Solinho in the Cerrado

Soil: where food begins

Departamento de Ciência do Solo
Programa Ponte Solo na Escola

Solinho in the Cerrado

Soil: where food begins

2nd edition

Book prepared for the Children's Book Contest promoted by United Nations Food and Agriculture Organization (FAO), International Union of Soil Sciences (IUSS) and Global Soil Partnership (GSP) about soils, where food begins.

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Introduction

This story is set in the Brazilian Cerrado and references one of Esopo's fables: The Town Mouse & The Country Mouse

In such a large country with many biomes, the Cerrado is called the barn of Brazil, producing about 55% of the total meat, 56% of grain and occupies second place in the dairy sector, with 28% of the national production (SANTANA, et al., 2020)

September arrived, bringing the first signs of spring to the Cerrado.

Despite the natural local abundance and living on the farm with her grandmother, Anne felt lonely, although she knew that in a few months her aunt Louise and cousin Peter would live in the countryside. It would be the first time the cousins met there, and they were both very nervous.

While waiting, Anne enjoyed the waterfall baths and the beauty of the spring landscape.

Click and play a classic Brazilian Cerrado song.

Aquarela do Cerrado

Although it looked like a Savannah, there were spots of colour everywhere. She thought the flowering ipês and pequizeiros were so beautiful!

Pequizeiro (*Caryocar brasiliense*): typical tree of the Brazilian Cerrado, whose fruits are called "cerrado gold" because of their yellow colour.

Ipê do Cerrado (*Handroanthus ochraceus* (Cham.) Mattos): native to the Brazilian Cerrado, ipês can grow up to 14 m and bloom from July to September.

Cerrado Biome: in Brazil, the area of Cerrado, the Tropical Savannah, is estimated at 2,036,448 km ^{2}(IBGE, 2020).

Finally, December 5th arrived.

Louise dropped Peter off at the farm with Anne and their grandmother, Ms. Mary. Then she returned to their new home to unpack. The cousins were finally together!

To celebrate the date and welcome Peter, Anne took her grandmother's recipe book and asked her to prepare a delicious chicken with pequi.

Ms. Mary, visibly worried, said that they might not have the necessary ingredients.

Peter, trying to help, suggested that they go to the supermarket, but Anne explained that they couldn't because the closest one was two hours away from the farm and no one could take them.

"But I know what to do!" said Anne and hurried out into the yard.

Confused, Peter went after her. Ms. Mary, a little discouraged, followed her grandchildren.

Chicken with Pequi recipe

Ingredients

- 1 chicken, approximately 2 kg
- 15 to 20 pequis
- 2 ripe tomatoes
- 1 large pepper
- 2 large onions
- 3 cloves of garlic
- 2 tablespoons homemade seasoning (garlic, salt, black pepper)
- 1 tablespoon of ground annatto
- 3 tablespoons of oil
- 3 chilli peppers

Method

- Cut the chicken into pieces.
- Season with homemade seasoning, leave for about 15 minutes.
- Heat the oil in a pan.
- Add the crushed garlic and annatto and let them brown.
- Clean pequi in running water and add to the pan.
- Add the chicken pieces until cooked
- Add the onion, pepper, and tomato, cut into cubes.
- Add water little by little, until it boils, leaving a thick broth.
- Add crushed chili pepper and salt to taste.
- Serve with white rice.

In the garden, the children noticed that the tomatoes, peppers and onions did not look very good.

Peter commented that in the market the food seemed more appetizing. Anne replied, saying that the farm was also wonderful, but...

“Unfortunately, the plants have looked weak and lifeless for a while now. I often come to the garden hoping to find more lush plants, but they seem worse every day.”

In the chicken coop, they observed their grandmother taking a look at each of the chickens but none of them would be big enough for the recipe.

Anne, a little desolate, showed her cousin that the corn reservoir for the birds was almost empty and the corn stalks didn’t look healthy either.

Upset, they returned home to prepare a simpler meal.

Ms. Mary thought it was time to talk to Louise, who had graduated in Agronomy, Soil and Plant Nutrition. The field hadn't been looked at by a professional in a long time and Louise was the new Agronomist of the region.

Louise, saw how bad the farm had become and remembered how productive it used to be. Her mother agreed too:

"Yes, we produced everything! Now, only native plants develop well, like ipê and pequi."

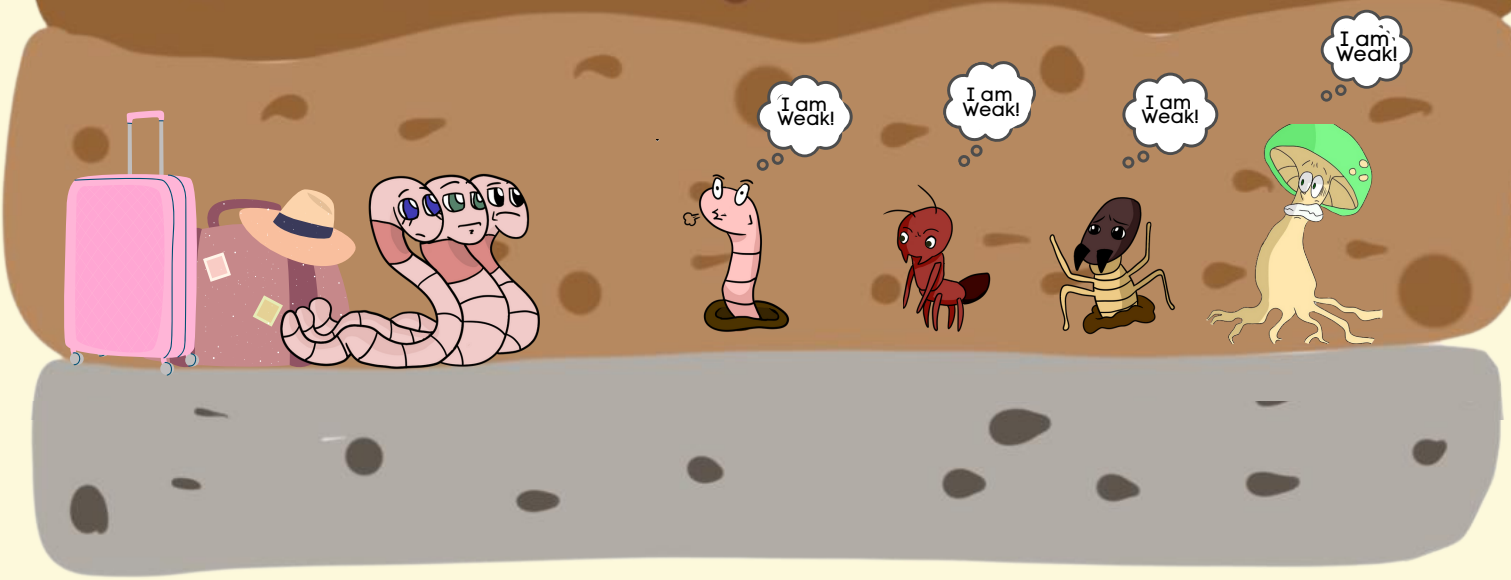
Worried because her mother had not told her anything before, Louise asked if the problems could be related to the management of the farm.

"I've been doing what the last Agronomist instructed - preparing the soil and using good seeds. I just haven't been able to buy fertilizers, because they are very expensive," explained Ms. Mary.

Louise asked her mother for permission to take a soil sample to the city's laboratory.

Meanwhile, in the basement...

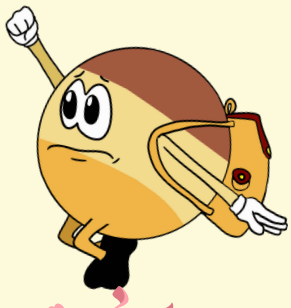
Some of the city's Earthworms also moved to the countryside in search of a less hectic life, but when they came across the weak organisms from the farm, they were frightened.



The countryside's Earthworm apologized:

"We are sorry to welcome you like this, but we don't know what's happening. Some time ago we were all strong and healthy, but lately we have no energy for anything."

One of the newly arrived Earthworms, who had lived in a university's experimental laboratory, knew these organisms needed help. She screamed as loud as she could:



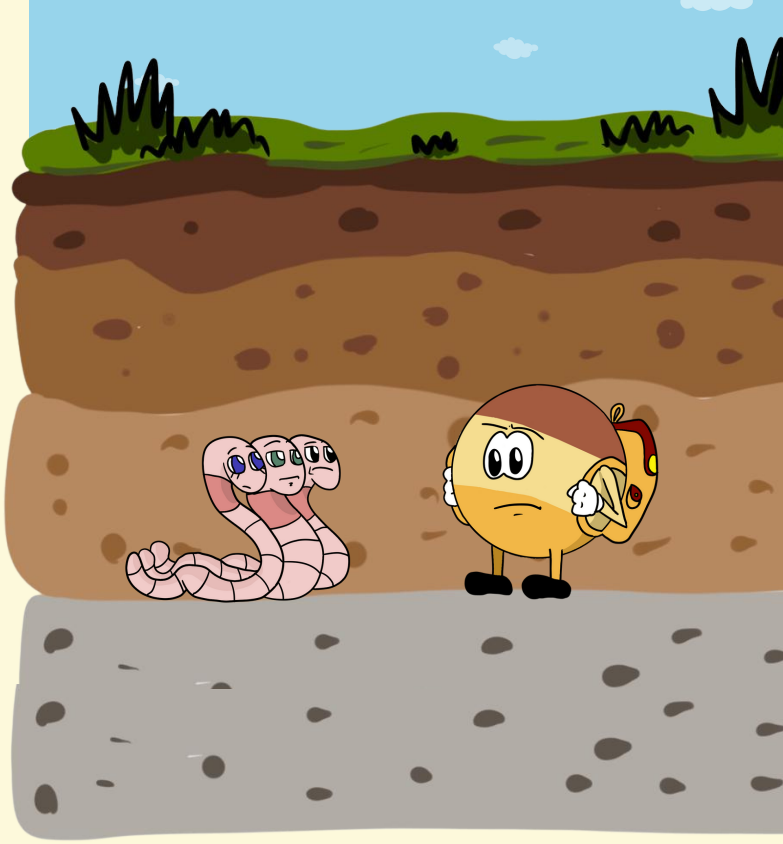
"Solinhooo!"

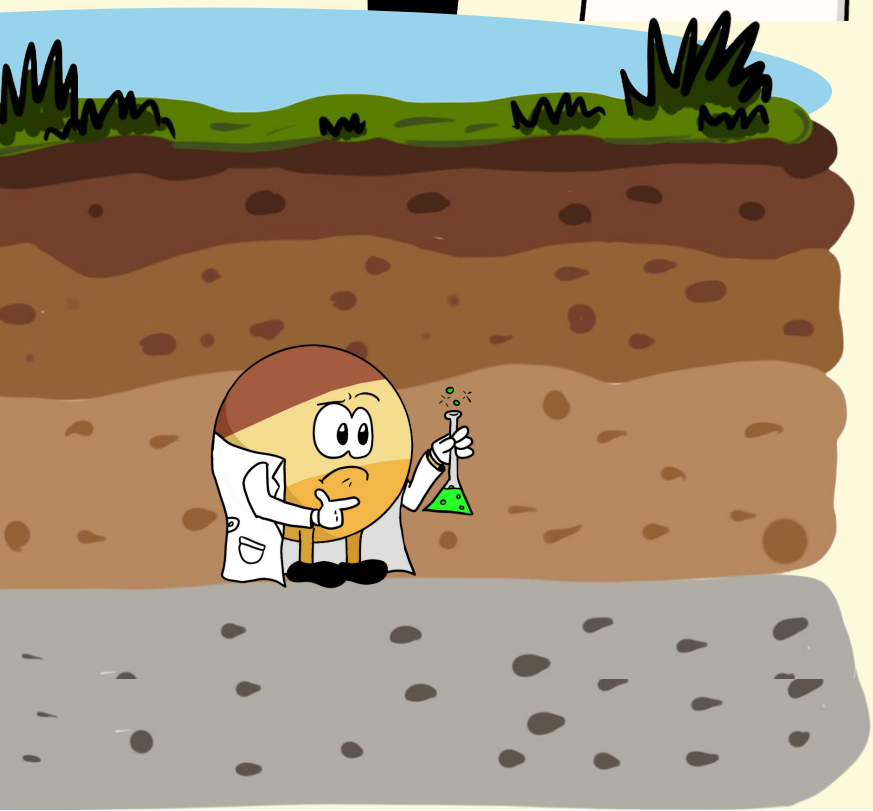
As soon as he heard the call, Solinho entered the soil profile.

When he arrived, Solinho observed the weak and frightened organisms. To understand the problem, he asked what was happening.

“We have just arrived from the city and are dismayed by the state of the inhabitants here. They all look sick!” Explained the Earthworms.

Solinho had an idea of what was affecting these organisms, so he did the same as Louise: collected a soil sample for analysis.

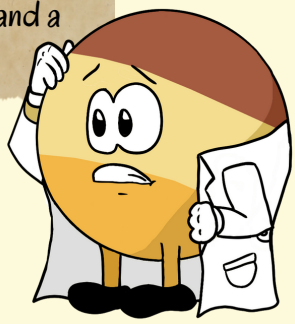




Without even talking, the two scientists came to the same result: the farm’s soil had high acidity and low levels of available nutrients, a problem that affects all organisms.

Days later, Louise returned and explained to her mother that the soils of the Cerrado are naturally very poor in nutrients. The analysis also showed very low soil pH, so only native plants, such as ipê and pequi, could produce well, as they had developed specific mechanisms for those soil conditions.

Tomatoes, onions, peppers and corn are domesticated by humans and developed to produce more, requiring greater demand for nutrients and a higher pH.



Louise, seeing her mother's concern, explained that correcting the acidity with limestone and introducing nutrients with fertilization could greatly improve the quality of the local soil.

Ms. Mary understood but warned her daughter that she would not be able to invest in limestone and fertilizers at the same time. But Louise reassured her:

"With some waste materials from the farm to compost it is possible to produce low-cost organic fertilizers, which will save enough money to buy limestone!"

- The most common types of Cerrado soils are the Ferralsols and Acrisols (WRB/FAO, 2015), which generally have a low pH (acidic), causing high levels of aluminum (Al^{+3}), which is toxic to plants, and low levels of nutrients such as potassium (K^{+}), calcium (Ca^{+2}) and Magnesium (Mg^{+2}), which different organisms need for development.
- Limestone is a basic rock that has Calcium and/or Magnesium. When ground, it can be applied to the soil, as it has the ability to reduce acidity.
- Fertilizers are substances, of mineral (ground rocks) or organic origin (animal or vegetable waste), that are applied to soil or plant tissues to provide nutrients.
- pH is a measure of the amount of Hydrogen (H^{+}) - the most abundant chemical element in the entire universe - that makes up various types of organic and inorganic substances, which indicates the acidity or alkalinity of these substances.

In the underground, Solinho explained:

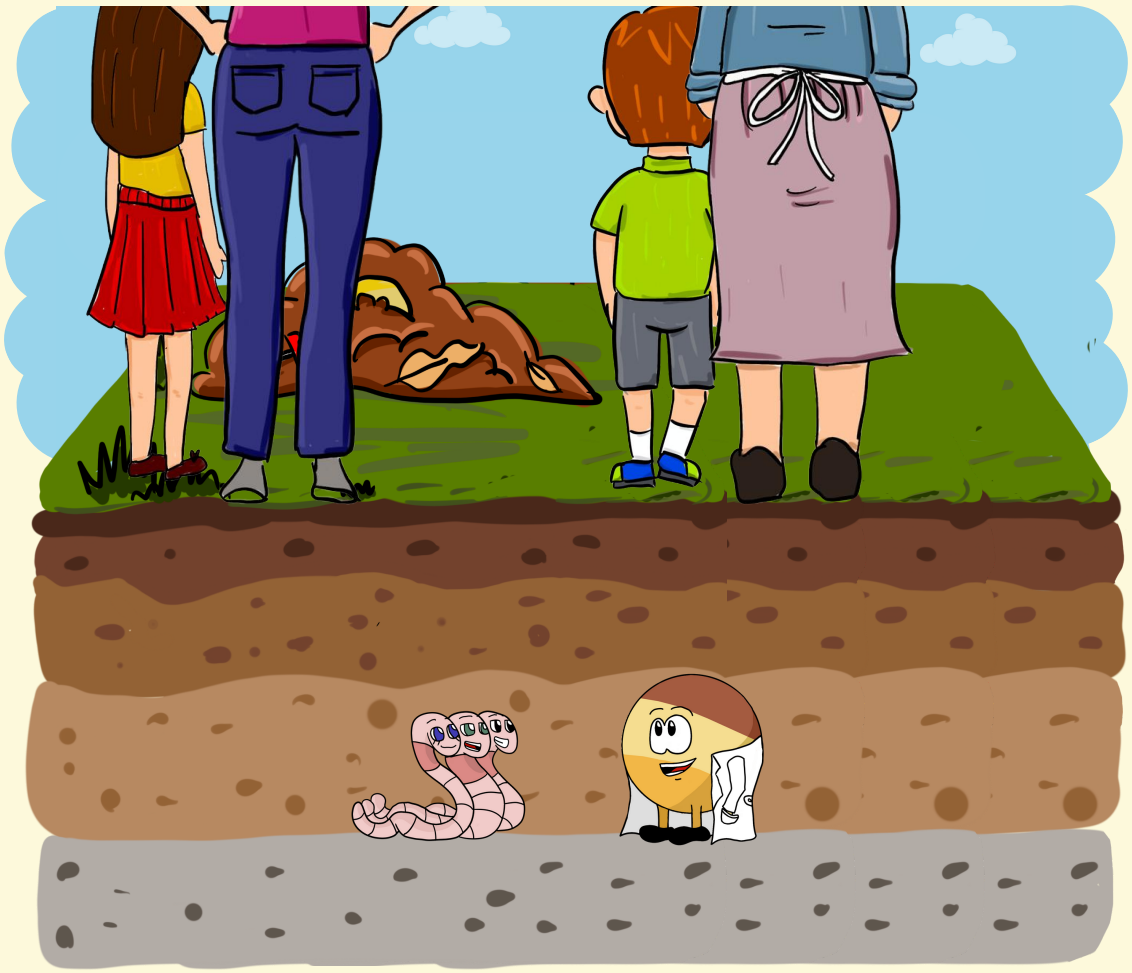
“The organisms in the field are weak because there are few available nutrients in the soil. We need to find as much organic material as possible to get these nutrients.”

“Come on...” said the camp Termite, moving with difficulty.

Seeing the other organisms were also struggling, Solinho realised that they could not perform the task.

Above ground, the excited children began to stack organic materials - tree leaves, fruit and vegetable peelings, animal manure - to form a compost.

Meanwhile, Ms. Mary applied limestone to correct the soil pH.



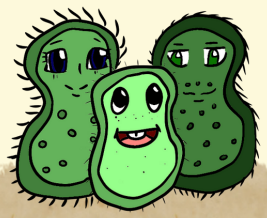
Soon, the organisms were able to feel a change in the soil and could smell plant residues. Solinho, excitedly identified it as organic material that was being stacked just above where they were.

“So, the problem is solved?” asked the city’s Earthworms.

“Almost, but we still need to release the nutrients to the others.”

“How do we do that? This is our first time in the field.”

“I’ll show you!” said Solinho.



The process of releasing nutrients begins with the breaking of organic material into smaller pieces, an action performed by the macrofauna and soil mesofauna, such as earthworms and beetles. Then the fungi and bacteria – soil microorganisms – release the nutrients to be aken up by plants and animals.

As if she were connected to Solinho, Louise mentioned that the soil organisms would be responsible for breaking down the collected material into nutrients the farm needs.

“But to help these organisms, it is important to turn over the pile of organic materials often,” she explained.

“How does that help them?” asked Anne.

“When we turn the material, we allow oxygenation which stops unhelpful microorganisms from growing and reduces bad smells,” replied Louise.

The process of turning the compost depends on the composition of the material and can be done once a week, making sure that:
- temperature doesn't exceed 70 °C
- humidity doesn't exceed 55 %
- there's no bad smell, which indicates rotting
- there's good oxygenation for the organisms to break down materials.

The important elements that make up the organic materials used in composting are Carbon (C) and Nitrogen (N). We classify these materials using the ratio of how many molecules of C exist for each molecule of N, the ideal ratio being 30:1, that is, 30 molecules of C to 1 molecule of N. It is possible to mix different materials, to get the optimal ratio and thus optimize the compost.

With the help of the grandmother and grandchildren turning the pile, the organisms gradually resumed their activities, the organic material providing them with nutrients while they broke it down into compost.

Once nutrients are available in the soil, they are absorbed by the roots and distributed to all parts of the plant. When vegetables are eaten by animals or humans, they contribute to their nutrition.

Four months after the process started, the material was ready to be used in the soil. Louise and Peter went to the farm to help Ms. Mary and Anne.

Based on the results of the soil analysis, Louise was able to calculate the amount of organic fertilizer to be applied.

Thrilled, she knew that the quality of the fertilizer achieved was due to the excellent work of soil organisms.

“You know, kids, even if we can’t see the work happening, the soil organisms play a very important role in that process.”

Everyone smiled at them gratefully.

Nutrients are classified according to the amount required by plants:
- Macronutrients - required in larger quantities:
  N, P, K, Ca, Mg, S.
- Micronutrients - required in smaller quantities:
  B, Cl, Mo, Cu, Fe, Zn, Mn.

After the application of organic fertilizer, the nutrients that were missing for the vegetables produced at the farm were now available. Gradually, all the seeds and seedlings planted by the grandmother and grandchildren germinated and grew strong and healthy.

The amount of limestone and other fertilizers should be recommended by professionals in the area.

The corn also developed well and could soon be used as chicken feed. Louise was happy for her mother and niece, and the results found on the farm would be used in scientific studies in the laboratory where she worked.

Peter considered his mother, grandmother and cousin heroines. Curious, he investigated and found that in addition to them, the Brazilian Cerrado had other prominent women, including::

Mercedes Bustamante,

master in Agricultural Sciences and PhD in Geobotany, is "one of the main references in the Cerrado biome, working in the area of ecosystem ecology focused on changes in land use, biogeochemistry and global environmental changes".

To learn more, click here

Biography

Joana Döberainer,

an agronomist from Czechoslovakia living in Brazil, pioneered research on improving soybeans and other vegetables through Biological Nitrogen Fixation, which made the country's agriculture competitive with other nations.

To learn more, click here

Biography

Ieda Mendes,

Agronomist, PhD in Soil Sciences and researcher at Embrapa Cerrados. Her studies on biological nitrogen fixation, microbial ecology and soil quality bioindicators influenced the development of soil bioanalysis technology through which farmers identify soil quality.

To learn more, click here

Biography

After a year of cooperative work between humans and organisms, the soil of the Ms. Mary's farm entered full productivity and fertility.

To celebrate, the family were finally able to prepare their delicious recipe of chicken with pequi, using fresh and organic ingredients that the soil had produced after being fertilized with the compost made on the farm.

Nutritional properties of pequi: The pulp and almond contain 267.9 kcal/100 g and 317 kcal/100 g, respectively, constituting a rich source of calories (Unicamp, 2006).

Under the new management, all organic waste was now composted and used in the production of food for humans and animals.

The organisms were also happy and healthy due to the abundance of nutrients in the soil.

Even unintentionally, aal of them had collaborated to produce a nutritious soil and healthy plants.

Then Solinho knew that it was time to say goodbye.

In that story, we learned a few lessons:

- We must pay more attention and value native plants and their mechanisms of survival in the environment;
- We can, in addition to mineral fertilizers, use alternative sources of nutrients,

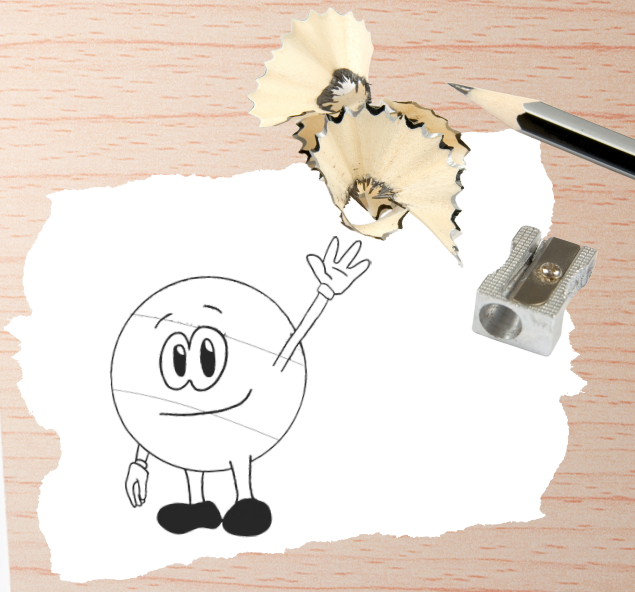
such as organic fertilizers. Thus, we should prioritize sources associated with the recycling of compounds, such as domestic organic waste;

- We have seen that soil fertility is not only the chemical part, but also biological (and can affect soil physics!).

Did you know?

Brazil is the only country so far that has a biological evaluation system for routine fertility analyses.

BioAS - Soil Bioanalysis Technology



The end

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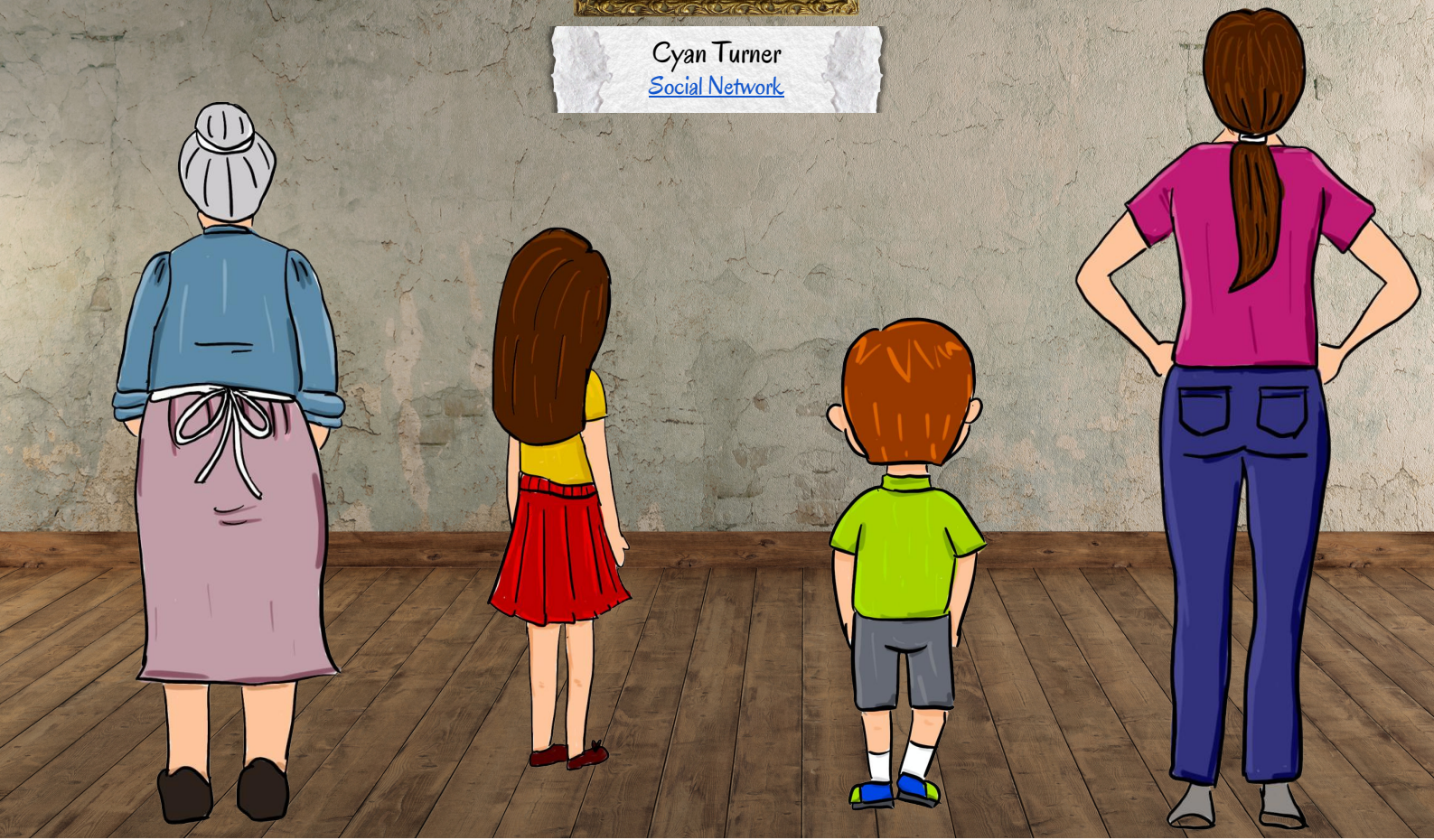

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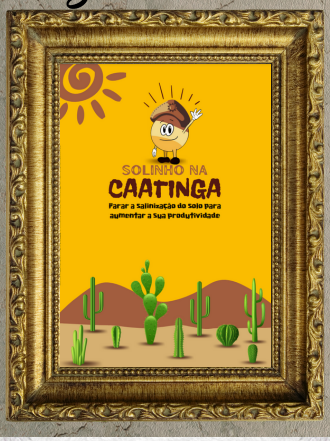

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