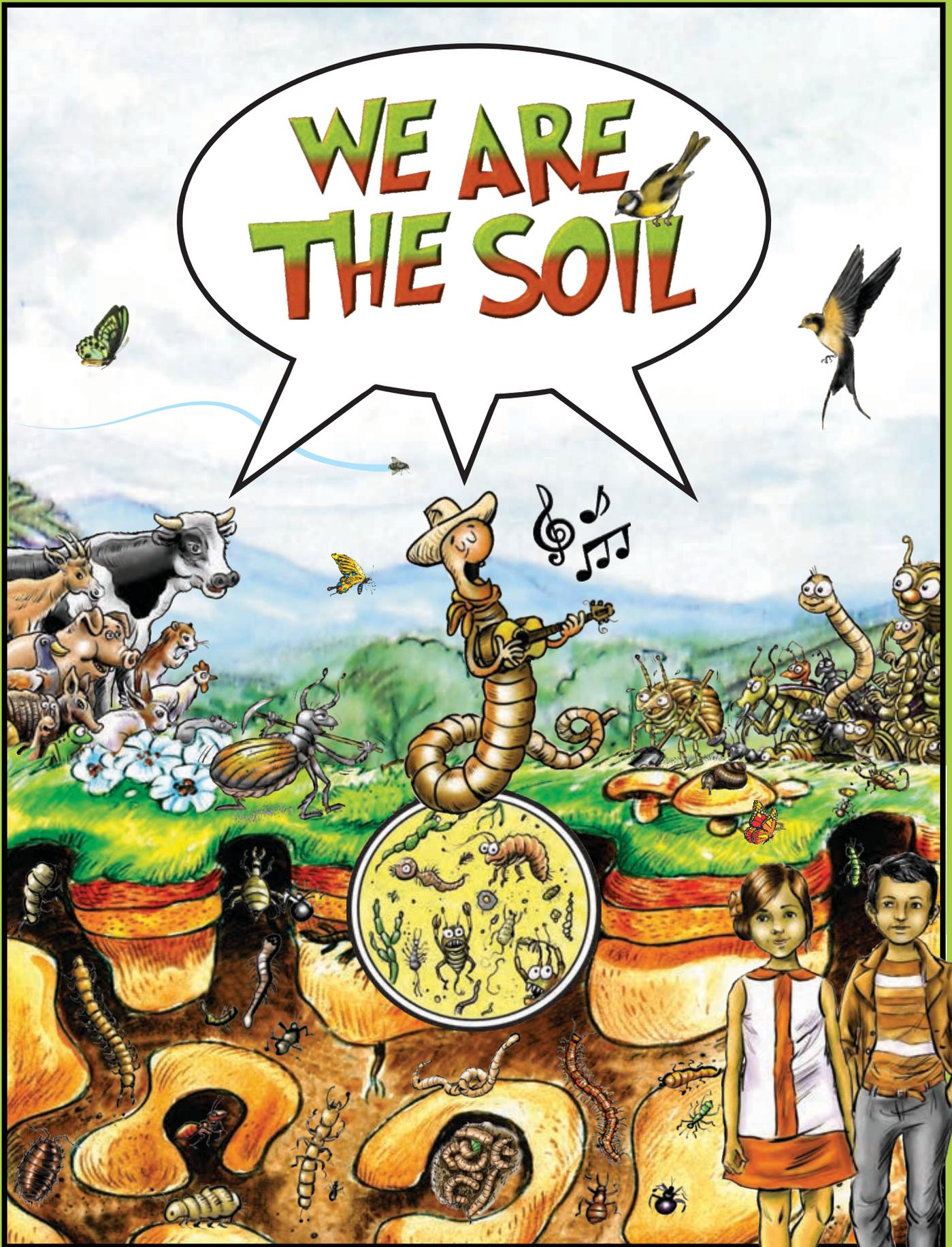


**WE ARE  
THE SOIL**



**KEEP SOIL ALIVE, PROTECT SOIL BIODIVERSITY**

# NATURAL AND AGRO-ECOSYSTEM

Maria and Thomas are two ordinary kids, like you and your friends. They live in a city, not very far from the place you see in this picture.

They seem a bit out of place standing there. Do you agree? Here's the thing: their parents were having a hard time getting them away from their computer screens. Does it sound familiar?

It's true that video games and the Internet can be a lot of fun, but there is another "Web" their parents want them to know: the Web of Life, those interactions in nature that sustain life.

So, instead of making yet harsher rules, mom and dad challenged their kids. They asked them to get out to the countryside, no cellphones allowed, and learn something new about nature. Maria and Thomas accepted, although unenthusiastically.

So, this is the beginning of the adventure. Their parents just dropped them off and the kids seem at a loss as to what to do next. They're not fully aware of it, but not having their phones is making them more observant of their surroundings. Maria noticed the leafy trees glistening in the morning sunlight and the bees pollinating flowers, which will become delicious fruits. The clear water running down the river and the animals placidly grazing called Thomas' attention. A bird flying over a cultivated field was nice to watch. It wasn't so bad after all!

Next, Thomas, who has a very good ear, thought he heard a little voice coming from a hole in the ground. Resisting the urge to run away, he got closer and saw a host of little creatures welcoming them into their world! He could hardly believe it! It was like stepping into another reality, just like in a video game!

The kids were baffled and amused to see an earthworm calling: "hey kids, get closer!" It was Will, one of soil's most celebrated residents. Will had crawled up to a plant and was standing on one of its leaves. "Welcome to our neck of the woods!" said Will cheerfully. "We're proud of our soil and we'd like to show you around!"

This beautiful place and many others like it in nature, provide us with energy, food, water and health. However, many of our visitors seldom consider how nature can stay healthy, bountiful, and beautiful.

Many people are surprised to learn that nature can take care of itself, if only we don't take too much from it. They look puzzled when I tell them nature's health has a lot to do with what happens in the soil below their feet.

I'll be glad to explain to you how me and many friends who call soil home, do what we love the most! But first, I'd love to tell you about *Photosynthesis*, because without it, none of us would exist.

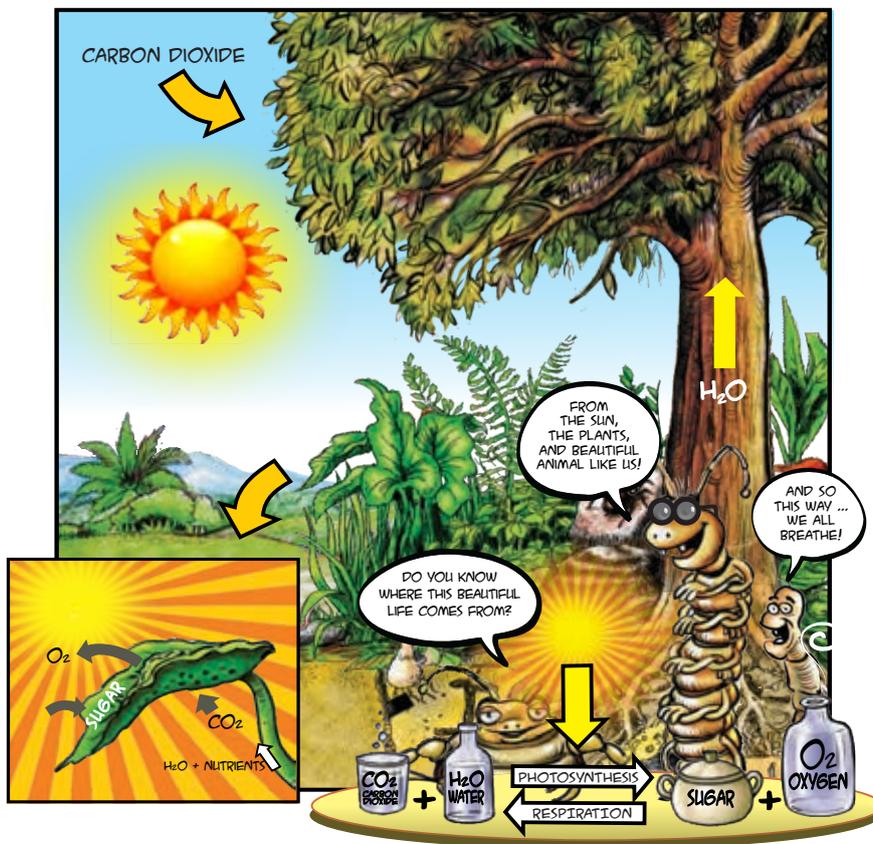




# WHERE ALL THIS LIFE COMES FROM?

All plants use their leaves, to absorb carbon dioxide ( $\text{CO}_2$ ) a colourless gas in the air we breathe. Leaves act as solar panels to capture the energy of the Sun. Plants use that solar energy to transform carbon dioxide, water ( $\text{H}_2\text{O}$ ) and some minerals from the soil into sugar, properly called glucose, and then, chains of different types of sugars, make carbohydrates. Carbohydrates are the most common type of organic compound in nature (made up of carbon, hydrogen and oxygen.) If you need to remember something about carbohydrates is that they can store energy that can later be used by other life-forms.

Plants are often described as little factories, making living tissues to build their leaves, flowers, fruits, seeds and wood (from carbohydrates). The amazing thing is that the oxygen we breathe is released by plants while doing it.



This process of transformation is called *Photosynthesis*. The only organisms in nature that can carry out *Photosynthesis* are plants and algae which contain chlorophyll, the pigment that gives them their green color and allow them to do it.

This is why plants are so important and are on the first level of the food chain. When other organisms eat those plants, they benefit from the organic matter full of nutrients created by them through *Photosynthesis*.

## WHO EATS WHO?

“And what is the food chain?” asked Maria.

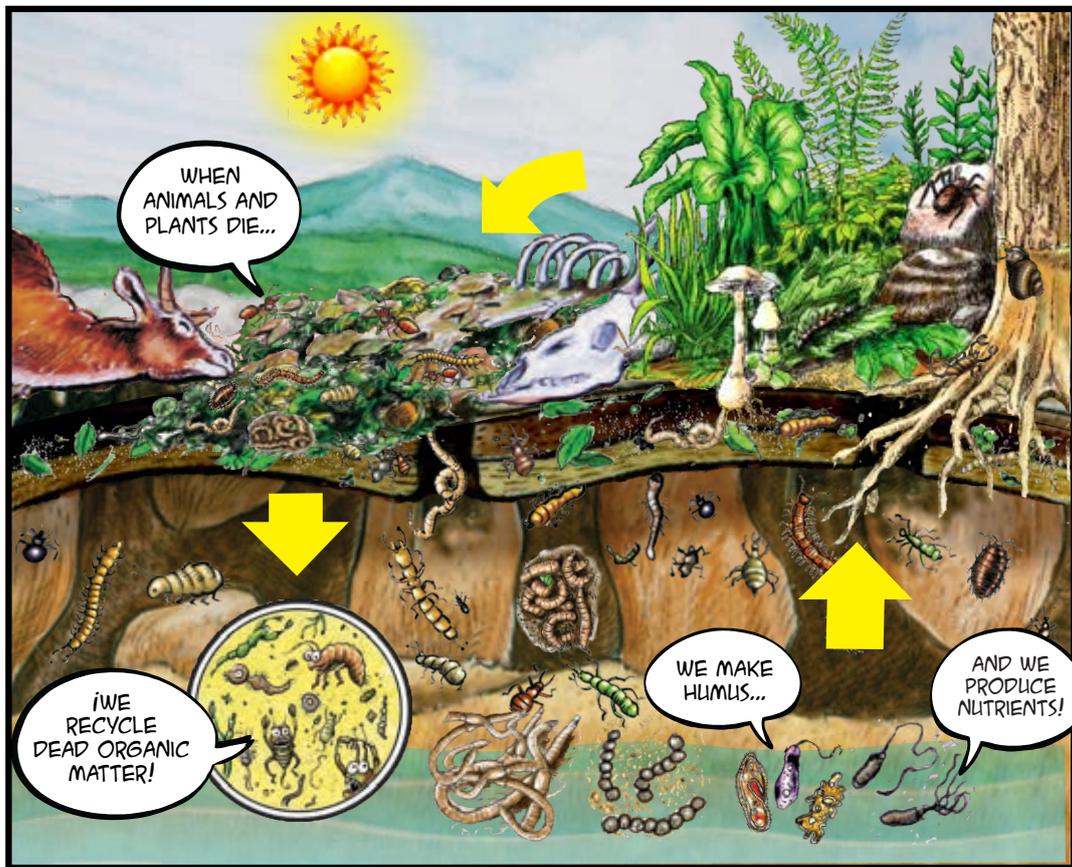
“You could answer this question by simply observing who eats what in nature” said Will.

You can see the food chain clearly with trees and big animals above ground, but underground, the same thing is happening! Everything starts with the wonderful plants, which make their own food and serve as food to a great number of life-forms. Then come herbivores, organisms which eat only plants. Then, animals known as carnivores, which are predators that hunt and eat those herbivores. Most humans are omnivores, because you eat plants, herbivores and carnivores. Or are you vegetarian?





*Humus* can be lost gradually or it can happen quickly. In any case, what's important is to protect it! I and my soil-mates are in charge of decomposing dead organic matter to transform it as *Humus* or minerals. We're many and quite diverse bunch of professional decomposers getting the job done! Soil is actually teeming with life. You'd be surprised to know that we represent about 25% of all living organisms on this planet! How could we be ignored? There can be from 10,000 to 50,000 (and even more) species of bacteria in a single teaspoon of soil!



Other very diverse organisms in the soil are fungi. Mushrooms are the reproductive organs of the fungi we see above ground. You probably know that some mushrooms are edible, while others are poisonous. But there is a lot more to them! Below ground, fungi grow a vast net called mycelium. It resembles a wide web or root system. Those “roots” called hyphae, are very thin and can extend themselves for kilometres!

My pals that make up the **mesofauna**, which include mites, springtails, some small ants and beetles, are tiny and many. They measure in average three times the thickness of a human hair, but we could count about 10,000 of them in each square meter of soil, from more than 200 different species!

I, my fellow earthworms and other amazing creatures like larvae, mature beetles, ants, termites, earwigs, sowbugs, centipedes, millipedes and spiders are the **macrofauna**. In average, there are 700 of us per square meter, also belonging to more than 200 species!

Some say there are more life-forms in the soil than stars in the universe!

The mesofauna and macrofauna crowd are the life-forms you can see with the naked eye. We're mostly responsible for breaking up and grinding leaf litter and wood. Then come the **microorganisms** crew, like bacteria and fungi, many of which are not visible at plain sight. They take over to finish the job of transforming organic matter into *Humus* and minerals.

So, as you can see, soil is so much more than rocks, gravel, sand and clay, it is alive and biodiverse!



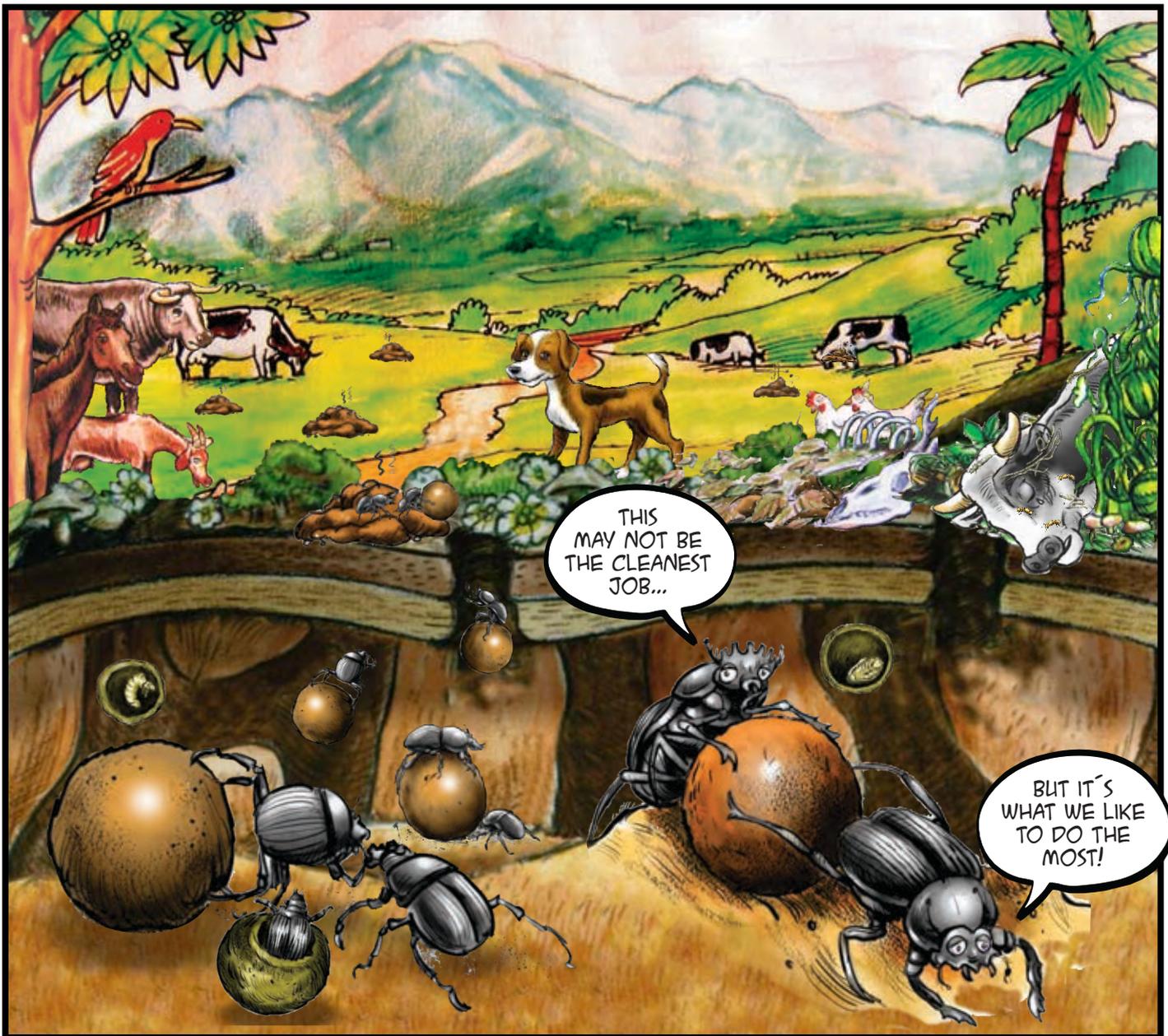
# I'M PROUD TO BE AN EARTHWORM

Earthworms are a key group in the formation of the soil. Some species of worms, like me, eat leaf litter and rooting organic matter and live on the surface of the soil. Others live within the soil. Some species bury leaves in the soil to quicken their *Decomposition* and eat them later. Some of us ingest two to five times our own weight of soil (minerals and *Humus*) in a single day! That would be about 200 truckloads per hectare, a space equivalent to a football field! We are a hungry bunch! Although, I rather watch my figure!

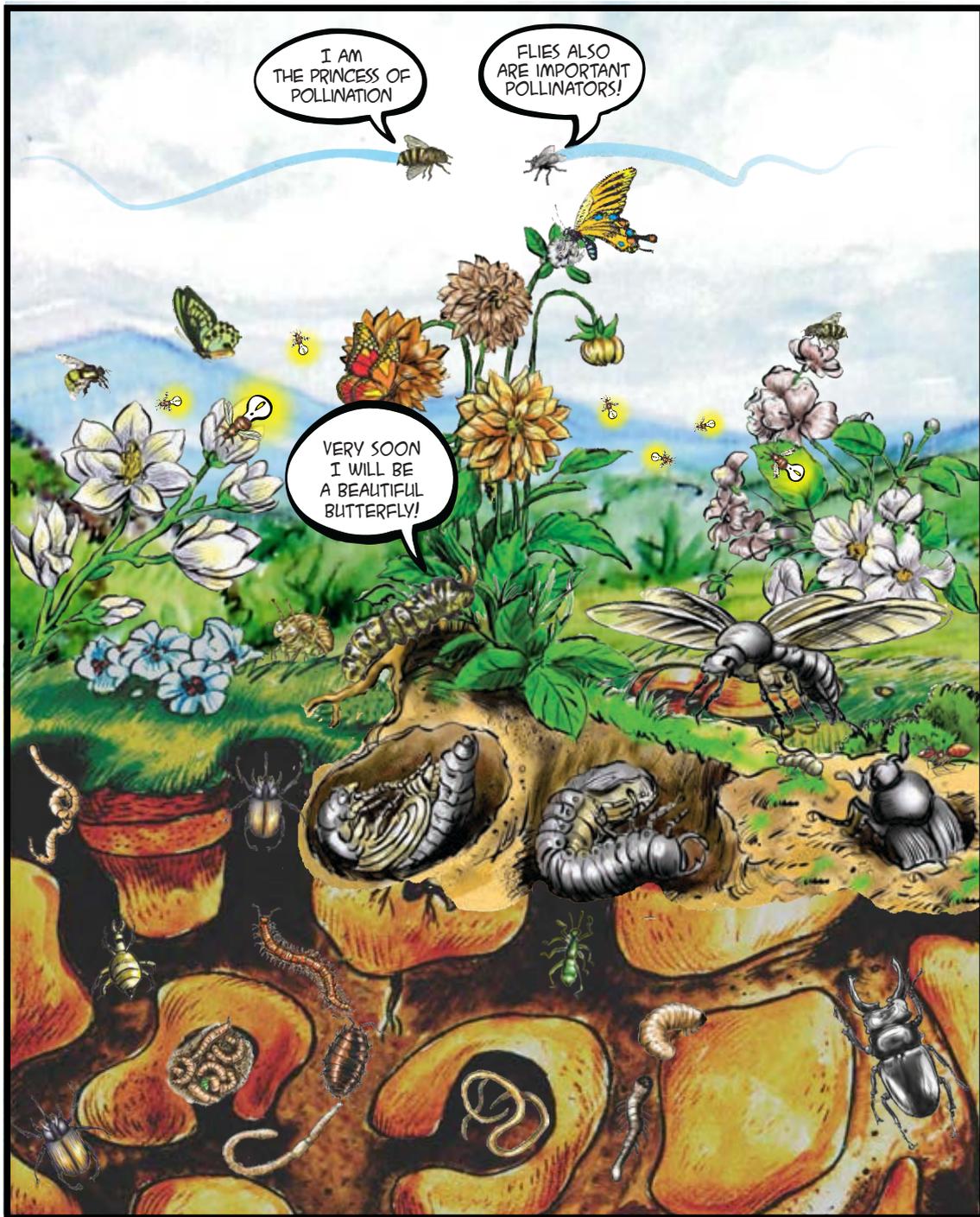


# THE BEAUTIFUL BEETLES AND THEIR ORIGINAL WORK

*Decomposition* is a collective task. We get a lot of help from many organisms which have found their own ways to take advantage of rooting matter. Scavengers and some ants literally clean carcasses of dead animals and leave the bones bare, reintegrating the remains to the soil. There are also dung beetles. Those bugs love to make little balls with cow manure and dog poop! Some of the balls they eat themselves, while others they bury in the soil to lay their eggs. This ensures their larvae a food supply and, at the same time, nutrients go back to the soil!



# THE IMPORTANT POLLINATING INSECTS



Did you kids know that many insects go through a life phase as an egg, a larva or a nymph in the soil until they become adults? Cicadas' larvae can live in the soil up to 17 years, before emerging as adults!

When they come to the surface, some of these insects, like fireflies, some flies, ants and butterflies become pollinators and are as important as bees. Their role is crucial in plant reproduction, to produce fruits and seeds. So, when soil is not healthy or is lost, lots of potential pollinators disappear!

# THE COLLABORATION BETWEEN PLANTS AND FUNGI IS FAMOUS!



Even though the soil is a fascinating place, life there is never easy. Soil is dense and dark and it's hard moving around. Also, food is not always of the best quality, it can be scarce and not uniformly distributed, which makes it hard to get it. In order to survive in such a place, many soil dwellers had to enter a mutually beneficial alliance or symbiotic collaborations.

Do you recall that fungi mycelium have hyphae that resemble thin roots? These hyphae penetrate the root systems of plants, it is called a mycorrhiza. When this happens, plants double their ability to absorb minerals from the soil! This is specially true for phosphorus (P) because fungi have the ability to convert it into an absorbable mineral. Plants in return give fungi the sugar they need to feed themselves, which they produce during *Photosynthesis*. Remember?

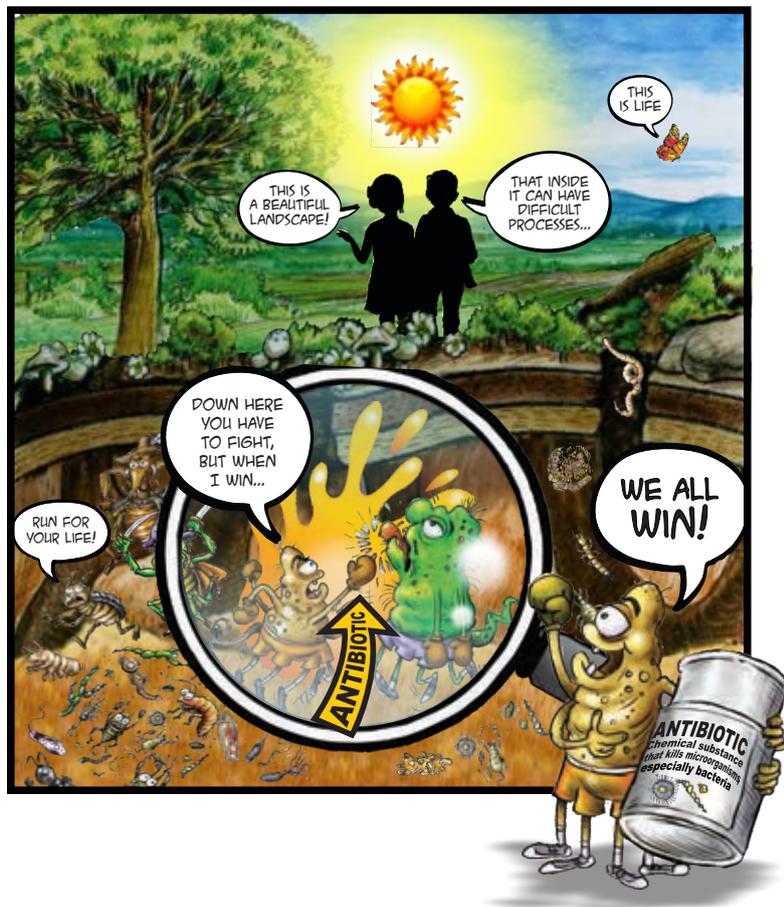
Sugar can also be secreted from plants' roots as an exudate. Some soil bacteria need that exudate to decompose organic matter. A few of them can also fix nitrogen (N), another major component in the air, into the soil. This make possible for plants to absorb nitrogen as a mineral.

You and us, benefit from collaborating with other life-forms as well. Humans, earthworms and termites need bacteria in our intestinal track to help us with digesting what we eat!

## ANTIBIOTICS

Even though collaboration is common in the soil, competition for food and space is also a reality. The less nutrients available, the more ruthless it becomes! Some have actually developed sophisticated ways to defend themselves. Fungi and bacteria, for example, secrete toxic substances known as **antibiotics**. Sound familiar? You probably have been prescribed antibiotics by your doctor more than once.

Humans learnt to cultivate antibiotics in labs to cure many illnesses like pneumonia, tuberculosis and typhus. So, thank fungi and bacteria for antibiotics and many of modern day medicines! You might not be here if it weren't for them!



# CONTAMINATION!

## SAVE YOURSELVES IF YOU CAN!

The worst things that can happen to soil are erosion and pollution. Soil erosion means that the most fertile top layer of soil, the valuable *Humus*, gets carried away, mainly through water, wind and tillage. It can happen quicker in places where there aren't many trees due to deforestation. Often, trees and native vegetation is removed to use the land for agriculture. This is bad news for us living in the soil! Cultivated fields, specially big ones, are usually treated with harmful chemicals (herbicides, pesticides) and excess of fertilizers, which harm or even destroy soil's fertility. As a result, there is a reduction, or even a disappearance of its biodiversity. That means, many of us living in the soil die because of lack of nutrients or poisoned!



You, your parents and friends could become superheroes and save us from erosion and pollution. By protecting native vegetation, or at least, keeping the soil covered with plants, you could slow down erosion. You could also support farming practices that don't use harmful chemicals to deal with so called "plagues".

Practices like crop rotation and organic agriculture preserve biodiversity in the soil. Amazingly, biodiversity discourages plagues and illnesses so, pesticides and fertilizers are less needed.

It's our mission, yours and ours, to make sure the soil is healthy! When processes and services carried out in the soil are interrupted or not done properly due to its poor health, the whole ecosystem is thrown out of balance. An ecosystem out of balance is the cause of many plagues and illnesses that affect us and humans too. We can't allow this to happen kids!

Let us always remember that our own wellbeing is highly dependent on soil's wellbeing. Let's "keep soil alive, protect soil biodiversity!"

Biodiversity encourages a state of equilibrium and health we all benefit from!

## COMPOST AND VERMICOMPOST

Something you Maria and Thomas and all your friends could do to help us keep soil healthy is compost! And you can do it right at home! First, find a specific place, preferably in the backyard, to establish a compost pile or bucket. All organic leftovers such as fruit and vegetable peels from the kitchen, as well as leaf litter, dead tree branches, dried grass and dog poop from the garden, can naturally decompose and become nutrients for the soil! Some earthworms, like myself, that live on the soil's surface, actually specialize in composting, or rather in vermicomposting, which is how it's called when we get involved.

Keep in mind a couple of things when composting. It's important to inform yourselves how to create and control the right conditions of temperature and humidity in your compost or vermicompost. This will allow us and other microorganisms you already know, to thrive. We will be healthy and have the strength to do our job of transforming leftover organic matter into nutrients and humus, quickly and naturally. We like it warm but not too much, we like it humid, but not too much! Are we too demanding?

Composting or vermicomposting at home can be a great contribution to your community and the environment. Not only would you be helping to reduce the amount of waste that ends up in an ugly and smelly landfill. You could use the spongy, nutritious, fragrant black humus we will make for you, as a natural fertilizer for your vegetable garden, garden or house plants!





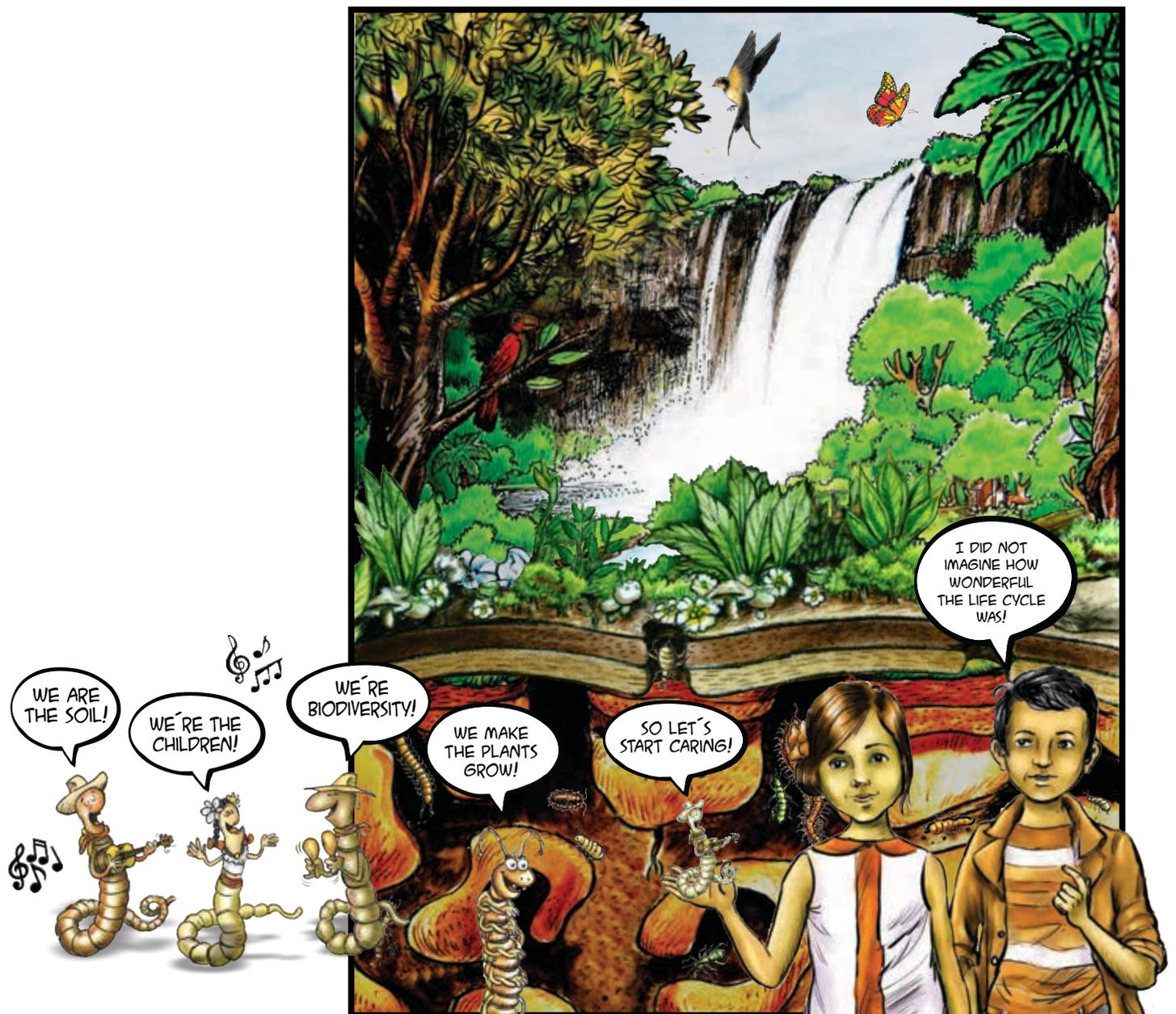
# CLOSING THE CYCLE

Now that you know about *Photosynthesis*, *Respiration*, *Decomposition*, *Humus*, *Composting* and *Vermicomposting* and many of the organisms that make it all possible, it's time to go home. Mission accomplished!

Tell your parents about the importance of a healthy soil for the cycle of life to continue! Tell your friends as well. Tell everybody you know! If you need to refresh your mind about all you've learnt today, just go back a few pages.

We certainly appreciate all the help we can get! And don't forget that we all come from the soil and we and everybody we know, will go back to the soil when we die, helping new life to emerge! So, we shall meet again!

Meanwhile, let's sing this song together!



This booklet is born out of the enthusiasm of four people who want to communicate how essential is biodiversity in the important process of *Decomposition* on and in the soil, as well as its role in the cycle of life and *Photosynthesis*. Since children are its main target readers, it has illustrative drawings that talk by themselves. Yet, as the subject is complex, it would be preferable that an adult accompany the reading to help clarify concepts, if needed.



Food and Agriculture  
Organization of the  
United Nations



International  
Decade of Soils  
2015-2024



World  
Soil Day



GLOBAL SOIL  
PARTNERSHIP