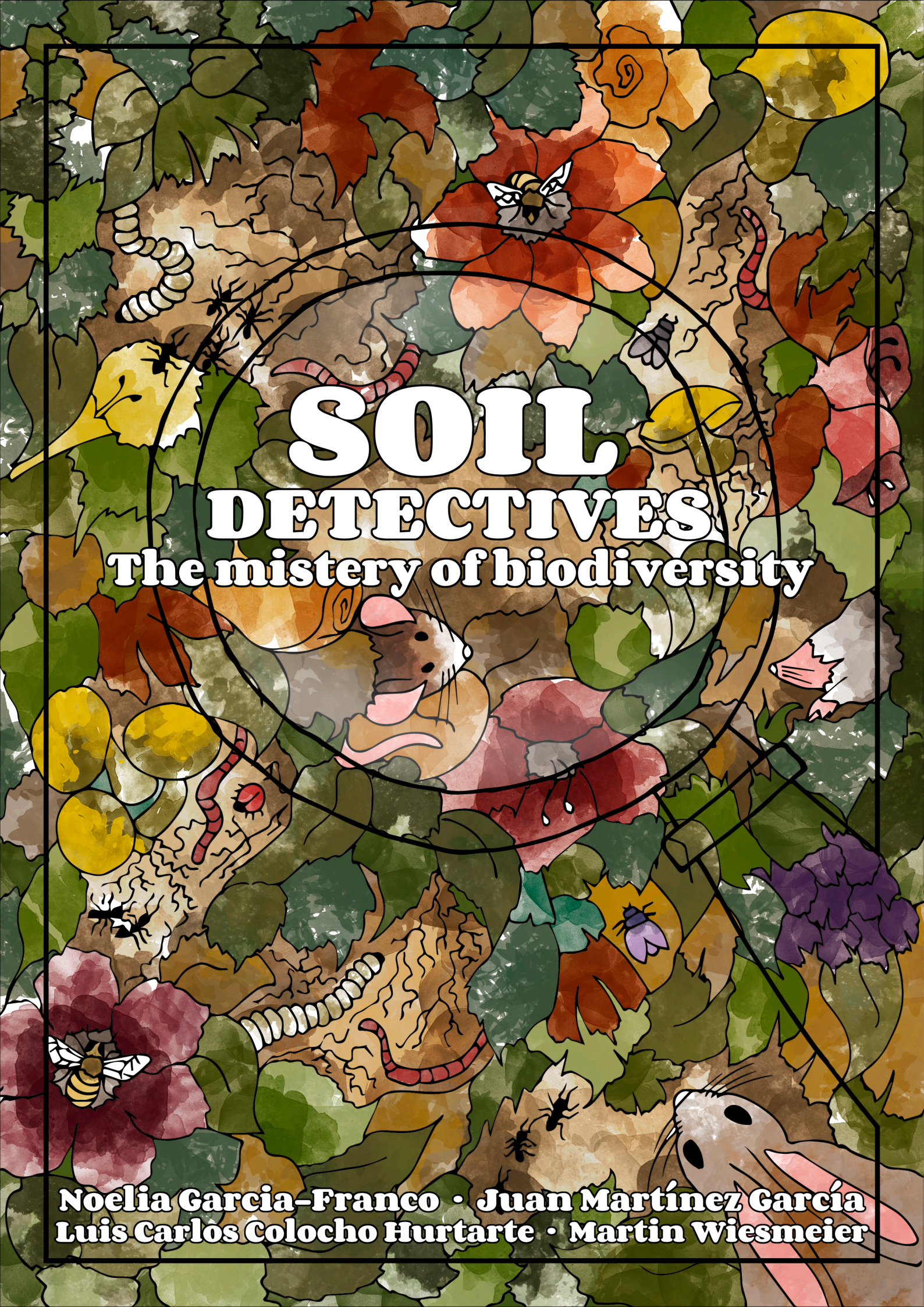
SOIL
DETECTIVES
The mistery of biodiversity
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In memory of
Dr. José Luis Colocho Ortega
father, friend and soil scientist
and
Pedro Franco and Simeón Ruiz
grandparents and farmers of
soil and life.

Special thanks to
Josefa Martínez grandmother and
inspiration.





"Keep soil alive, protect soil biodiversity".

The vacations had just begun, but Theo was sitting in his room, saddened. He had broken his arm two days ago when he was playing with his friends from school. Now Theo had to spend the summer vacation with a cast on his arm. Which meant that he couldn't go to the swimming pool or ride his bike with his friends.

- How many adventures I will miss - Theo thought sadly.

To pass the time, Theo's mother had brought him magazines and books to read, but Theo did not feel like reading. It was a hot afternoon, so Theo decided to open the window of his bedroom to get at least some wind in it. Theo thought about how boring the next few weeks would be, until suddenly something ripped him out of his dull thoughts and scared him.

-Oh! -It... it... it's a ghost! It's a ghost in a raincoat?! - Theo said loudly to himself, hiding behind the curtain of the window.



Suddenly the ghost with the raincoat turned around and waved his little hand, which was barely visible outside the raincoat:

- Hello Theo!

- Oh no! The ghost knows my name! - Theo turned pale and continued to hide behind the curtain so that the ghost could not see him.

- Theooooo! Theo, look here! It's me, Paulina, don't you remember me?

Theo peered out from behind the curtain and when he realized that it was not a ghost in a raincoat, he breathed a sigh of relief:

-Hello Paulina! You are still smaller than me, you haven't grown much since last summer, I didn't recognize you in that huge raincoat you have on.

- This is my grandfather's raincoat, do you like it? - He also left me this magnifying glass. Did you know he was a detective? And now I'm going to be a detective too! My grandfather promised to teach me. Do you want to be a detective too?



- A detective? - Theo thought the idea was interesting, but he was surprised. He never thought that Mr. Louis would have been a detective. His parents had always told him that he was a very famous professor at the university and he had sometimes helped Theo with his homework.

- Yes, yes, like Sherlock Holmes! - Paulina replied excitedly as she bounced back and forth with her raincoat.

- And what are we looking for? Has someone disappeared? Has there been a robbery? - Theo asked worriedly.

- No - answered Paulina.

- No? What kind of detectives are we then? - asked Theo with a shrug of the shoulders.

- We are on the trail of soil biodiversity!

- What?! Theo didn't understand a thing.

- Yes, come out to me, then you will understand. My grandfather and I will show you. Please bring a raincoat! - Paulina yelled to Theo.

Theo was not quite sure what he was getting into, but he decided to follow Paulina anyway.

- Okay, I'll come with you. But without a raincoat, Paulina, it is very warm today!



Arriving in the garden, Paulina handed Theo the magnifying glass she was carrying.

- Theo, you can't make research notes with your arm in a cast, so you are responsible for using the magnifying glass - said Paulina.

At that moment Mr. Louis came into the garden in a smock similar to that worn by doctors, but so old that it was impossible to guess whether it was white or yellow. Then he took a round table from the house, a microscope, very fine tweezers, scissors and several glasses with different liquids.

- Good day, Theo! How is your arm? My granddaughter told me that you also want to be a Sherlock Holmes of the soil - Mr. Louis greeted him with a proud smile.

- Good afternoon, Mr. Louis! Yes, I would love to be a detective or a superhero who solves mysterious cases and kills the bad guys, but... if we want to be detectives... why are you wearing a doctor's coat?

- Ha ha ha! - Mr. Louis couldn't stop laughing... Well...let's say, between a soil detective and a soil doctor... there's not much difference. Besides, this gown is an old friend that I've been wearing for more than 45 years and with whom I've solved many cases in my life.

- It does not matter now! Please, let's start, please! - interrupted Paulina impatiently.

- You are right, Paulina! So let's go ... Please children, follow me into the garden, between the orchard and the compost.



They followed Mr. Louis into the garden, until suddenly a large deep hole opened up in the ground in front of them.

- Wow, a big hole! What was in it? Perhaps a treasure? - asked Theo and peeped into the hole.

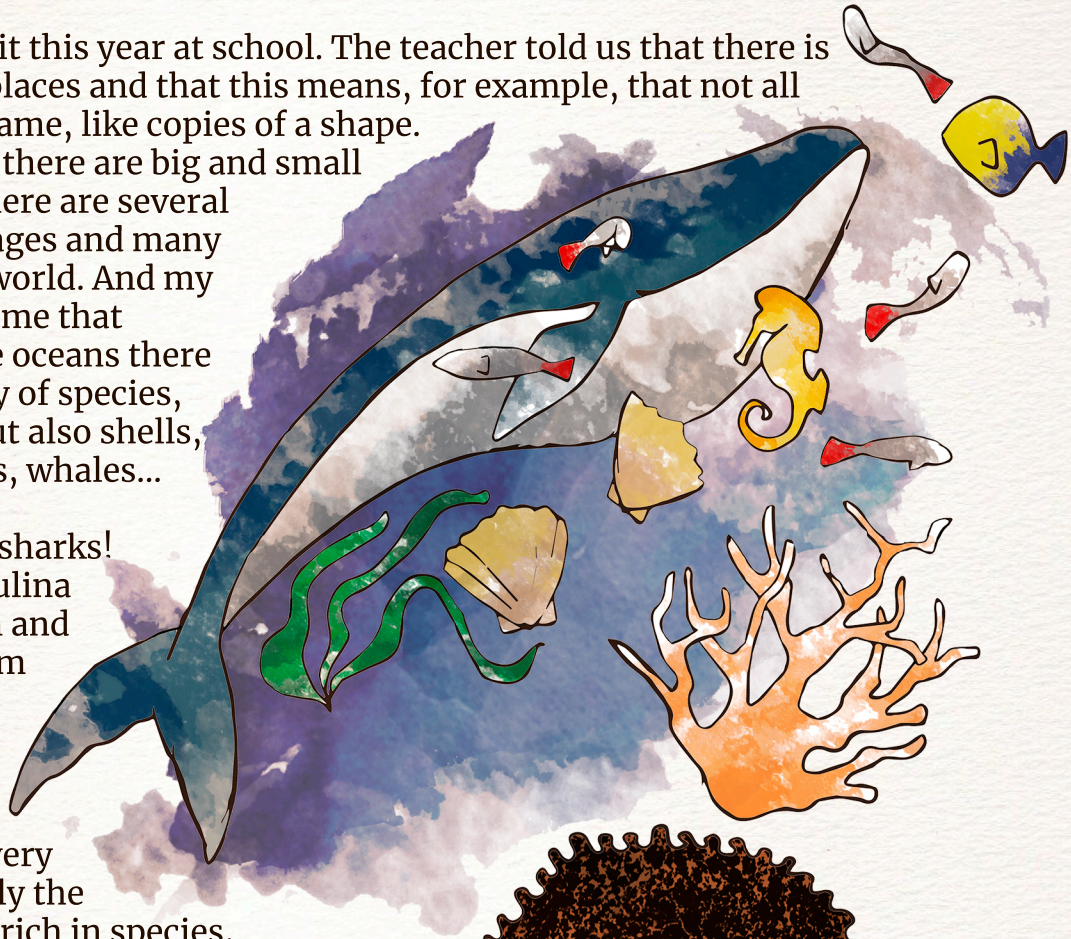
- Dear Theo, the question is not which treasure was in it, but which treasure is still in it. - answered Mr. Louis mysteriously as he descended into the hole.

- Theo and Paulina, please sit down here. A good detective must first observe a lot, perhaps for several hours or even days. And he must ask questions, that is the most important thing. Let us begin. This big hole you see here is what we call a "soil profile" and it helps us to examine the soil. Soil is not just the surface on which you walk every day, where houses, schools, and roads are built, rivers flow, or plants grow. The soil is made up of many different layers, we call them horizons, and is full of life. Soil means biological diversity. Do you know what that means? - asked Mr. Louis.



Theo answered quickly:

- Yes, I learned it this year at school. The teacher told us that there is diversity in all places and that this means, for example, that not all people are the same, like copies of a shape. She told us that there are big and small people ... that there are several different languages and many cultures in the world. And my friend Max told me that especially in the oceans there is a great variety of species, not only fish, but also shells, algae, seahorses, whales...



- And there are sharks! Grrrrrrrrr! - Paulina interrupted him and scared Theo from behind.

- Very good, Theo! You explained that very well. But not only the oceans are very rich in species, there is a whole universe of biodiversity in the soil. We call this biodiversity because we are going to talk about the living beings that are in it. So it is time for you to take a closer look at the soil profile with me - said Mr. Louis.



- Wow, how exciting to be here in the soil profile! - called Paulina.

- Let's check if this soil is a healthy soil - said Mr. Louis - For that we have to examine its biodiversity by taking samples and examining clues, my little detectives. Observe the soil carefully, imagine that you have to draw what you see on a piece of paper...

- I see a lot of colors! The floor has different colors; they are darker near the surface - Paulina interrupted him when she touched the floor with her little fingers - It looks like a "mousse" of many different chocolates.

- Ha ha ha! Good observation - laughed Mr. Louis loudly.

-There are plants on the ground surface! And the roots of these plants penetrate into the soil - said Theo.

- Bravo, children! You are doing very well! - said Mr. Louis - the dark color of the soil is one of the first hints. A dark colored soil generally indicates that it is a fertile soil. This dark color is known as organic matter, and it is the remains of plants and living things in various states of decomposition, which are full of nutrients and help the plants, worms, fungi and bacteria of the soil to grow.



- And... why is a healthy soil so important? - asked Theo.

- A healthy soil means food and a place to live for people and all living beings on the planet. A healthy soil is a clean soil that protects us from pollution, compaction, salinization and erosion. But the soil is also important for the climate, because like a giant vacuum cleaner it absorbs harmful substances from the air, which we call greenhouse gases. Therefore, soil plays an important role in the fight against climate change.

- Grandfather! Theo... ... please... look... look quickly! I think there's something in the hole!

- Paulina suddenly called out and pointed her finger at something... Theo, the magnifying glass, give it to me, quickly!

Theo gave Paulina the magnifying glass and she used it to examine the holes in the ground in front of her.



- Wow, it is a huge worm! Look, Theo!

- It is a worm, indeed! - said Theo, who looked at the worm with the magnifying glass.

- Hahahaha! - Yes and no, laughed Mr. Louis. Let's see, this is another clue to solve our case. But what you have found there, we don't call holes, but pores. The pores come in different sizes and they are very important because they are like channels through which air, water and nutrients circulate in the soil. You have to think of them as the streets of a city, all of which are connected. And this is not just any worm, but an earthworm that created these pores here.

-Wow! There is a road system in the soil - said Theo amazed and watched exactly where Mr. Louis had pointed.

-The earthworms are known as "ecosystem engineers", and they are indispensable because they can change the soil and thus allow other organisms to live in it. If you take a closer look at this pore, you can see that they were used by roots to reach deeper regions of the soil to absorb water and nutrients.

- Hello earthworm! Come with me, I call you Chloe! - said Paulina and tried to get the earthworm out of the pore.



- Let's summarize again, children - said Mr. Louis - how many clues do we have so far? What have you written in your notebook?

- Theo replied: "We have the dark color, we have plants that root through the pores into the depths that the worm has made...

- And Chloe! - Paulina interrupted Theo and pointed to the earthworm.

- Paulina, we call this earthworm *"Lumbricus terrestris"* - said Mr. Louis while cleaning his glasses.

- Okay, grandpa, hello my little sweet Chloe *terrestris*!

- We'd better continue - said Mr. Louis shrugging his shoulders when he saw that he could not convince his granddaughter that Cloe is not the scientific name of the earthworm - what other evidence can point to a biologically diverse and healthy soil? Can you think of anything else?

Theo looked at the notebook in which Paulina had written down everything her grandfather had said and answered:

- Fungi and bacteria!

- All right, Theo! We are still missing fungi and bacteria. Fungi and bacteria are generally difficult to detect if we do not have the necessary instruments like a microscope. But sometimes they are easy to distinguish or identify. In the case of fungi, they are living creatures that resemble plants in one way and animals in another. Fungi are neither able to move (or not much), nor can they produce their own food. For this reason they often work together with plants or other organisms in a process called "symbiotic relationship".



- And what is a symbiotic relationship? - asked the children.

Mr. Louis replied:

- Let's see, I'll give you an example: Before the summer vacations I helped Theo with his homework because he didn't understand some of it, and in return he helped me mow the lawn because at my age mowing the lawn gives me back pain. In the end we both got something in return for helping each other.

- Or if I give you some of my sweets secretly from my grandmother in return for letting me go to bed late. Would that be a symbiosis too, grandpa? - Paulina asked

- Good, good ... this is a symbiosis ... let's call it a "secret symbiosis", Mr. Louis smiled.

- And speaking of sweets and sugar: even mushrooms love sugar. Plants produce a sugar called glucose, which mushrooms get for free when they make it easier for the plants to absorb water and nutrients from distant parts of the soil with their roots. A group of these fungi are for example the mycorrhizae. Today we know that more than 97% of plants have mycorrhizae - while Mr. Louis explained this, he showed the children a plant with many "nodules" in the roots - This plant is a lens from my garden. Do you see the many small "nodules" in the roots? - Mr. Louis asked

- Yes- answered Paulina- what are their names?



- These are nodule bacteria that also live near the roots of the plant, we also call them Rhizobia. They are able to absorb an important nutrient: nitrogen. We call this biological nitrogen fixation. In this way, they release the nitrogen to the plants that need it to grow, but unfortunately we cannot observe this because they are very small. But in this book entitled "The Global Soil Biodiversity Atlas" I will show you what they look like.

-Wow, this book is very big! - said Theo.

After Mr. Louis showed the children the book, he asked them:

-Well, do you think we have enough clues to be sure that this is a healthy soil?

- Yes! - the children cried

- Because there is a great biodiversity in the soil - said Paulina. - ...And what does soil biodiversity mean? - asked Mr. Louis.

- It means the complete community of organisms that live and work together in the soil.

- Bravo! I am so proud of you! - said Mr. Louis enthusiastically.



Louis, children, there is cake - called a woman from the terrace. It was the grandmother of Paulina.

-grandmother, excuse me, we can't leave now, because we are discovering the biodiversity of the soil with the grandfather - answered Paulina

-Okay, okay...as you say... then I will discover the variety of chocolate alone, which is in the cake!

-Chocolate?!!!!- called Paulina, took off her grandfather's raincoat and ran onto the terrace.

-But Paulina... we are not finished yet! - called her Mr. Louis afterwards.

-I'm sorry, grandpa... but the composition of this cake is a difficult case, for which a detective like me is needed.

Theo and Mr. Louis looked at each other in silence when suddenly their stomachs growled.

-Hahaha- both laughed

-My dear Theo, I think we should take a break and examine the chocolate variety of the cake more closely, what do you think?

-In any case - grinned Theo, who had already completely forgotten his broken arm.




"It may be doubted if there are any other animals which have played such an important part in the history of the world as these lowly organized creatures."
– Charles Darwin