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vliruos SHARING MINDS, CHANGING LIVES

From A to Z,
nematodes colour our lives!

Colouring book and stories about nematodes

From A to Z, nematodes colour our lives!

Roundworms, pinworms, threadworms, eelworms, nematodes: who has heard of them?

Even though few people know about them, they are everywhere and there are many of them: between the sand under your feet when walking on the beach, in the potatoes in your garden, in the deep dark sea and even in space!

Nematodes can be microscopically small or they can be giants of meters long. They are mostly known because of the damage they cause to crops and they are also pathogens of animals, including humans. Nevertheless, some species of nematodes are very useful in biological control, for measuring soil and water quality and understanding the aging process.

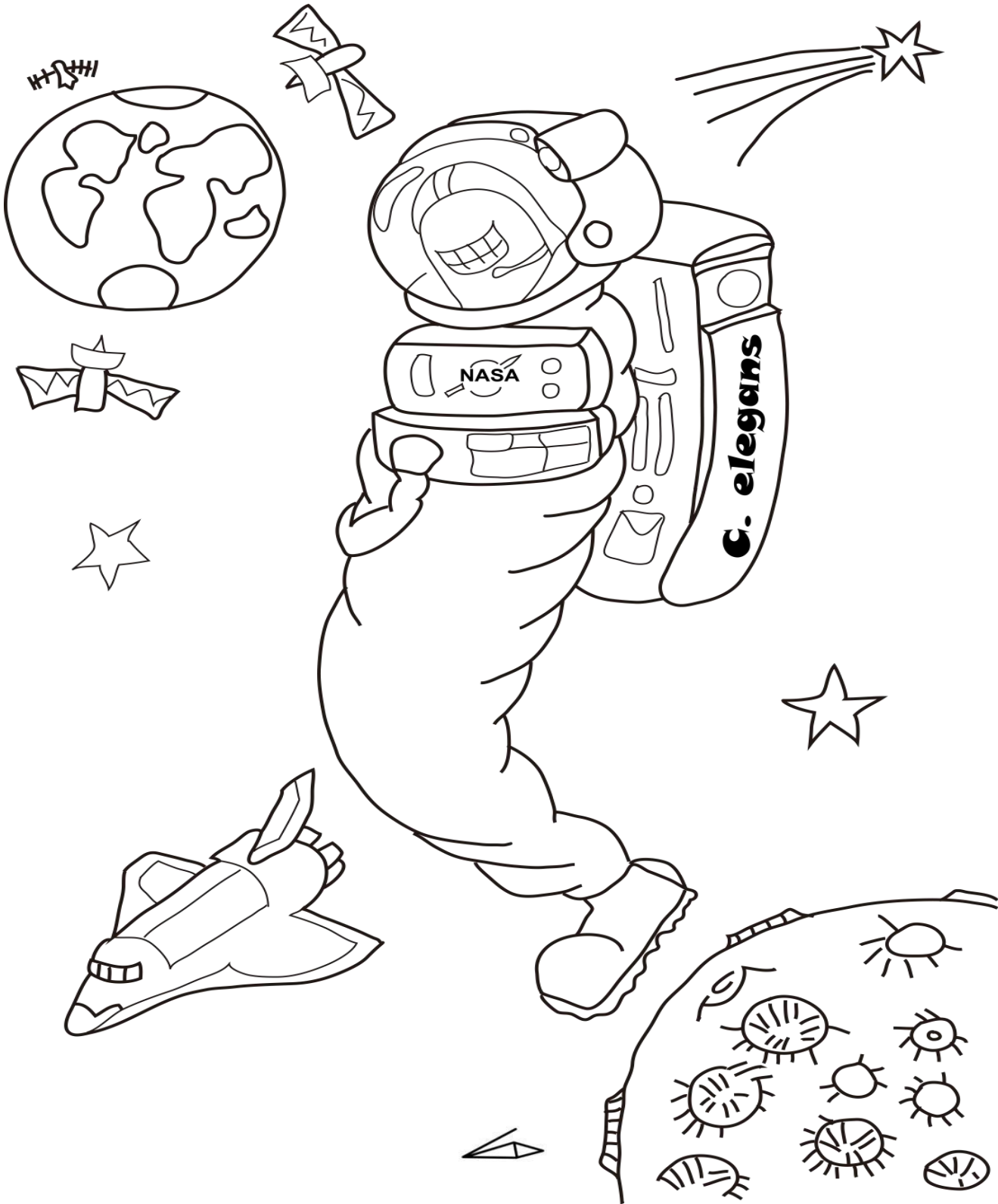
This colouring book, made by nematologists, introduces you to the diverse world of nematodes and shows you from A to Z why scientists find these little animals fun and interesting!

Astronaut

When astronauts stay in space for a long time, their muscles get weak, and this can cause injuries during their missions. The roundworm *Caenorhabditis elegans* is so convenient for science that scientists decided to take these little animals into space to be used as a model to learn more about muscle weakness.

The worms even survived the tragic accident of the Space shuttle Colombia in February 2003. They were found alive in the crashed aluminium tubes in the Texan desert.

Descendants of these worms were sent into space again in 2011. This time the experiments related to muscle weakness had a successful conclusion.


NASA
C. elegans

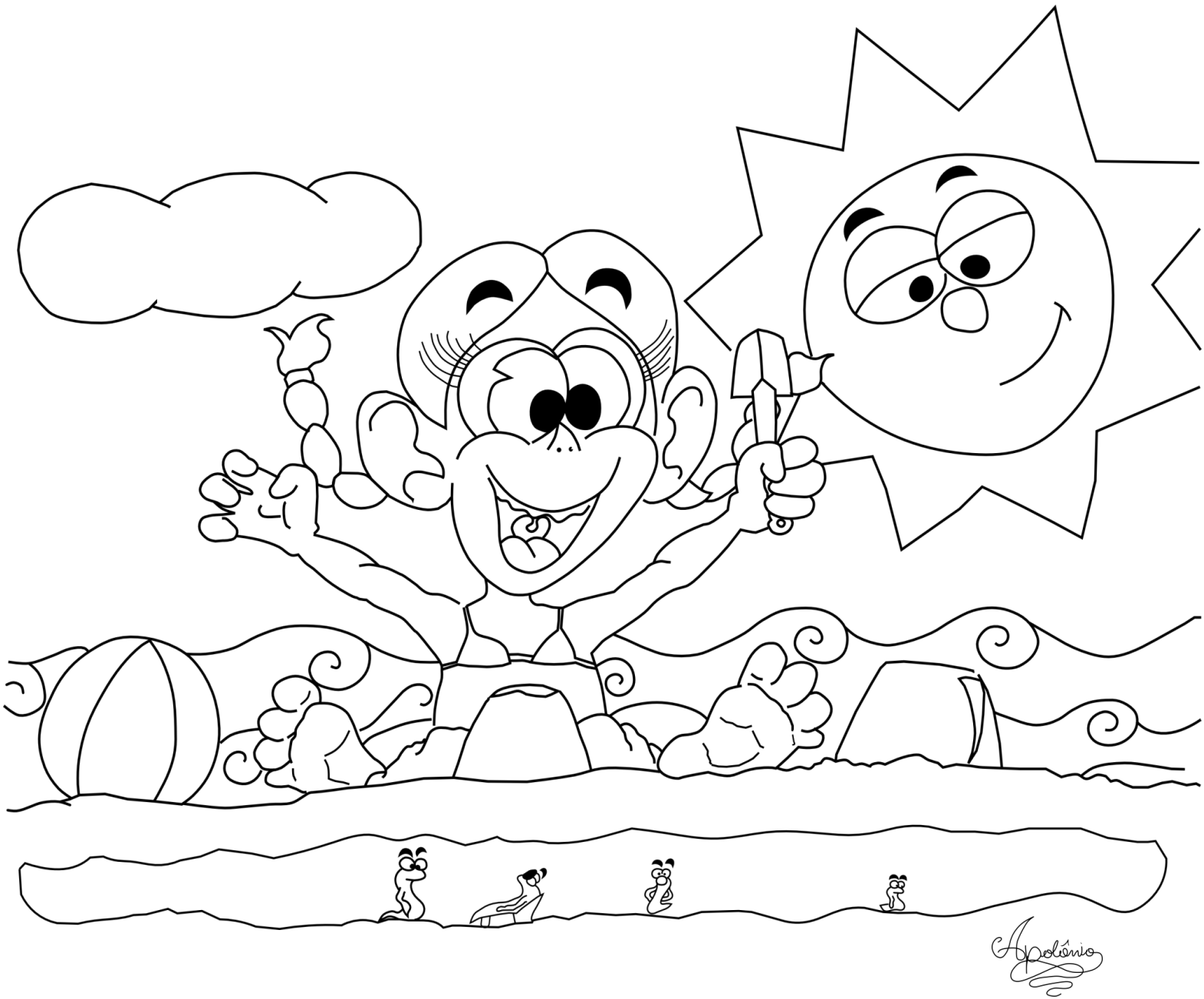
Beach

Do you find this sandy beach looking rather empty and even lifeless? Well, appearances can be deceiving!

Underneath your bath towel, little roundworms wriggle in the sand. Next time, when you build a sand castle digging out a square of 5 by 5 meter, know that you probably disturbed about 50 million nematodes. Not just one species, but perhaps even 50 different species!

These worms feed on microscopically small algae, bacteria, and on each other.

Yes, spectacular scenes occur underneath your bath towel, perhaps even as spectacular as those on the African savannah with lions, gazelles and zebras… Only just a tiny bit smaller.


Apolônio

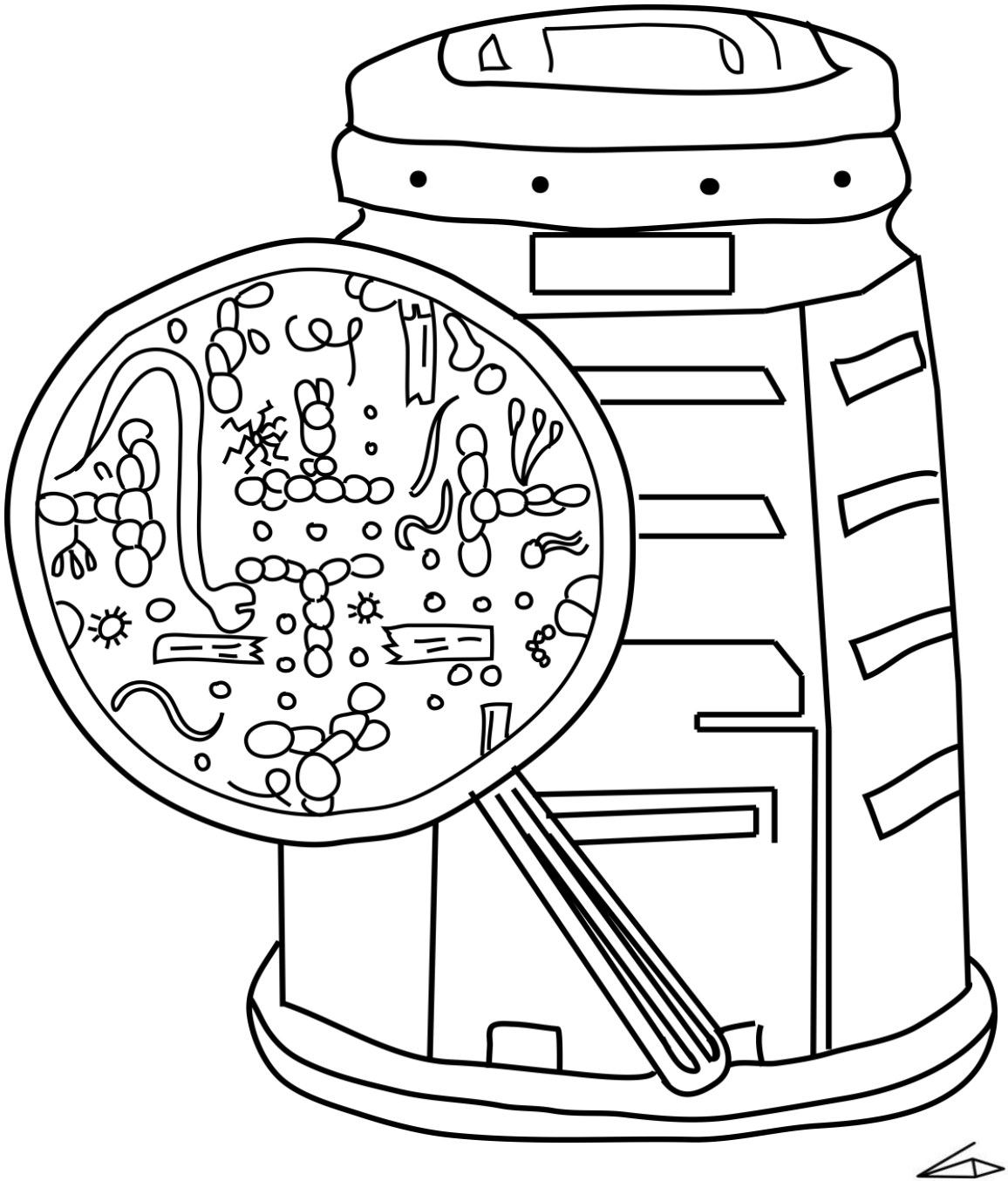
Compost

Compost is full of life!

Bacteria, fungi, springtails, mites, millipedes, centipedes and roundworms work together to decompose the waste and store valuable nutrients. Some of these organisms are so small that you cannot see them with the naked eye. You will have to use a magnifying lens or a microscope. Keeping a compost bin in your garden is useful because you can turn your vegetable, fruit and garden waste into valuable compost.

When you add this compost to the soil, your plants grow much better.

It is a great way to recycle, isn’t it?

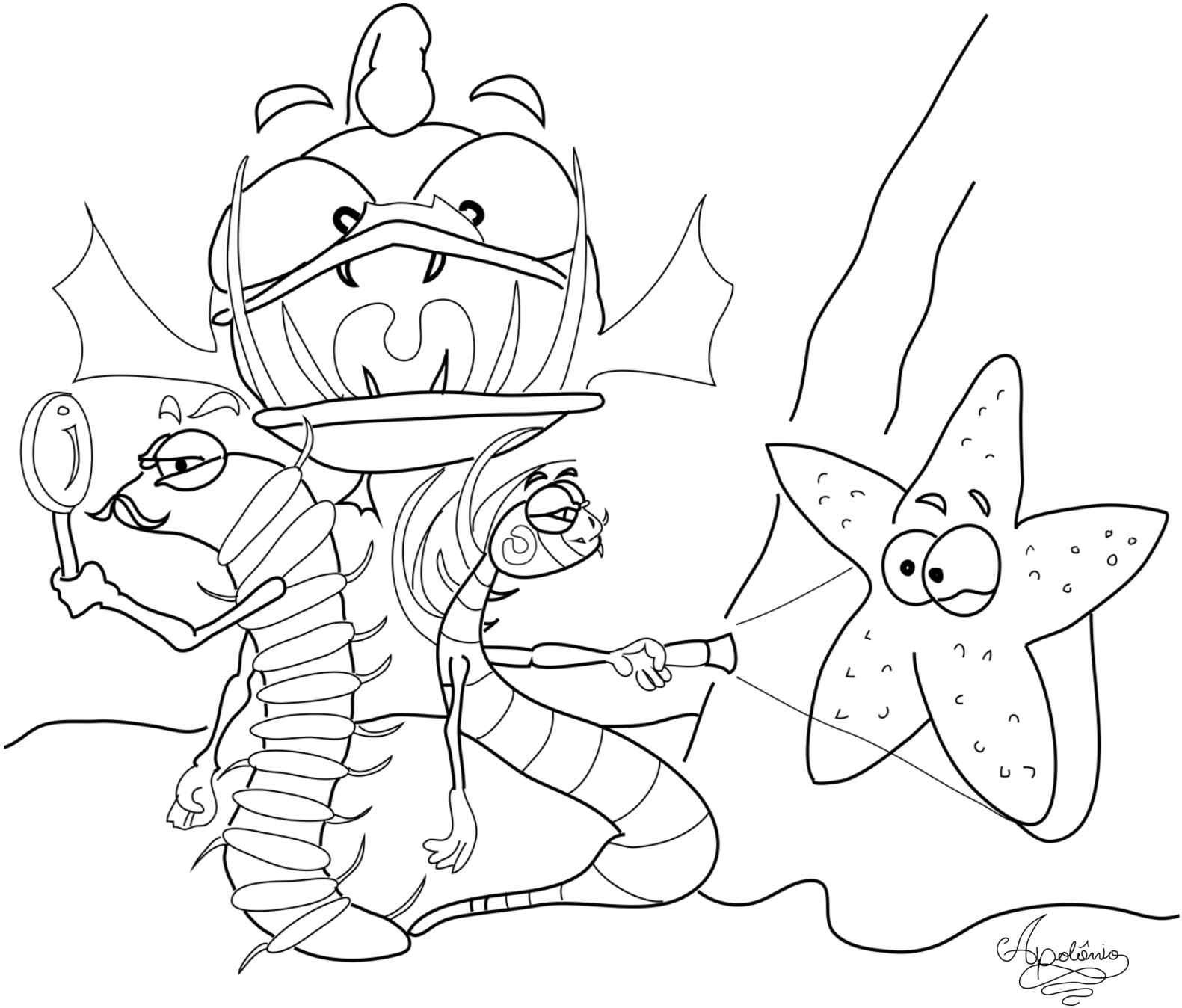


Deepsea

At the bottom of the sea there is not a single ray of light, leading people to think for a long time that there was no life to be found.

However, nothing could be further from the truth! Luminescent jellyfish, fish with big teeth, little crabs, starfish and many other animals swarm in the abyss of the ocean. Also, nematodes love it there. With their specialised sense organ, the amphid, they can survive in the dark without eyes. They use it to detect food, friends and enemies.

You see, there are many interesting things to discover in the deepsea!

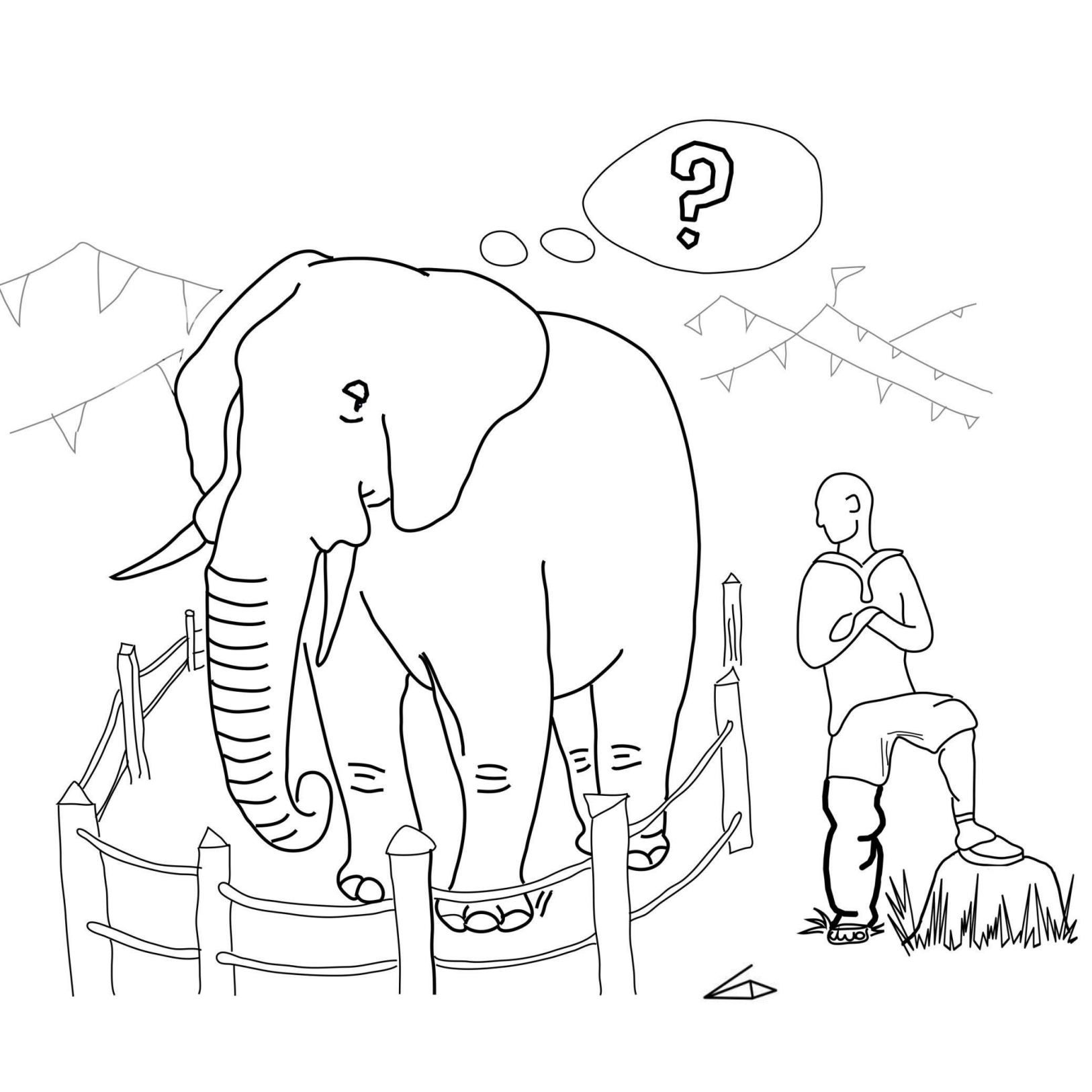

Apolênio

Elephant

Did you know that roundworms can make you look like elephants? Good news for the elephant lovers? Not really!

The cause of this elephant-look is an infection of small parasitic roundworms. These little worms live in our lymphatic vessels and obstruct them, preventing body fluids from escaping. This causes swelling, making our legs look like those of elephants.

Crazy isn’t it!?



Fossil

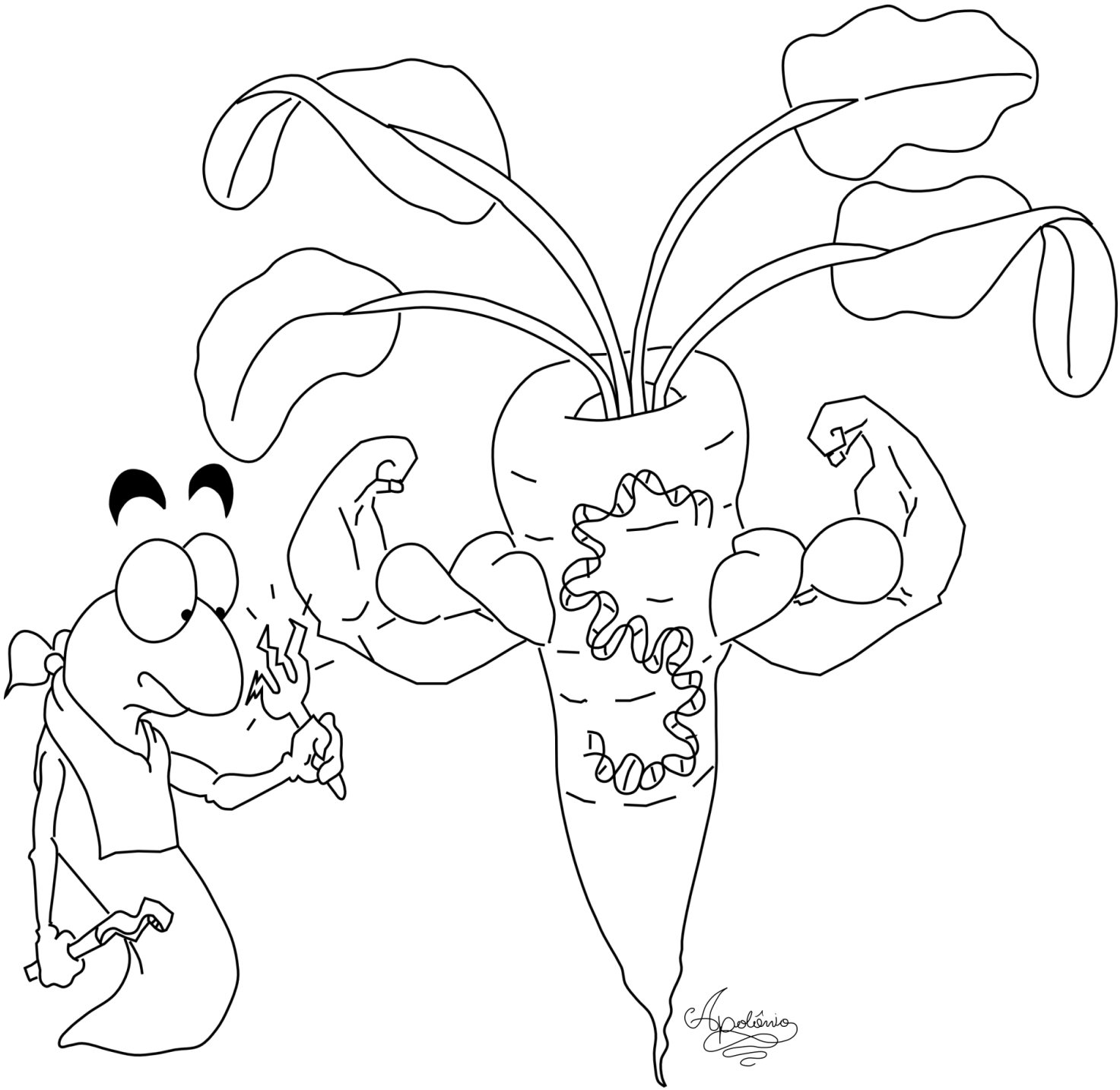
Nematodes already existed when dinosaurs were roaming the earth. We know this because nematodes were captured in resin of prehistoric pine trees. The resin fossilized and preserved the worms very well. This fossilized resin is also known as amber.

Insects were also captured in the amber. Scientists found nematodes in the insects, telling us that in the Jurrassic period nematodes were already parasites of insects.

We do not yet know who is the ancestor of nematodes, but we can be almost certain that the very first nematodes lived in the sea.

GMO

Genetically Modified Organisms (GMO) are animals, plants or microbes in which scientists put an extra gene, on top of all the other genes already present in their DNA. In this way a plant or a crop can be better protected against diseases caused by nematodes and other pathogens. There is then less need for pesticides in agriculture. This is better for the environment and our health!


Apolônio

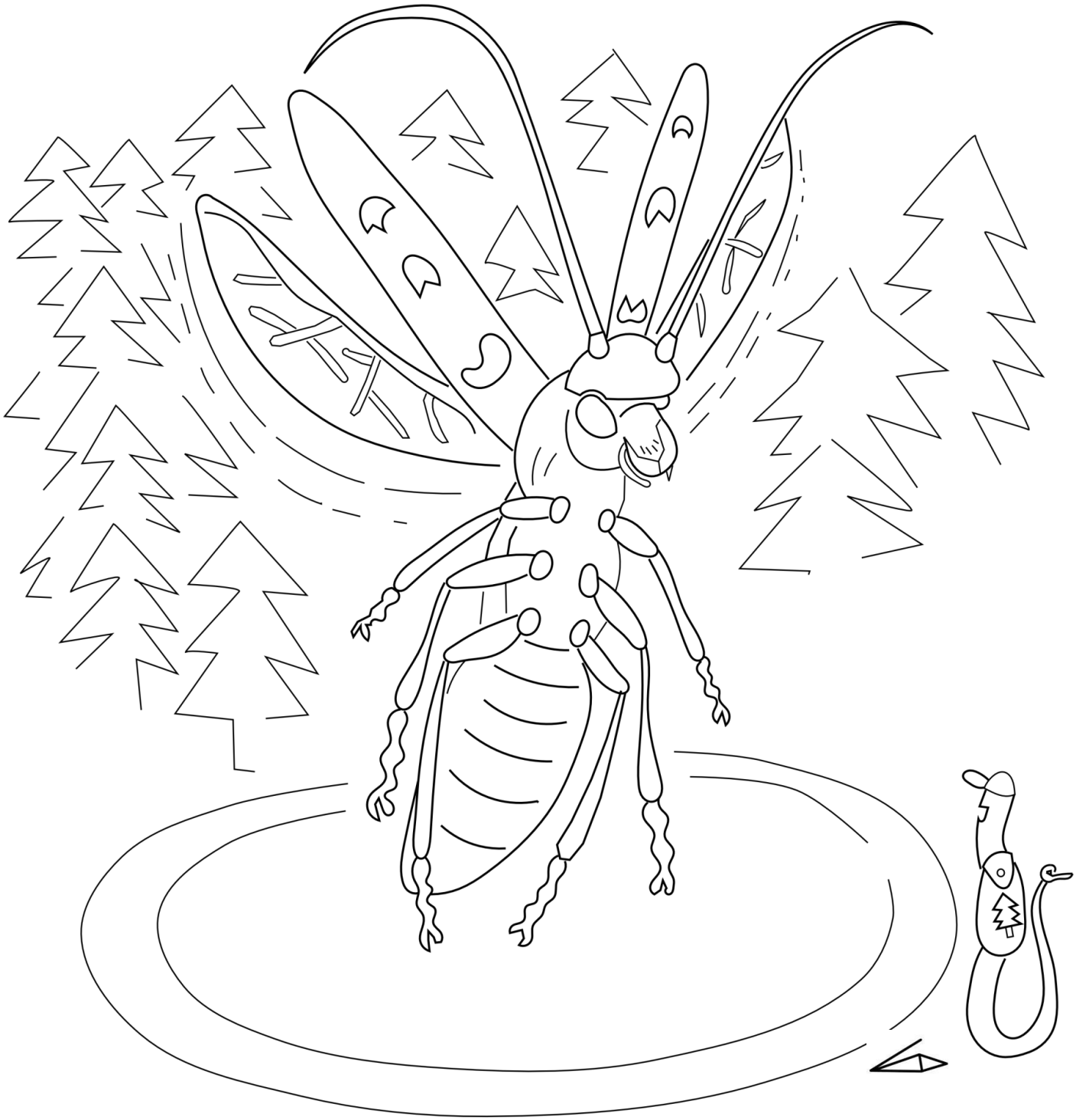
Hitchhike

Some worms are really smart.

Pinewood nematodes hitch a ride with beetles to fly from one pine tree to the other. The beetles drill little holes in the tree to feed themselves and to lay eggs. The nematodes use these holes to reach the water and food channels in the tree. There, they find a good environment to multiply but after a while they block the channels, causing the tree to become unhealthy and eventually die.

Beetles thus help the nematodes and the disease to spread.

Unfortunately, this friendly hitchhike is a serious danger for pine tree forests all over the world.

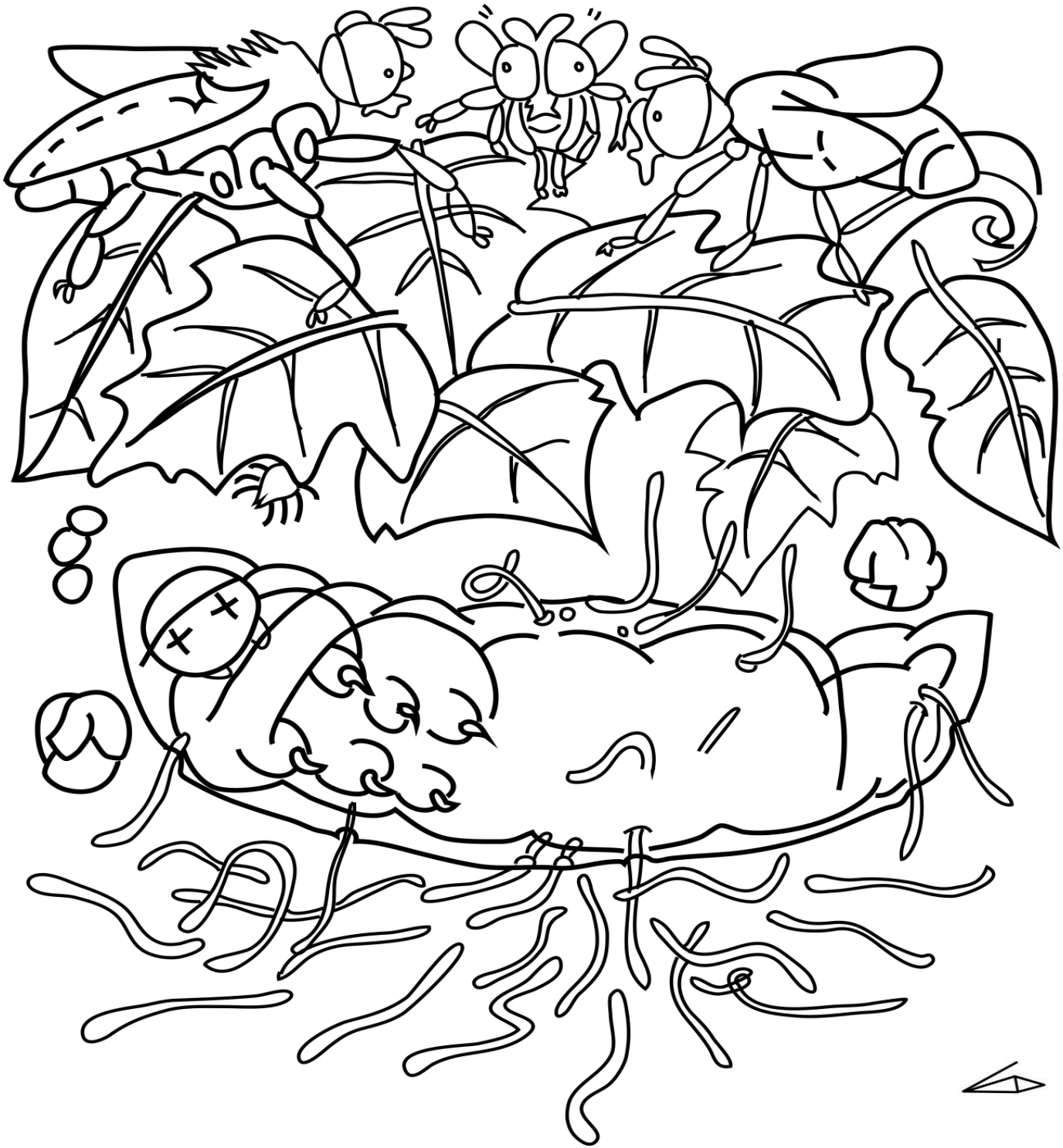


Insect

Sometimes insects can be very annoying. They drill holes in our fruit and damage trees.

Luckily, there are nematodes that help us fight these insects. When nematodes are small, they enter into the larva of the insect. The bacteria carried by the little worms multiply in the larva, providing food for the worms. The nematodes also grow further and multiply until there are thousands in the larva, causing it to die!

In this way we can protect crops with living worms without having to use chemical products. This we call biocontrol.



Jungle

Animal parasites often have a complicated and ingenious life cycle. They even use several animals to get them to their final host to complete their life cycle.

An amazing example is that of the nematode *Myrmeconema neotropicum,* that lives in the tropical jungles of South- America and likes to reside in bird droppings. These bird droppings are eaten by ants, so the nematodes end up in the belly of the ant. The nematode is a parasite and develops inside the ant. The belly of the ant starts to swell and changes colour: the body turns from black to bright red making the ant look like a round red berry!

Birds love berries, making the ant an attractive prey for the birds. The birds eat the ant and spread the parasitic nematodes again in their droppings; in this way the life cycle of the nematode is completed.


Apolônio

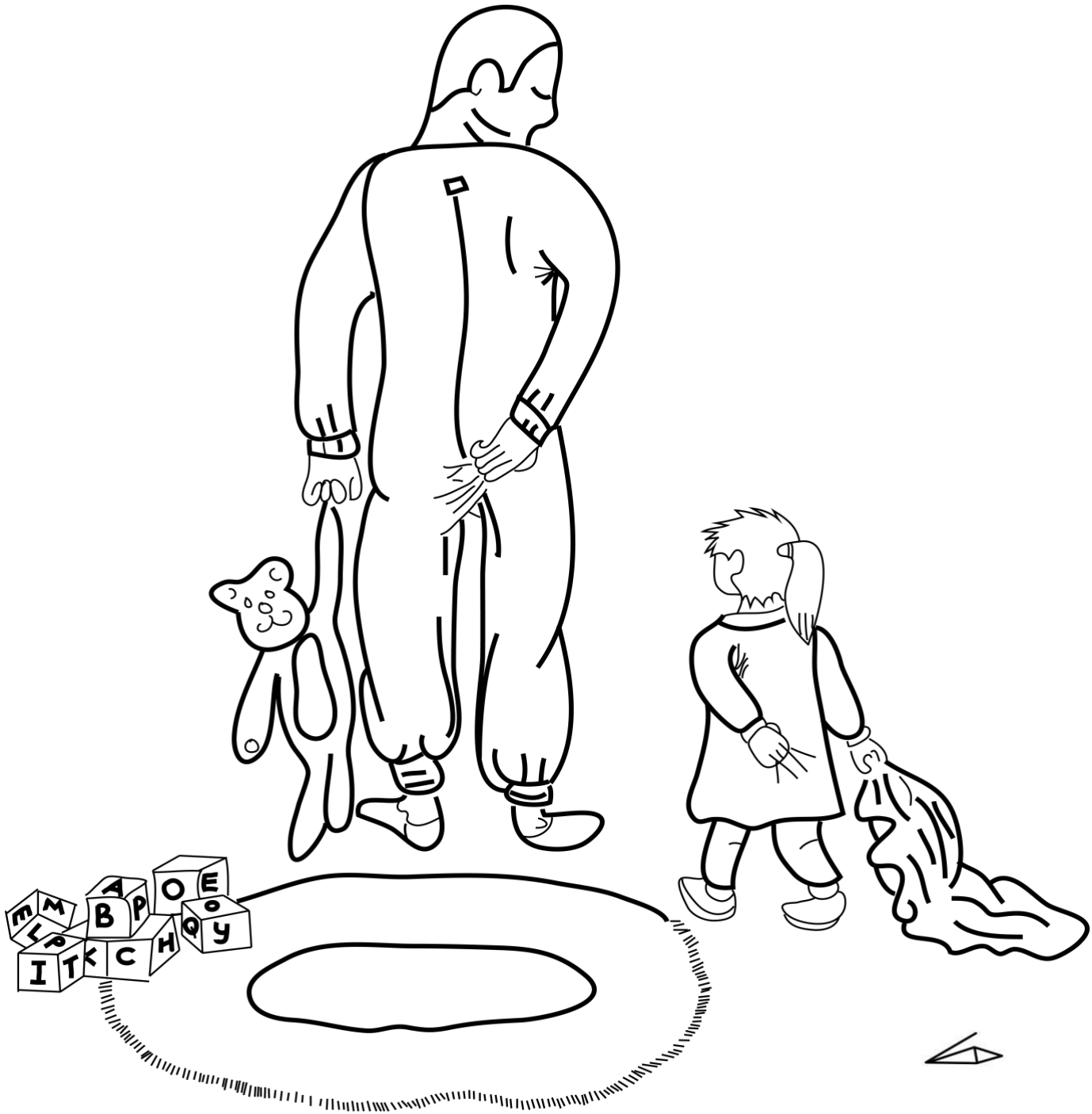
Kid

Are your buttocks itching? Maybe you have pinworms?

A pinworm infection is very common in kids. The female pinworm lives in human intestines. At night they lay their eggs near to the anus where oxygen, necessary for the young pinworms to hatch out of the eggs, is present.

The wriggling of the worms causes your buttocks to itch. When you then start scratching, the eggs get spread by the fingers to toys.
When a kid puts the toys in its mouth the eggs are swallowed, and the infection happens.

So, kids, wash your hands!!!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Love

Every nematode species has its own way to make love. Many species do the same as human beings: there are males and females who produce the young.

In other species you only find hermaphrodites. These are individuals that are male and female at the same time, and are capable of producing offspring by themselves.

Sometimes there are no females at all. We only find hermaphrodites (self-fertilisation) and once in a while a male (cross-fertilisation). The males first do a dance, then mate with the hermaphrodites.

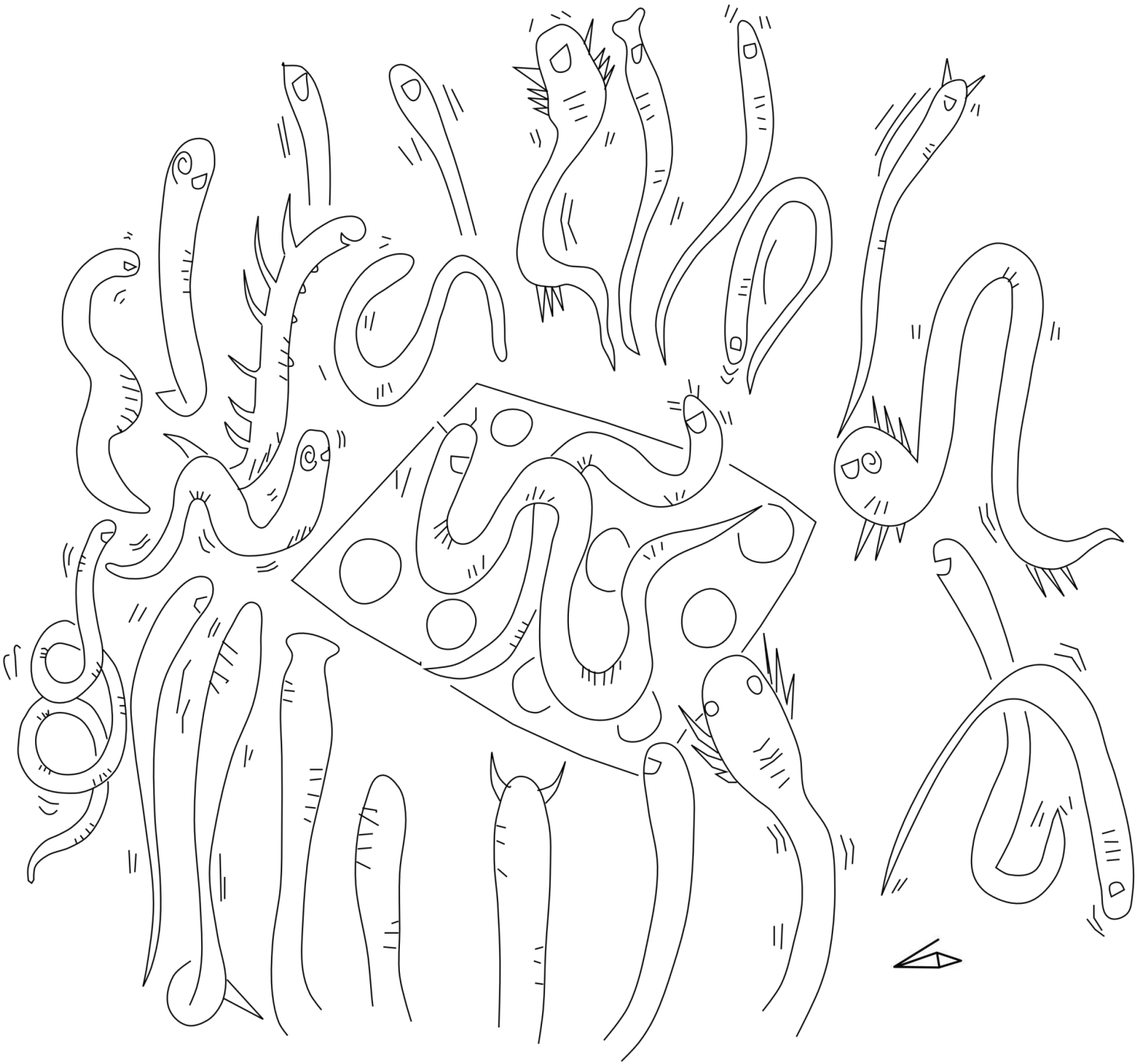

BB '13

Movement

Roundworms are very agile. Most of them move like a snake: they move in a whip-like or sinusoidal motion, using their bundles of muscles stretching from head to tail.

Some are sluggish, but others are extremely quick, in this way you can even recognise species by the way they move.

A few short and thick roundworms with long appendages, like limbs, behave differently; they use these appendages like stilts and move like caterpillars.

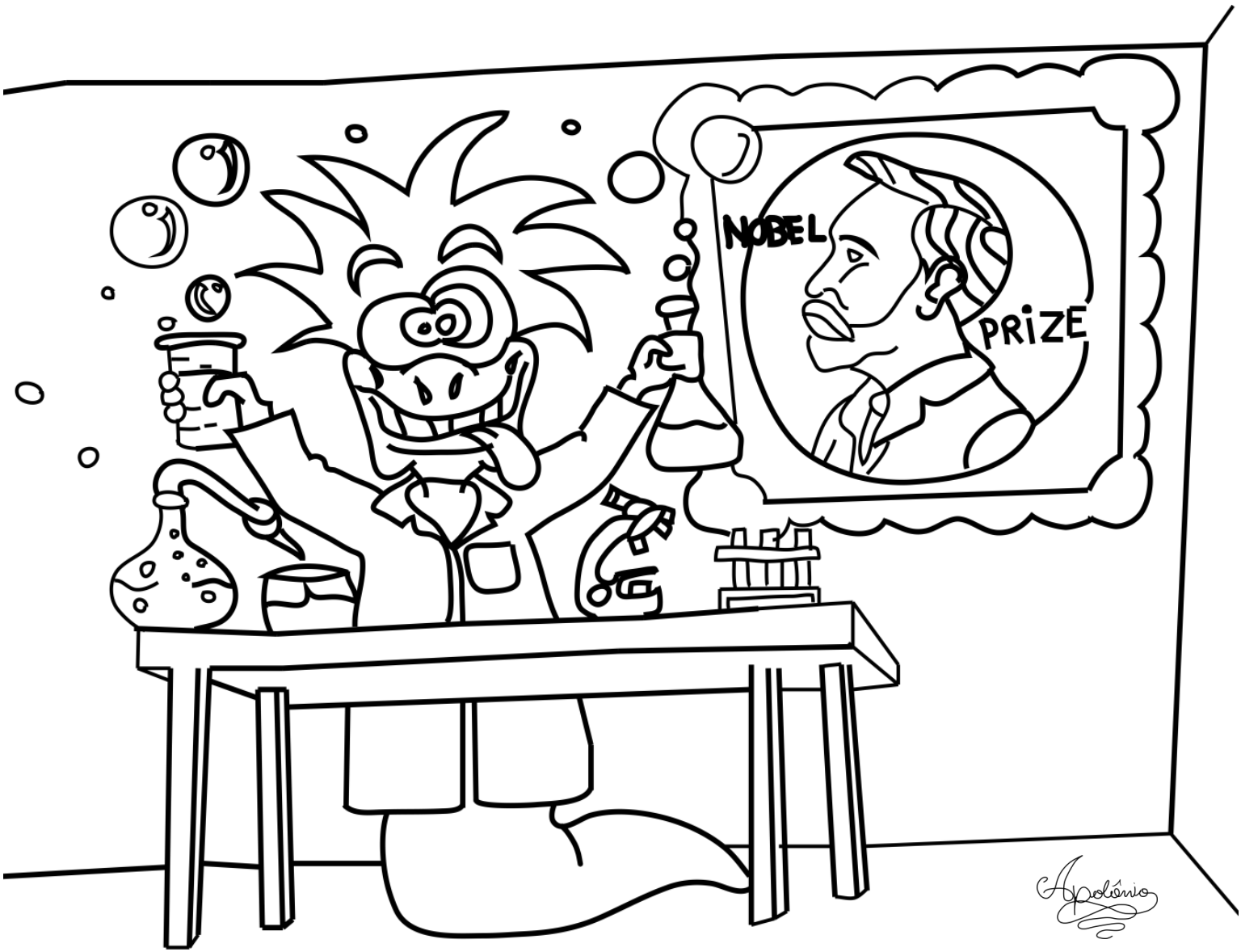


Nobel prize

The roundworm *Caenorhabditis elegans* is famous among scientists. They have been used to find answers to many questions in the science of life.

For example, How does an egg develops into a worm? How can the worms smell food or how can they wriggle?

In recent years many important discoveries have been made and new methods were developed using this little worm. These discoveries were so important that between 2002 and 2013, six scientists working on *Caenorhabditis elegans* were awarded three Nobel prizes in total.

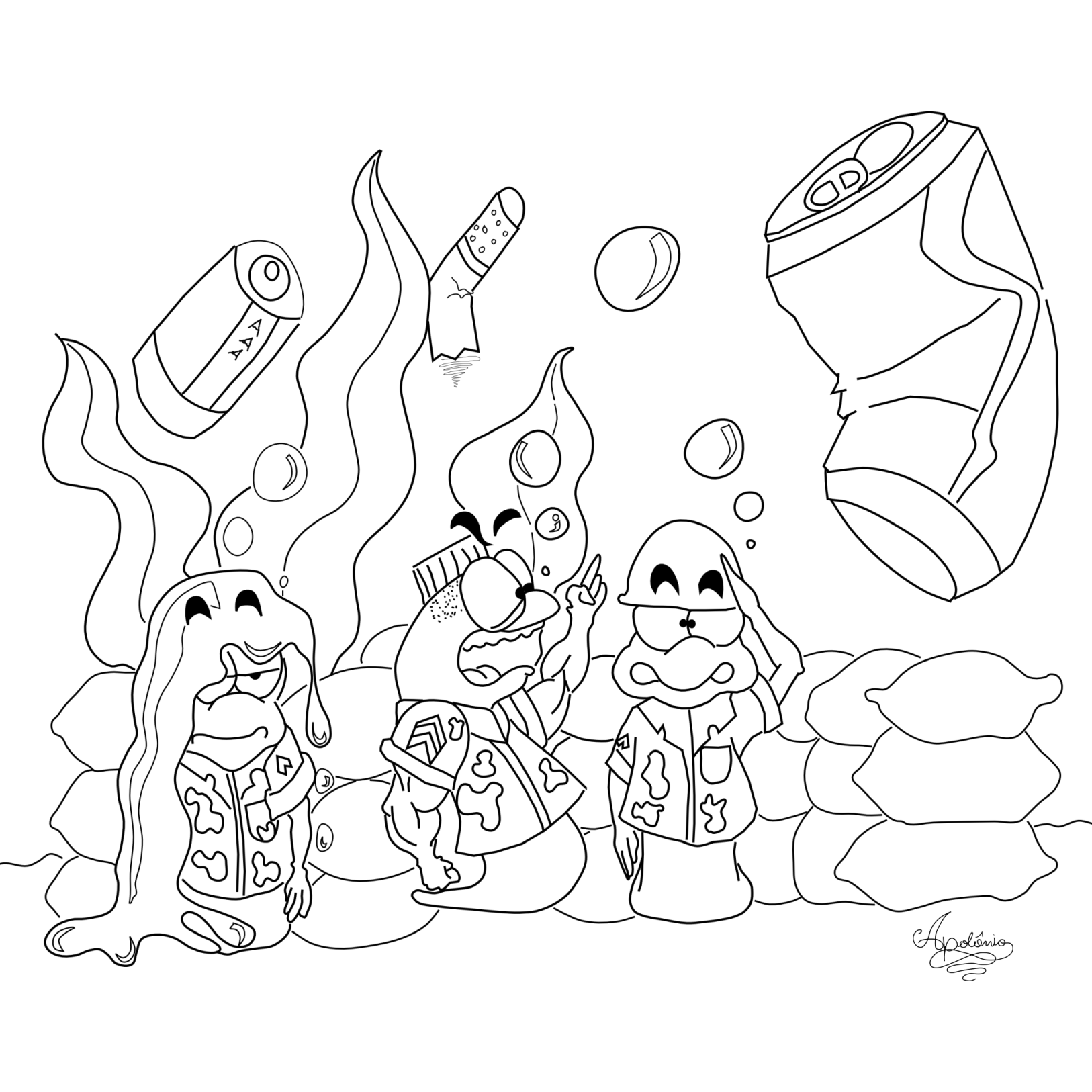

NOBEL
PRIZE
Apolônio

Ocean

The ocean is of priceless importance to people. Unfortunately, we do not take care of it very well. Oil, tons of waste, and toxic products are dumped into the ocean.This has a very important impact on the animals that live there. When there is an oil disaster the toxic filth washes ashore, and almost all animal life dies, except… nematodes.

Nematodes are by far the most numerous animals in the seabed and there are also many different species. Some are very sensitive to pollution such as oil spills, while others are very resistant.

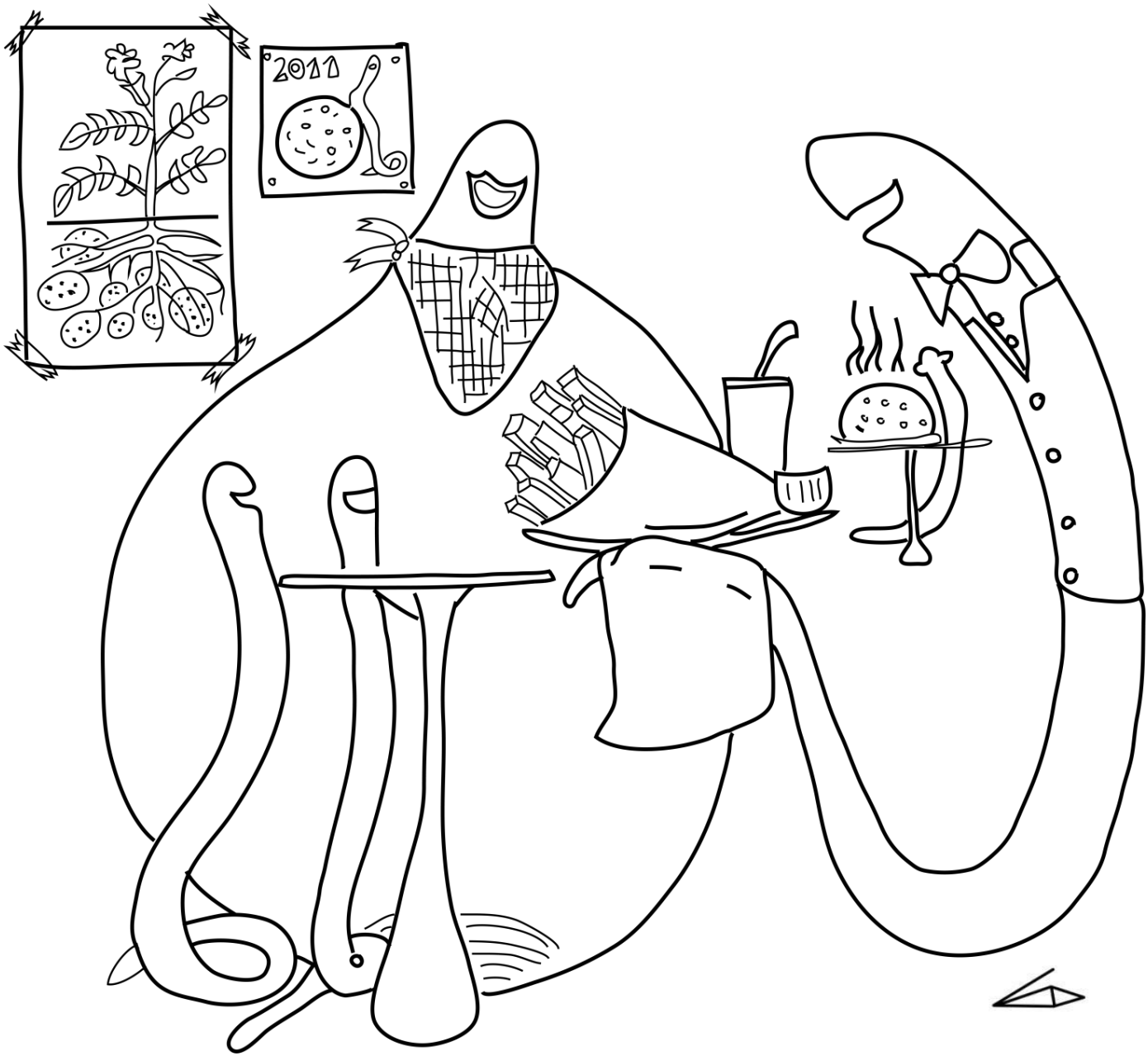
Scientists have found that some nematodes are likely to help to biodegrade the toxic oil waste. In this way, research on nematodes tells us a lot about the consequences of seabed pollution, as well as demonstrating that nematodes can help get rid of pollution and let the ocean recover.


Apolônio

Potato

Fries, baked and mashed potatoes, we all like them. Did you know that nematodes also like potatoes?

Potato cyst nematodes and root-knot nematodes can be found in the roots and tubers of the potato plant. Because of this, the plants grow poorly, giving the farmer a smaller harvest with fewer potatoes. The root-knot nematodes create knots and warts on the potatoes, making them look very unattractive, so the farmer cannot send them for sale in shops.


2011

Quarantine

Some nematode species make plants very sick, resulting in poor harvests of vegetables, fruit or cereals. The growth of ornamental plants can also be damaged.

When a damaging and dangerous nematode species does not occur in a country, that country will try everything it can to keep the nematode out. This nematode will end up on a list of quarantine species. Customs officers use this list when forestry and agricultural products are imported or exported. Products that contain these nematodes will be returned or destroyed.

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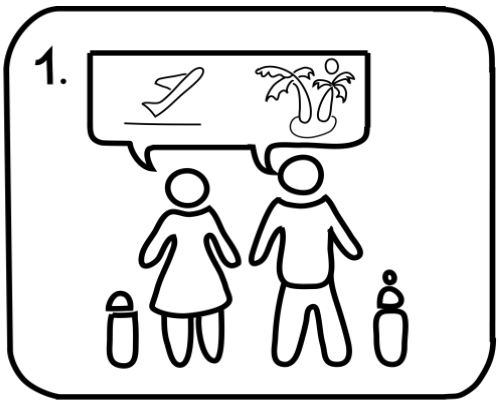

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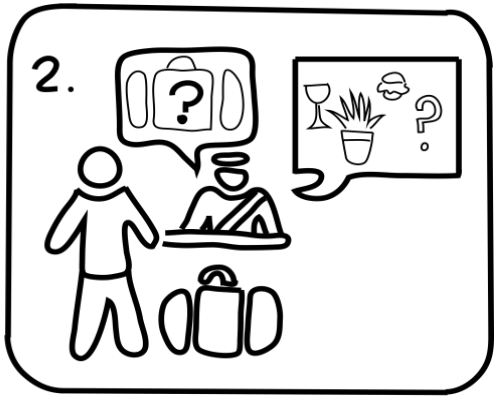

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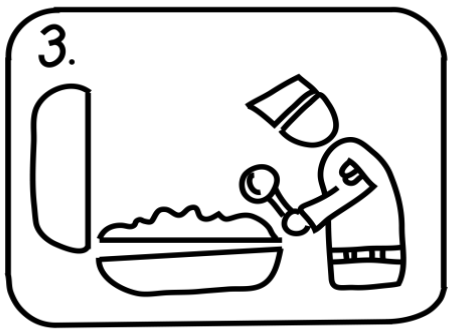

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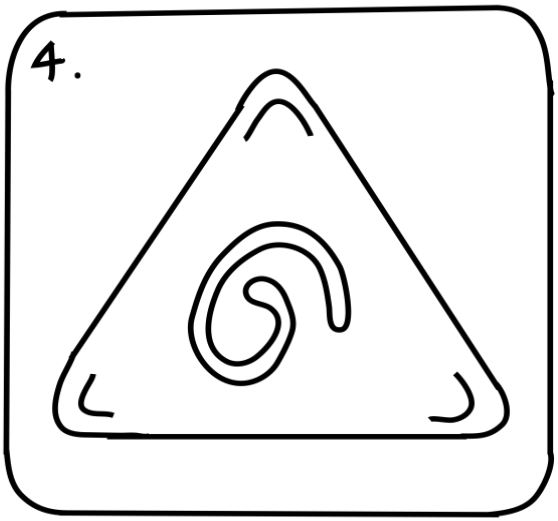

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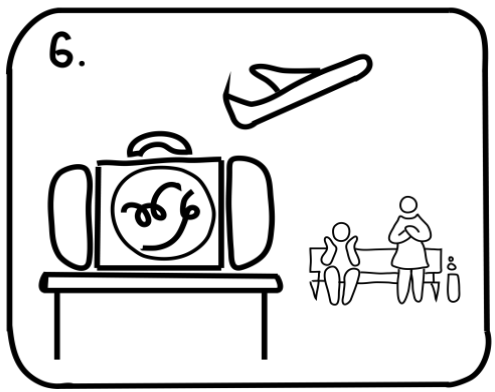
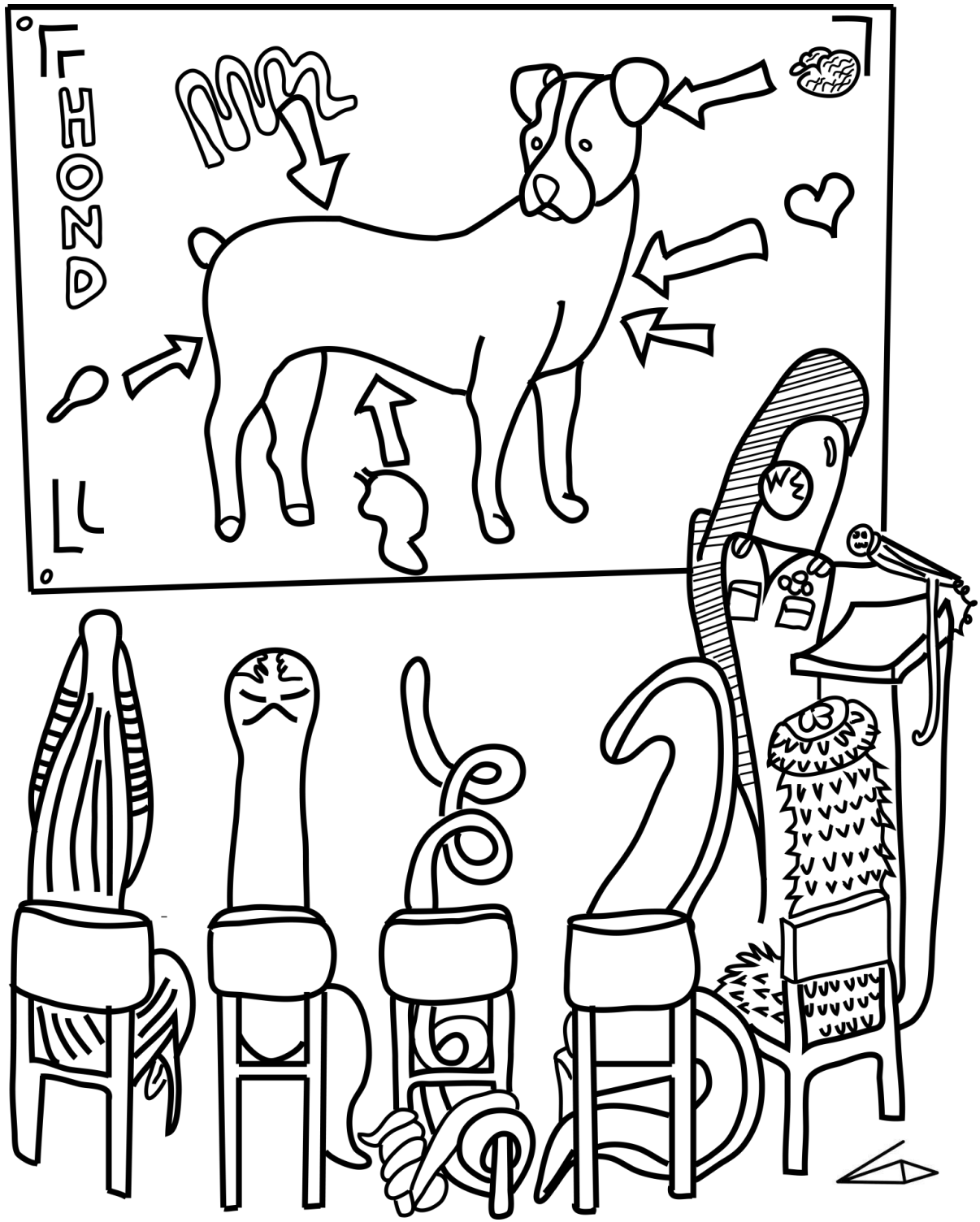


Retriever

In a Retriever, or in any dog, many nematodes can occur: heartworms, lungworms, hookworms and whipworms. These worms are transmitted with the mother's milk or through the environment. They live in the intestines, lungs or heart.

Often, you do not realise that the dog has these nematodes, but sometimes serious illness can occur such as bleeding, respiratory problems or severe weight loss.

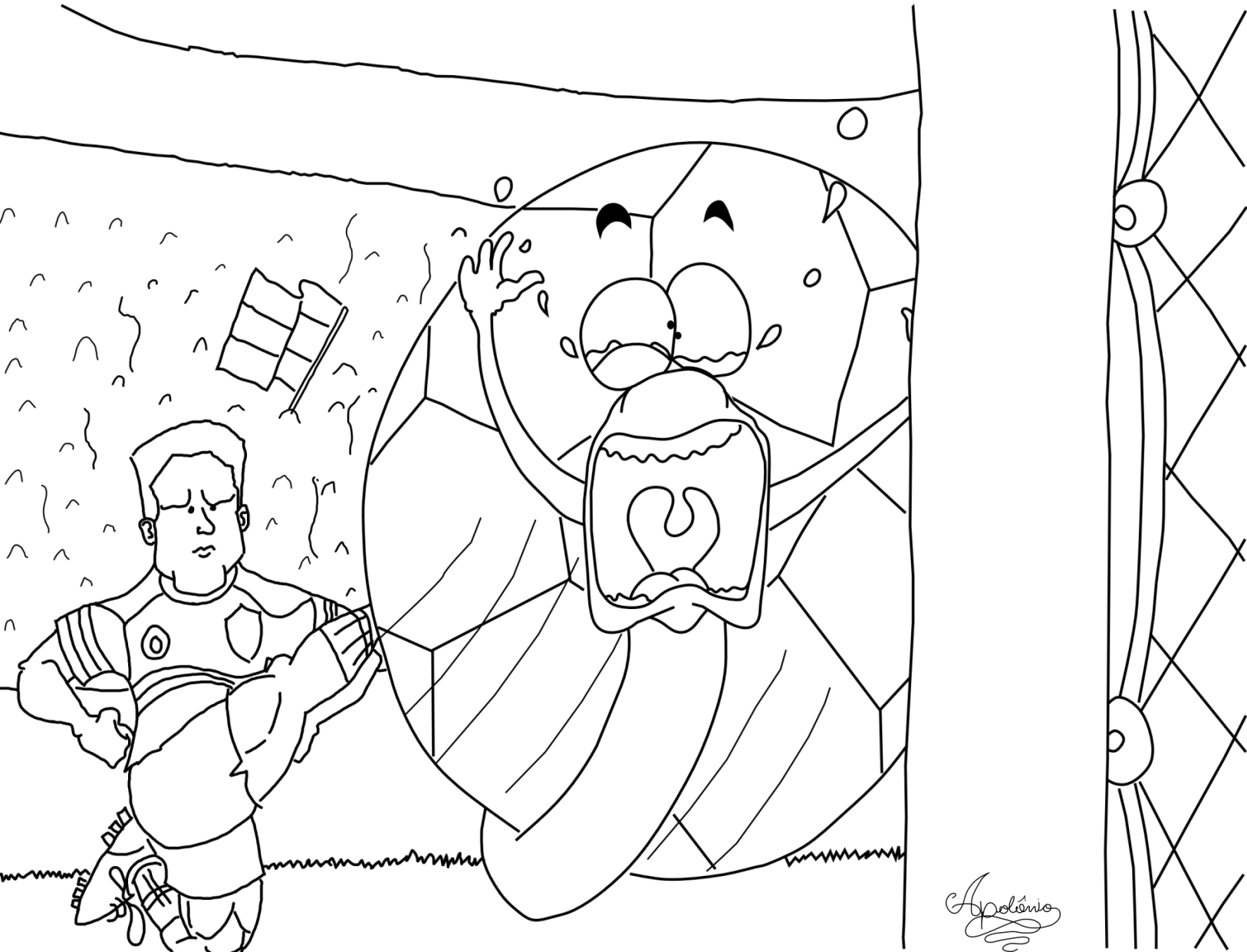
The best thing to do is to make sure your dog is 'wormed' on a regular basis using medicine recommended by animal doctors. Then all those nematodes die, and your dog stays alive and kicking and healthy!


LEONARDO

Soccer

Soccer fields are carefully looked after. They are watered every day and some even have under-soil heating. Plant parasitic-nematodes love this! In their mouth they have a needle-like hollow spear, which they use to suck the juice out of the roots of the grass. Often there are millions of these nematodes in soccer fields.

Usually the damage to the grass is limited, but if there are very large numbers of nematodes, brown spots appear on the grass as the grass dies, and finally the soccer field is destroyed. Nematodes can be really annoying for soccer players, but the reverse is not true: nematodes do not suffer from soccer players!


Apolônio

Teeth

Like little children, little worms also change their teeth. With nematodes, however, it happens four times before they get adult teeth. Among species, these teeth can look very different, depending on what they eat.

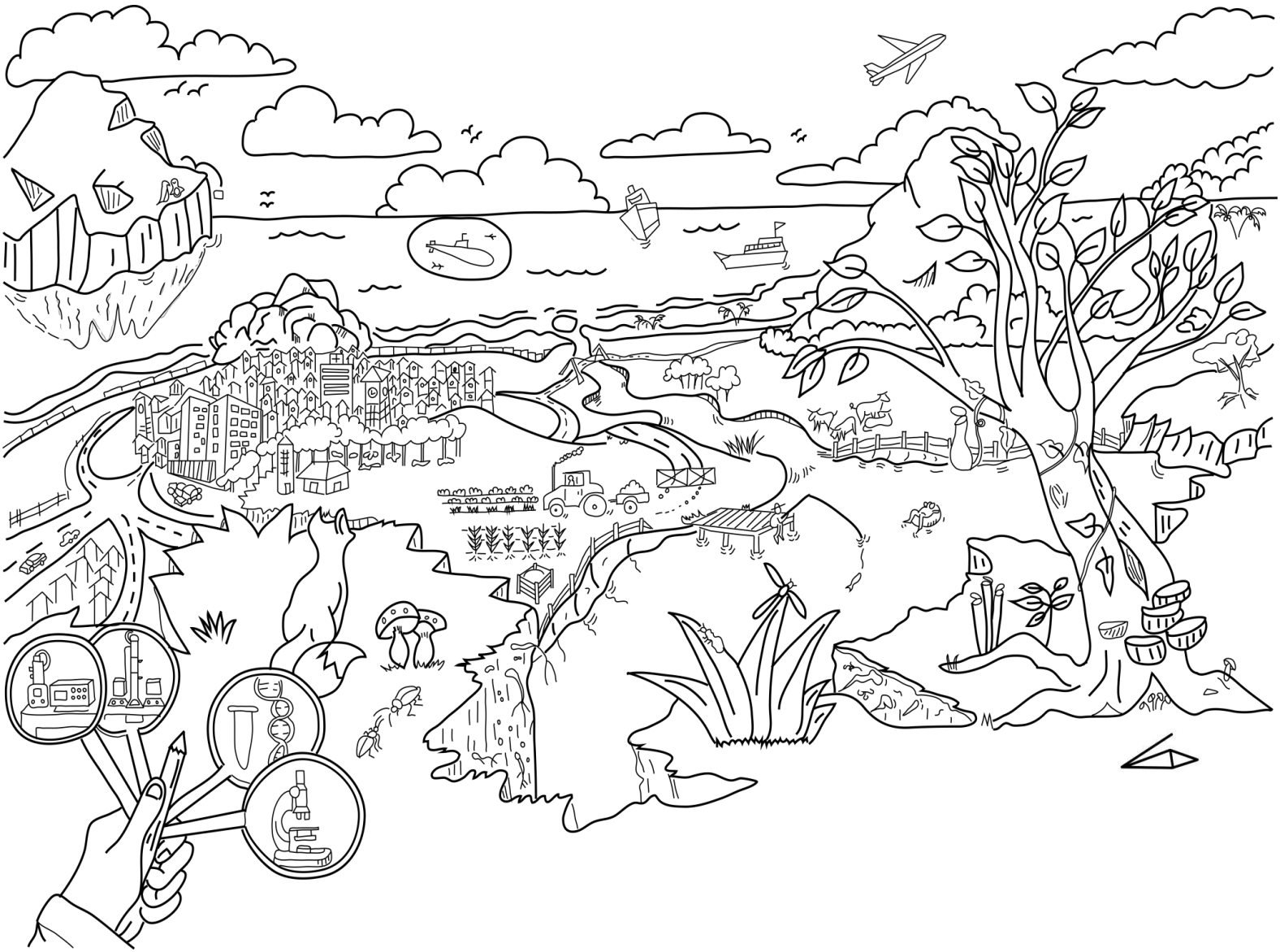
Some worms, such as predators, have sharp teeth with which they eat other animals. Other nematodes have just one tooth looking like a straw to suck the roots of plants. There are also worms having no teeth at all! They eat tiny bacteria, mmm… delicious!

Unique

While reading this text, imagine a beautiful piece of nature.

This can be everything: a white sandy beach and shiny blue sea, a swirling river or a vast forest. You can even think about animals and plants.

It does not matter which piece of nature you had in mind, all these places have one thing in common: nematodes live there. Look at the drawing, everything on this drawing is the environment of a particular nematode. Unique, isn’t it!?



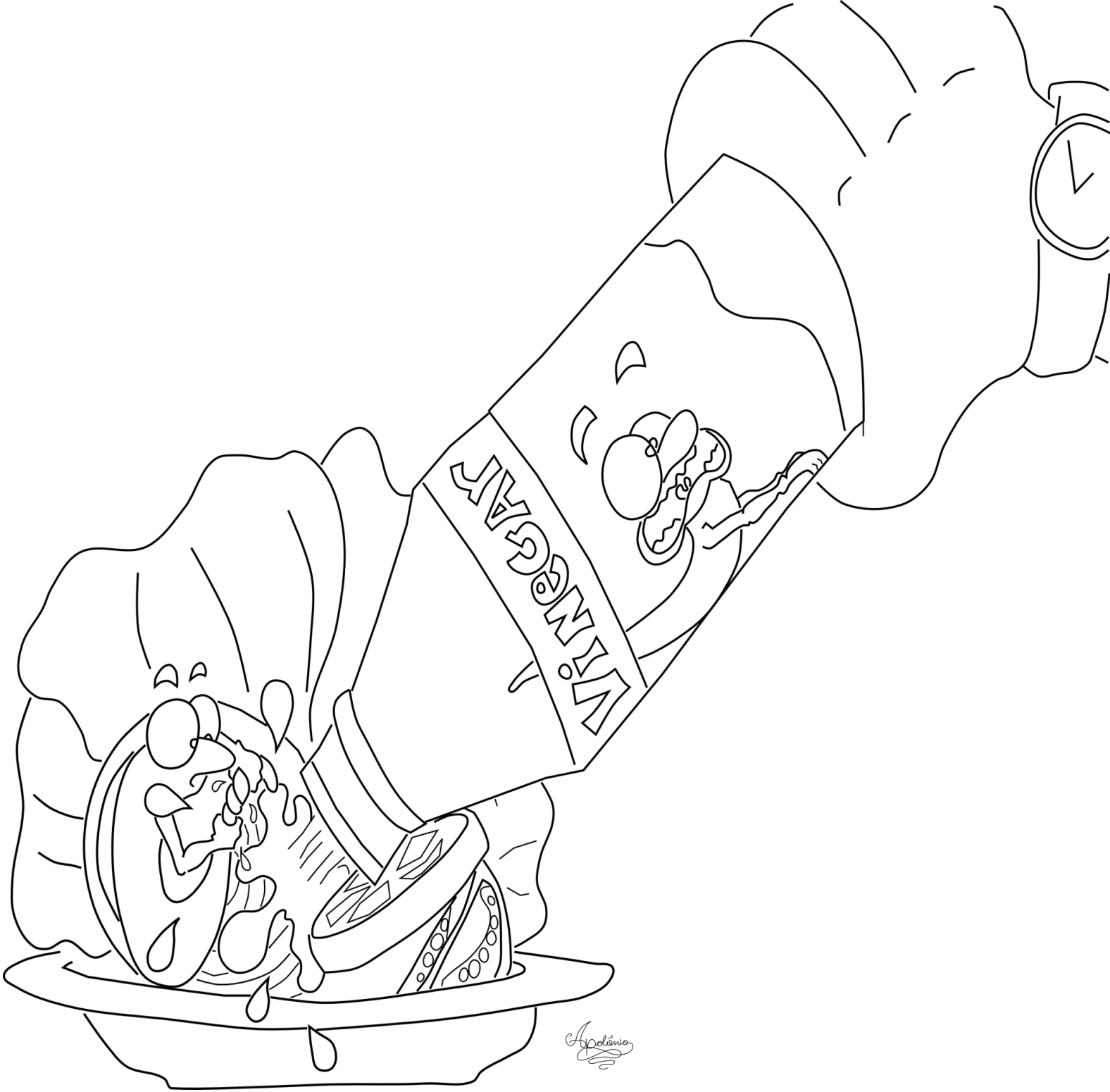
Vinegar

Vinegar eelworms or vinegar nematodes (*Turbatrix aceti*) are free-living nematodes that can live in acidic environments: acidic lakes, apples and yes, vinegar. They are about 1-2mm long and feed on the bacteria from apples and on the microbial culture, called mother of vinegar, in unfiltered vinegar.

Vinegar eelworms are ideal live food, rich in fat, for young baby fish such as guppies, and can very easily be cultured.

Do you like experiments and want to try culturing vinegar eels?

It is very simple: all you need is a glass or plastic bottle, apple vinegar or common vinegar with a piece of apple added, water, a tissue to cover, coffee filter paper and of course some vinegar eelworms to start with. Look for a recipe on the internet and… Good luck!


VINEGAR

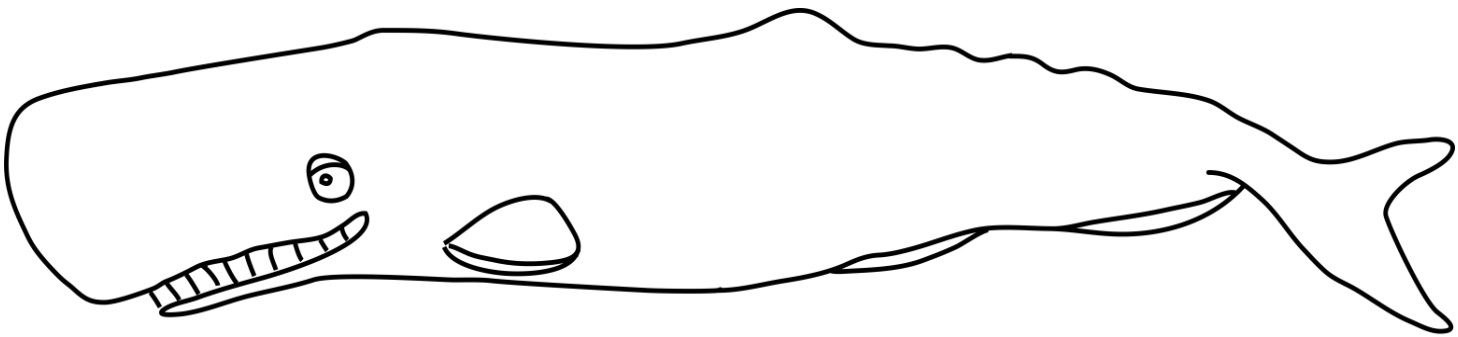
Whale

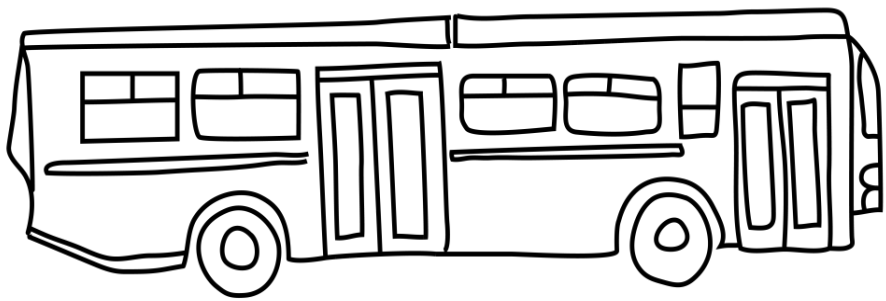
Do you know the book about Moby Dick, the white whale?

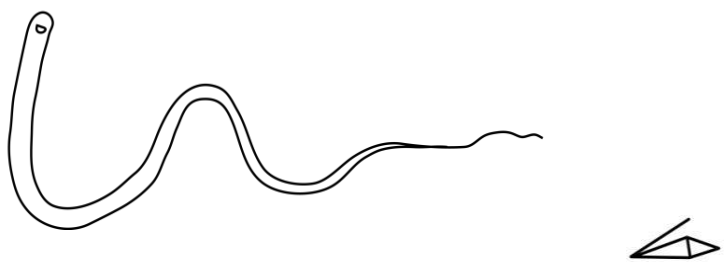
In this book the author describes Moby Dick as an unusually large, aggressive and dangerous sperm whale, causing many tragedies at sea.

Naturally, it is only a story, but the sperm whale is indeed one of the largest animals on earth, being larger than two buses. The largest roundworm ever was found in these whales: almost 8 meters long and 2.5 centimeters thick!

In the belly of the mother whale, the baby whale and the worm feast on the placenta. If you know that a sperm whale is very large and is pregnant for 15 months, you can understand why the worm gets so big!



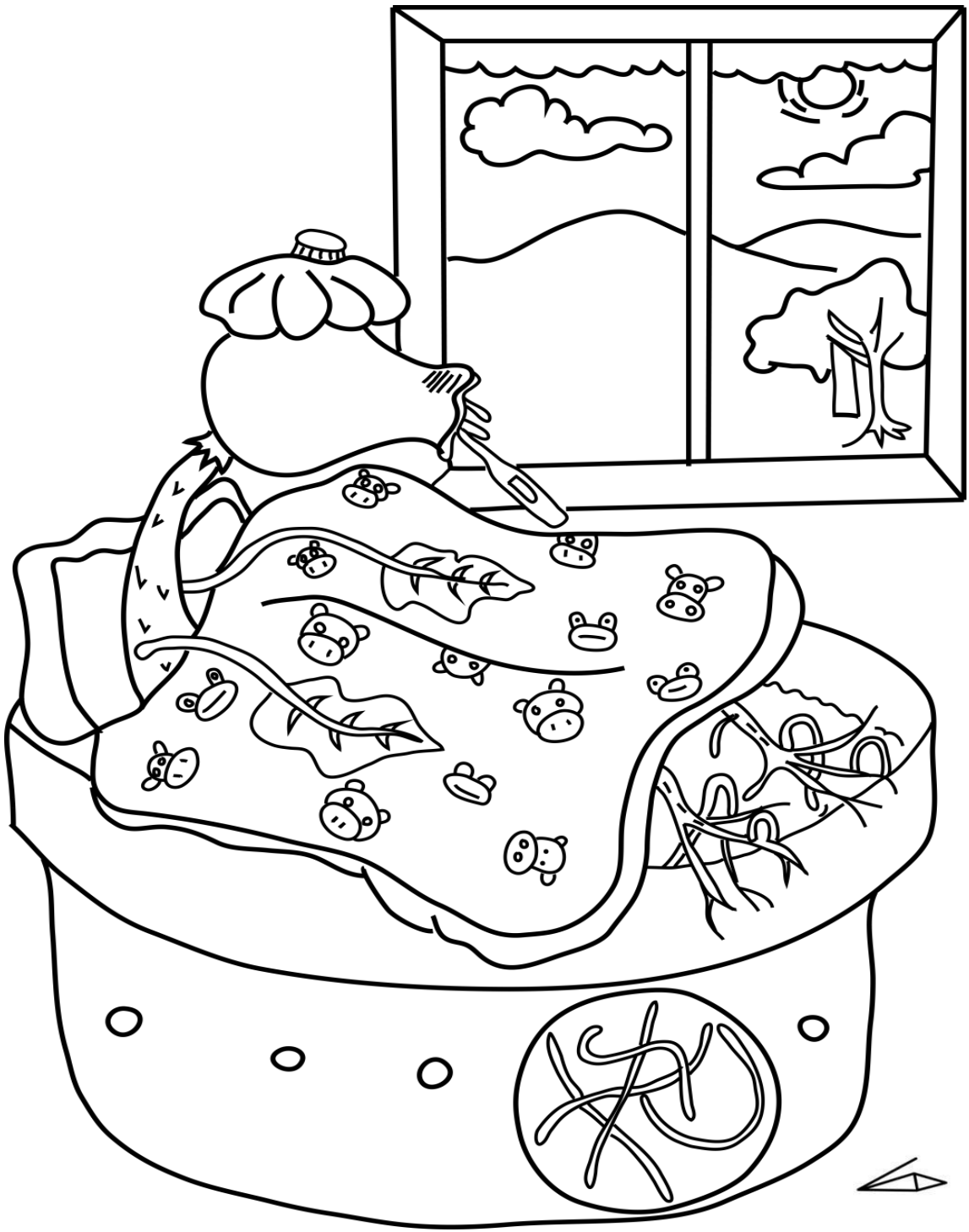




Xiphinema, what a difficult word!

Did you know that roundworms also get names?

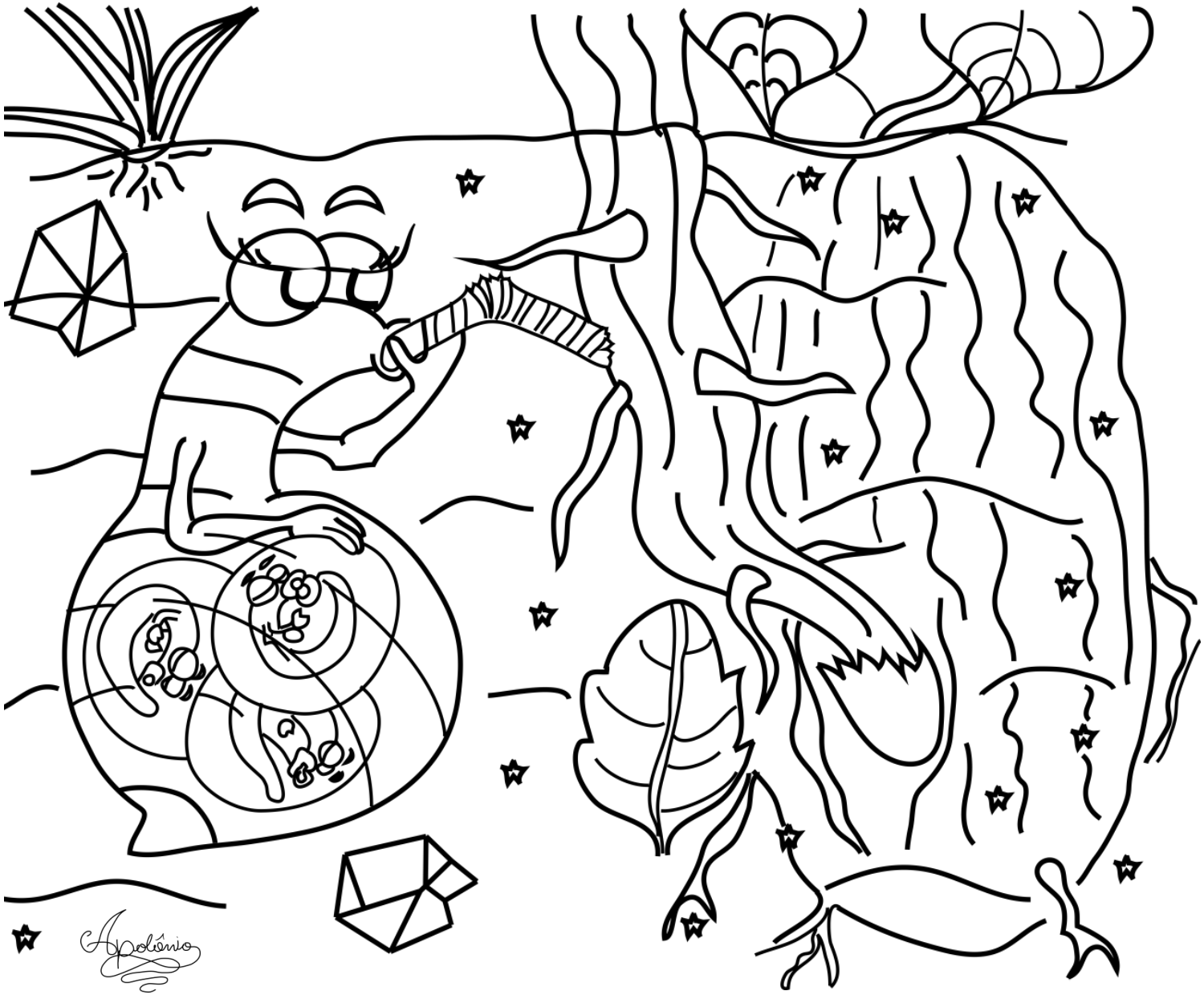
In the ancient Greek, *Xiphi* means ’sword shaped’. *Xiphinema* worms are parasites of plants and they have a tooth that looks like a sword. This feature made scientists choose this name for this worm. With this tooth they pierce into plants to feed. Some *Xiphinema* species carry viruses and these viruses can be transmitted to the plant, so that it becomes very sick. Fortunately, scientists and farmers have found cures to avoid plants becoming ill.



Yam

For many people in the tropics, yam is the basic food source. It looks like a big potato. Nematodes like to eat yam. They like it so much that they can destroy the whole root, leaving nothing to eat for the farmer and his family.

Some nematodes enter inside the root, sucking the root until they get really fat and lay eggs. Plants sense the presence of the parasite and react by forming knots on the root. That is why most people call this worm a root-knot nematode.



Zebra

Zebras are very closely related to horses and there is a fascinating story about nematodes, zebra and horses.

There is a very small nematode (only about 400 µm long), *Halicephalobus gingivalis*, that can invade zebras and horses *via* open wounds or through the mouth or nose. Once inside, they move into the bloodstream which brings them to the kidneys, liver and brain where they multiply very rapidly and may cause the death of the zebra or horse.

If the infection is recognised in time, the zebra and horse can be treated successfully, but because few people know about this tiny nematode and because these roundworms are resistant to drugs, the poor zebras and horses often die.


Apolônio