.
Lead (Pb)	Its effect is cumulative and harms the central nervous system. It produces symptoms such as diarrhea, vomiting, head aches and convulsions.	Metal used in industrial processes and until some years ago, in combustibles, was emitted in the form of particulate material.
Carbon Monoxide (CO)	Is connected to hemoglobin of the blood and impedes the transport of oxygen throughout the body causing death. It contributes to the greenhouse effect, smog, and acidification of air.	Is formed through oxidation of methane and the incomplete burning of combustibles such as gasoline.
Ozone (O <sub>3</sub> )	Aggressive gas that easily penetrates the respiratory apparatus causing inflammation, depression of the immune system, and changes to the metabolic function. It also affects soft organs such as the liver.	Caused by the photochemical transport of oxygen because of other contaminating gases and ultraviolet sun rays.

Source: National Institute of Ecology, 2008.  
[www.ine.gob.mx/dgicur/calair/indicadores.html](http://www.ine.gob.mx/dgicur/calair/indicadores.html)

**Source: Environmental Atlas of the U.S./1993**

Today, diverse efforts are taking place between governmental entities, private initiatives, and individuals with the objective of reducing air contamination. Science and technology have reoriented towards developing cleaner forms of energy, have been effective at removing contaminating substances before they get to the atmosphere and finding alternate sources such as solar, wind, hydraulic, geothermic, and nuclear. Another way is to simply conserve energy.



**WANT TO KNOW MORE?  
SOME PUBLIC INITIATIVES FOR  
IMPROVING AIR QUALITY:**

- In 1990, the United States Congress creates the *Clean Air Act* to regulate control over environmental contamination, creating external connections and models for economic incentives.
- In 1989 the *Montreal Treaty* vigorously enters with the objective of gradually getting rid of the substances responsible for the destruction of the ozone layer. There are 191 nations participating.
- The binational program *Border 2012* is a 10-year plan whose objective is to improve environmental quality and life of the inhabitants of the border regions of the U.S. and Mexico. It is represented by the Secretary of the Environment and Natural Resources and the *Environmental Protection Agency*.
- For the border regions, the *Center of Information for Air Contamination* provides technical support and bilingual assistance to evaluate contamination in this area. Their counterpart in the United States offers information about contamination in real time: *Border Air Quality Data*.

**2. Green Areas and Air Quality**

Human activity has taken more from nature than what corresponds to its share. In many cases, the lack of city planning due to pressure from uncontrolled population growth, has left insufficient green areas. Views that traditionally only look at recreation areas as important wildlife habitats often don't take into consideration their participation in the hydrobiologic cycles of nature or of their primary role as creators of oxygen.

The relationship between green areas per inhabitant in many cities, above all in the urban areas of more developed countries, is minimal. According to the World Health Organization, the ideal index is 9m2 of public green area per person.

The reason man has separated himself from his environment is not only economic. What makes it worse is that we live in a technological culture, in which children are given the choice of virtually knowing their



surroundings, with minimal contact with the natural world. Add to this that their environment is stripped of countryside, trees, clean water arroyos, wildlife, and that during their development, they do not have the opportunity to explore, discover, or make the connections necessary for understanding their role as members of a biological community.

Forests and jungles, and to a lesser extent, parks and gardens, are the lungs of the planet. The way to balance and re-establish the quality of air is very clear: restore green areas, make the energy that fossil fuels provides more efficient, responsibly dispose of waste and educate future generations about the concept of sustainability.

### **2.1. A world of interactions**

Everything is interconnected. In what seems to be an extraordinary and perfect equilibrium, every piece of the framework of life on Earth has its place and function. The trophic chain shows us the relationships between species, from the smallest one-celled organisms to the most complex mammal- each of which has an established role in the food chain and provides nutrients and energy necessary for their life inside the ecosystem.

Species are interdependent among themselves as food sources and through exchanging oxygen and carbon dioxide. At the same time, plant and animal species interact and

depend on each other to satisfy their necessities for protection and shelter, and to help in the pollinization and distribution of seeds. Also, the plant and animal world has provided man, thanks to the sciences, with unparalleled contributions to medicine, biology, and the understanding of our role in the chain of life.

However, human activity - beginning with the Industrial Revolution, and followed by urban expansion as a result of unchecked demographic growth, the indiscriminate deforestation of forests and jungles, and climate change - has inevitably brought about the loss of habitats for many species. According to studies done by the organization Conservation International, 23.9% of biogeographic systems on Earth have been completely transformed due to man's actions. It's believed that we lose a species every 20 minutes and that currently, 11 thousand species are in danger of extinction.

### **2.2. Biodiversity**

Biodiversity is described as the enormous variety of living elements that are found in the world and the standards they conform to, meaning the ecosystems in which they interact. Every ecosystem has a characteristic physical environment, including its climate and altitude, which produces a type of dominant



vegetation. The plants and animals that inhabit an ecosystem have adapted to the environment and inherit the characteristics appropriate for living within it. It's recognized that biological diversity is an important measure to the health of an ecosystem as it offers greater opportunities for the survival of species facing sudden change, like the impact of humans or climate change.

Plant and animal species, except for man, don't recognize geographic or socio-political boundaries that limit their patterns of transportation and behavior. Rather, they have started adapting to the space and environment that is provided to them. In the last 100 years, the characteristics of the border regions between the United States and Mexico have suffered many changes. The rise of populations within cities, the change in the use of the land to areas of cultivation or for livestock, and the lack of knowledge about the value of biodiversity, have caused loss of habitats for many endemic species, including some that have become completely extinct. Do you remember the place where you lived as a child? Are there any plant or animal species that you remember that were common then and that aren't around now? What were your surroundings like?

Without a doubt, the development and economic exchange between both countries has brought riches in

many ways, but there have also been consequences that have influenced not only the natural environment but also the culture and behavior of people. If we reflect over our lifestyle today compared to that of our parents and grandparents, we will discover vast differences. The manner of interaction with the environment, from stocking up on food, to transportation, were vastly different than our lifestyle today. Also, their recreational activities were outside and included riding bikes, taking walks, or being in contact with nature. Conversely, what are the recreational activities of today's generations?

### **2.3. Children and nature's deficit**

Scholars of modern psychology recognize the consequences of this cultural change in the general well-being of everyone in today's generation. Richard Louv, author of the book "Last Child in the Woods," mentions that the lack of connection between children and their environment has brought a rise in obesity, attention deficits, and youthful depression. The name "Nature Deficit Syndrome" is not an official diagnosis, but rather a mode of seeing the problem and discovering the human costs of detachment from the environment.

This disorder can be detected in individuals, families, and communities. Individuals have lost the feeling of what the author calls "compassionate intelligence," which



observe the well-being of all living beings as the guiding principle. This concept is based on the idea that a child should have a connection with their family and then later, with the Earth.

Note that in every culture, children begin the process of individualization around the age of seven, extending the bonds of affection, loyalty, and learning farther than the family. If their culture has a respect and affection for the natural world as one of their priorities, their attachment with the Earth will happen naturally. Ready or not, children create a bond with something outside of their family, and if they don't do it with their natural environment, then they will do it with the predominant culture, gradually losing a feeling of belonging towards the marvelous natural world.

### ***3. A world of challenges and opportunities***

Man is attracted to challenges. This essential characteristic has led to the most important discoveries and inventions for resolving technological and health challenges. Because of this, upon recently finding ourselves facing the reality that climate change has posed for us, efforts have united in the search for alternatives. It is necessary to understand the background of the problems that affect us locally and globally in order to make a personal commitment to the environment. In

this case in particular, the quality of air that we breathe is being affected, as we mentioned earlier, due to the disequilibrium between the gases that comprise the atmosphere and the environmental contamination due to natural human activities and the exploitation of resources.

#### **3.1. Green areas and environmental services**

In order to clearly understand the role that the planet's large expanses of green areas play, the concept of environmental services was coined as a model for conservation and sustainable production which aims to improve perspectives on development.

Environmental services refer to the processes and functions of ecosystems that, in addition to directly influencing the maintenance of life, generate individual and community well-being. These services offer intangible benefits which are indirect and often understood as components and processes towards integrating ecosystems.

Among the main ones:

- Climate regulation and lessening the impact of natural phenomena.
- Water provision in sufficient quality and quantity.
- Generation of oxygen.
- Control of soil erosion, generation, conservation, and recuperation.



- Capturing carbon and the assimilation of diverse contaminants.
- Protection of biodiversity, ecosystems, and life forms.
- Pollinization of plants and the biological control of plagues.
- Degradation and recycling of organic waste.
- Beauty of the landscape and recreation.

Only by means of protection will the conservation and sustainable operations of resources in diverse natural areas of the planet make restoration and biospheric equilibrium possible. In order to find environmental conservation attractive within an economic model, formulas have been developed that offer an incentive to distinct agents for improving or decreasing the external costs (ecological imbalance) and raising the activities that generate benefits. These methods include direct controls (laws, regulations, rules) or economic instruments<sup>1</sup> that today are operating successfully.

### **3.2. Deforestation and implications**

Have you heard that jungles and forests are the “lungs” of the world? What would happen if you donated voluntarily one of yours? Surely your capacity to breathe would be enormously reduced and your way of life would completely change. Why, then, aren’t the implications that indiscriminate logging would bring to the environment better

anticipated? According to information published by the United Nations ((WRI/WCMC/WWF, 1997), 50% of forest surfaces on the Earth have disappeared. It is estimated that every day we lose 130,000 km<sup>2</sup> of tropical forests (a surface equal to the state of Durango).

Efforts to stop deforestation are happening slower than they should, but some successful cases do exist, like in Costa Rica, with its enormous biodiversity, that have favored a sustainable economic model based on ecotourism and forestry.

Deforestation is due to factors like the demand of agricultural activities, forest operations, and the expansion of the urban masses. This loss of forest density has caused the desertification of large territories that lose their capacity for capturing water and leaves them sterile. The consequences: species lose their habitat and with it their ability to sustain themselves.

Reforestation campaigns clearly serve restoration and recuperation objectives for environmental services that green areas provide us in direct and indirect ways.

### **3.3. What is a habitat and how does it work?**

A habitat is described as a space in which certain determined organisms find what is necessary for their



survival: food, water, protection, and a place to raise their young. The living elements that interact in it form a lively community. There are many distinct types of habitats derived from every particular combination of the physical environment and the living community. Species adapt to living in it with particular physical and chemical conditions that include climate (temperature and precipitation), land (its physiology and supply of water and air in roots), exposure to the sun and air composition, among others.

An urban green area, on the other hand, is a space designed inside a city (that in many cases was an extension of a forest) or that has been cultivated with the objective of offering environmental services to nearby residential, industrial, or commercial zones. These services include climate regulation, rainwater collection, improving the urban landscape, and functioning especially as a habitat for birds and small mammals like squirrels. In turn, they serve as extensions for recreational areas and well-being of local and visiting inhabitants.

### **3.4. Native species**

Native species are plants that occur naturally in a determined place and that have not been introduced from some faraway place. Native plants develop in their heyday in a place of origin without interrupting the natural ecologic processes because

they are designed for the specific conditions of that place. Wildlife in a particular area prospers among native plants that are already providing the most optimum elements for survival.

On the other hand, non-native species, or species that have been introduced, alter the ecosystem because they don't have natural predators and many times the native species aren't adapted to manage their presence, which can lead to their disappearance. If we want to attract wildlife and restore the species of our ecosystems, the best thing to do is reintroduce our native plant species, which cover the necessities of food and protection for the wildlife: bees, wasps, and butterflies, insects, salamanders, beetles, spiders, and thousands of others that sustain the food chain for animals like birds, squirrels, bats, frogs, reptiles, and turtles, among other. Native species have exceeded many of the species introduced to our landscapes in the last few years. Additionally, once established, they don't require fertilizer or irrigation.

The majority of local nurseries market native species. In some cities, nonprofit organizations and other groups promote the planting of native plants. Search online to find resources in your city. To access a complete list of the species in your area, we recommend contacting the offices of ecology in your state or city and in some cases, garden clubs.



#### ***4. Steps for creating a sustainable green area in my school:***

All the information we've shared up until now has been brought to us like a movie, a visualization of the Earth from space, with the atmosphere that surrounds it, its changing climate, its large expanse of green areas, its ecosystems, and little by little, we've gotten closer to the cities. Imagine now that we are flying towards your school and we see it from the air. What do we observe? Are there, perhaps, the roofs of buildings, patios, walkways, terraces, coverings, and....green areas? If you can't identify somewhere that calls your attention, it means that you're reading the right section. The objective of this section is to help you develop a high-impact school project beneficial to your area that will serve as:

- A habitat for the wildlife in your region.
- An open-air classroom for the entire school's use.
- An environmental service provider in your community.
- A space for enrichment and recreation.

#### **Steps to follow:**

**Next we present 9 (nine) steps.**

**Follow them to put sustainability into practice at your school:**

1. Investigate and plan the area. Establish a vision for your project and with a map of your school in hand, make an inventory and consider

available spaces, the traffic flow, and light and water.

You can utilize a space that's already planted and improve it as well.

2. Create a team. If you can get the entire staff enthusiastically involved, beginning with your principal, it is easier to be successful.
3. Develop a general concept for your green area that is accessible to everyone (including people with differing capabilities). The design should include plants and/or perennial or deciduous trees native to the region that can bring food and protection to diverse species (you can include trees with holes or small houses for birds) and a water source (drinking fountain for birds or a small pond).
4. With an outline of the design, integrate the community. Invite other teacher, parents, acquaintances, and/or experts that can volunteer their help in contributing ideas, resources, and work on the project.
5. Plan the construction. Consider all the necessary elements for constructing and planting the space and come up with a working plan that involves the participants in all aspects of execution. Make sure the goals and



- responsibilities are as clear as possible.
6. Come up with a budget. Based upon the list of requirements, establish necessary amounts of money and/or goods. Search for sponsors, donations, and organize fund-raising events.
  7. The big day. With all the elements in place, plan the construction and planting day as a big event in which everyone is invited to participate and celebrate. You can make an official inauguration inviting a renowned person in the community to cut the ribbon.
  8. It is very important that there is a person in charge of the work associated with cleaning, weeding, and watering (the native plants require moderate watering for at least a year after they are adequately established). In addition to the maintenance personnel, it's recommended to create work teams among the students so that they can develop a feeling of belonging. Vandalism can equally be prevented by encouraging all of the students to get closer to the space through academic or recreational activities so that they identify it as an area beneficial for their health and their environment. Using

signage that indicates how special the place is can also help.

9. We recommend that this space become a special place, commemorating dates like Tree Day, Earth Day, and other important celebrations. Keep a photographic registry of its evolution and growth and of any findings, and, above all, enjoy it!

**RESOURCES THAT CAN HELP YOU PROTECT GREEN AREAS IN YOUR SCHOOL:**

**Local Nurseries** or the **Agronomic Faculty** of your Local University.  
**Schoolyard Habitats Program de la NWF** (National Wildlife Federation). [www.nwf.org/schoolyard/](http://www.nwf.org/schoolyard/)

Some examples of these are: paying for carbon capture, projects for cleaner development, environmental service programs such as hydrolic, sustainable forestry, and ecotourism.