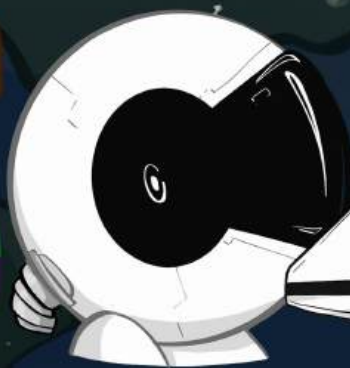


ILLUSTRATED BOOK ABOUT



Organization

Carolina Zabini

Illustrated book of Geosciences
Volume 1: Understanding Geosciences

BCCL/UNICAMP
Instituto de Geociências da UNICAMP
Campinas, SP
2024

Realization

Universidade Estadual de Campinas (UNICAMP) | Instituto de Geociências
Laboratório de Recursos Didáticos em Geociências | Programa Tempo Profundo

Financial Aid

FAEPEX 3162/23
PROEXT PG 88881.927462/2023-01

Organization

Carolina Zabini

Autors

Kamille Miranda Kuntz | Lara Susan Marcos | Carolina Zabini

Editorial Board

Prof. Alysson F. Mazoni (UNICAMP)
Profa. Elizete C. Holanda (UFRR)
Profa. Maria A. M. de Souza (UTFPR)
Profa. Marina B. Soares (UFRJ)
Prof. Rafael A. Ribeiro

Diagramation, Cover, Illustration, Final art and Graphic project

Claudinei Fernandes de Oliveira

Illustration

Gabriel Teófilo Guedes Silva

Translation

Lara Susan Marcos / Paula Oddone Souza

International Cataloging in Publication (CIP) Data

Sistema de Bibliotecas da UNICAMP (SBU)

Il69 Illustred book of Geoscience [electronic resource] / Carolina Zabini (organiza-
tion); authors: Kamille Miranda Kuntz, Lara Susan Marcos, Carolina Zabini;
translation: Lara Susan Marcos. – Campinas, SP: UNICAMP/BCCL, 2024.
1 online resource; il. (Understanding Geosciences; v.1)

Access mode: WWW
Digital publication (e-book) in PDF format [9.000 MB]
ISBN: 978-65-88816-67-7

1. Geociência. 2. Geologia. 3. Divulgação científica. 4. Extensão universitária. I. Zabini, Carolina, 1983- (org). II. Kuntz, Kamille Miranda. III. Marcos, Lara Susan. IV. Série.

24-019

CDD – 550

Librarian: Gildenir Carolino Santos – CRB-8ª/5447

Digital publication – Brazil
1ª edition – June – 2024
ISBN: 978-65-88816-67-7



IN THIS ILLUSTRATED BOOK WE ARE GOING TO TALK ABOUT GEOSCIENCES... AND I NEED YOUR HELP TO SOLVE AND UNDERSTAND THE HISTORY OF OUR PLANET!

TO start our adventure through the discovery process of the Geosciences, we are going to give you a challenge!

Can you answer these questions:

What is the name of the planet we are living on right now?

Is the Solar System part of a galaxy? If your answer is yes, what is the name of this galaxy?

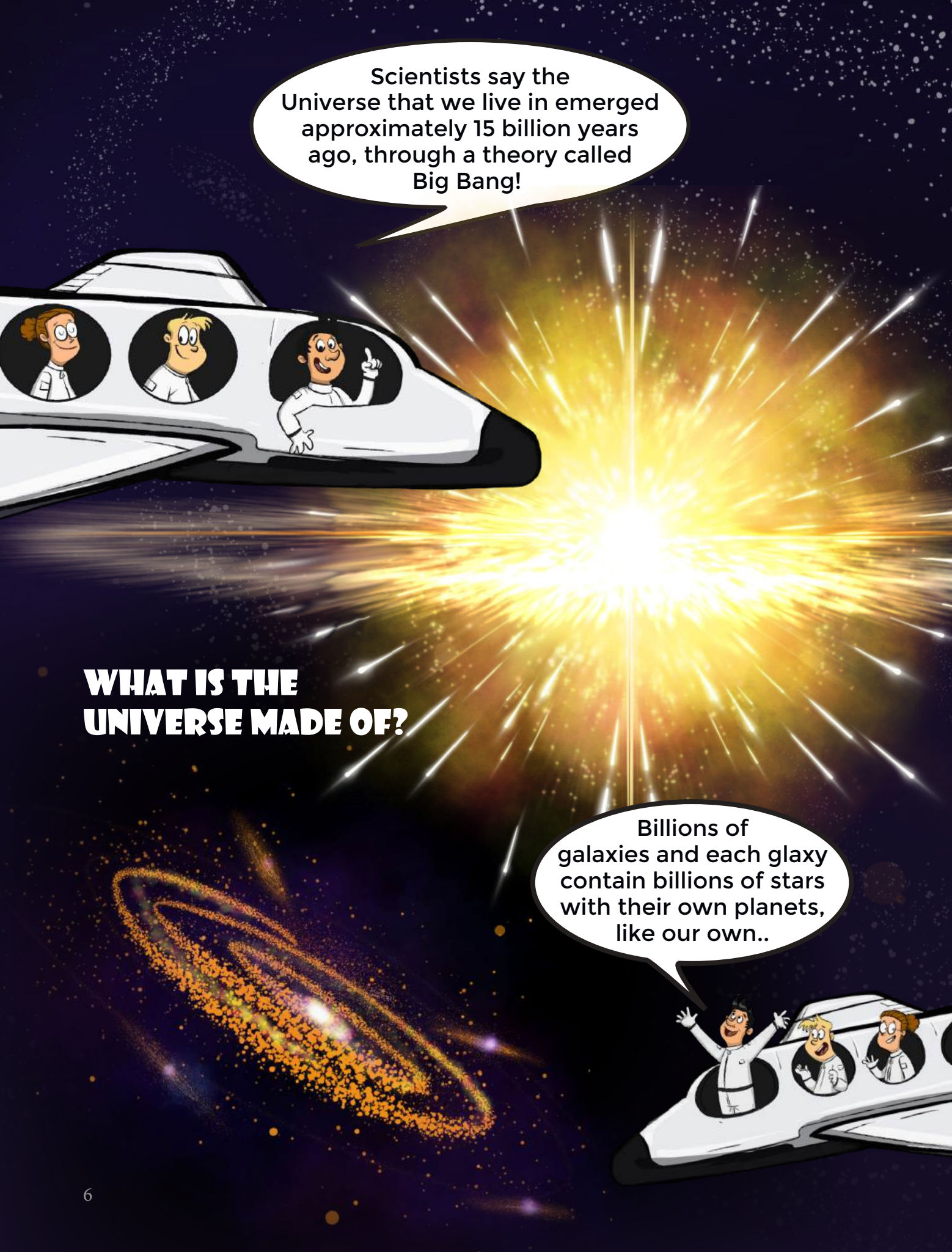
How many stars are there in the sky?

What is the Big Bang Theory?

What is the Heliocentric Theory?

Let's go!
Get on board this
rocket ship for an
adventure across
the Universe!






Scientists say the Universe that we live in emerged approximately 15 billion years ago, through a theory called Big Bang!

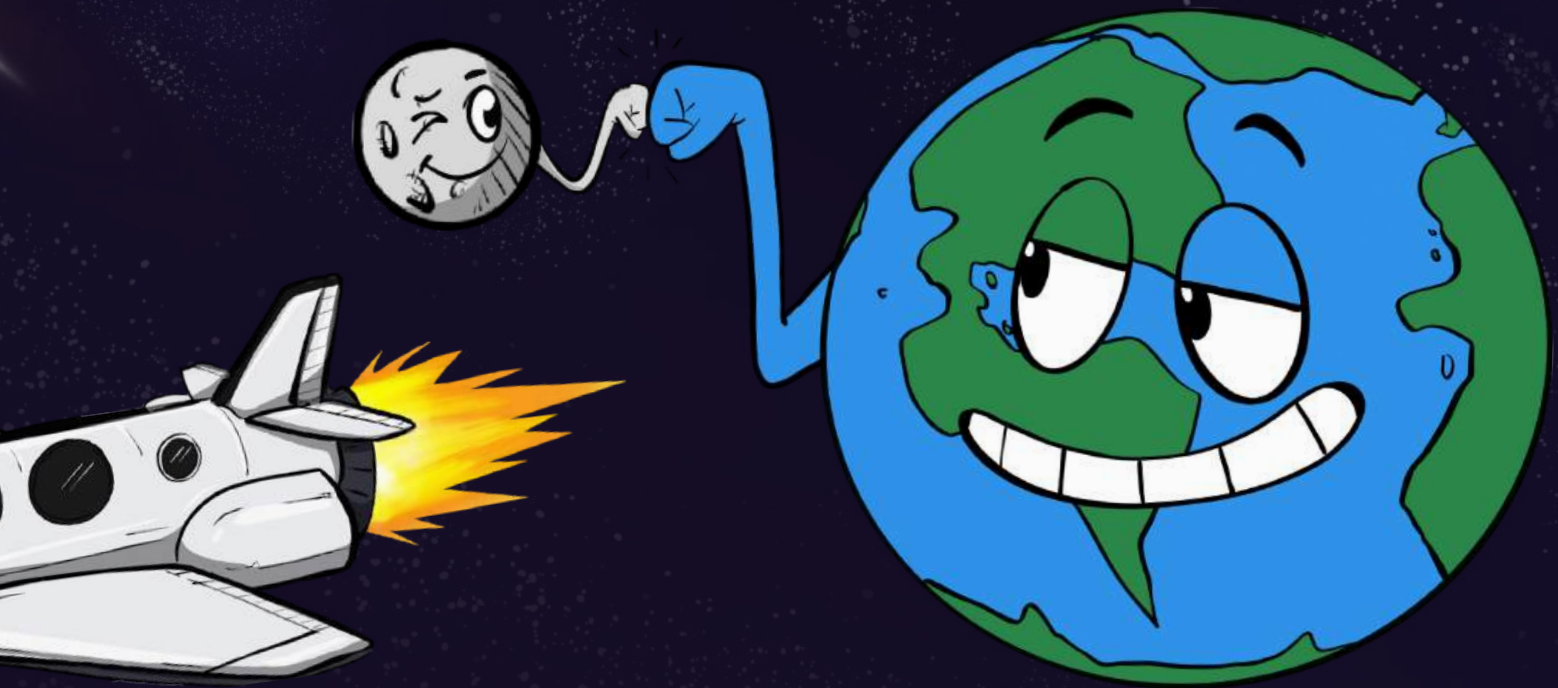
WHAT IS THE UNIVERSE MADE OF?

Billions of galaxies and each galaxy contain billions of stars with their own planets, like our own..



We live on a Planet called Earth. Besides this planet, eight other ones make up the Solar System.

THERE ARE ALSO NATURAL SATELLITES THAT SURROUND SOME OF THESE PLANETS, LIKE THE MOON, EARTH'S NATURAL SATELLITE.

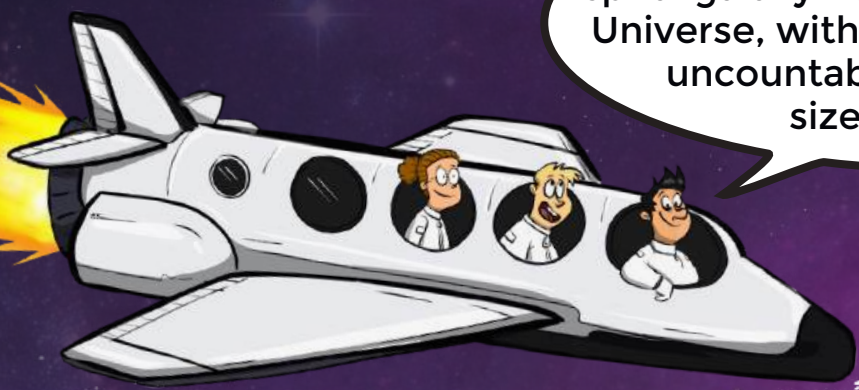


IN THE CENTER OF THE SOLAR SYSTEM, THERE IS A STAR CALLED THE SUN, THAT KEEPS US WARM AND LIGHTS UP OUR DAY!



OUR SOLAR SYSTEM IS LOCATED INSIDE A GALAXY CALLED THE MILKY WAY, WHICH HAS OTHER SOLAR SYSTEMS AND BILLIONS OF STARS.






The Milky Way is a spiral galaxy floating somewhere in the Universe, with so many other galaxies, uncountable ones, of different sizes and shapes.

THE UNIVERSE IS HUGE AND INFINITE. JUST LOOK AT THE NIGHT SKY AND YOU'LL NOTICE HOW HUMONGOUS IT IS... SO MANY STARS.






Do you mean
that the Universe is
everything that exists
beyond Earth?

**EXACTLY! AND WE ARE A
PART OF THIS UNIVERSE!**

Are we a part of it?
What do you mean?

**YES! OUR BODIES ARE MADE OF THE SAME ELEMENTS
THAT MAKE UP THE UNIVERSE! DO YOU KNOW WHAT
CHEMICAL ELEMENTS WE ARE TALKING ABOUT?**



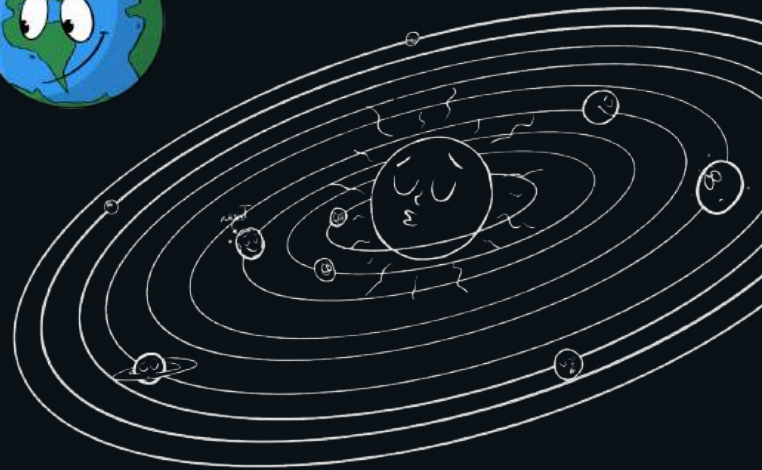
THEY WERE ALSO MADE DURING THE BIG BANG THAT WE TALKED ABOUT BEFORE. THE COMBINATION OF LIGHT PARTICLES CAUSED THE FORMATION OF HYDROGEN AND HELIUM, THE TWO MOST ABUNDANT CHEMICAL ELEMENTS IN THE UNIVERSE. AFTER YEARS OF LOSING INITIAL ENERGY AND STELLAR EVOLUTION, THOSE PARTICLES FUSED TOGETHER IN A PROCESS CALLED FUSION, TO CREATE HEAVIER ELEMENTS LIKE OXYGEN AND CARBON.

He H

C

Fe

Fe

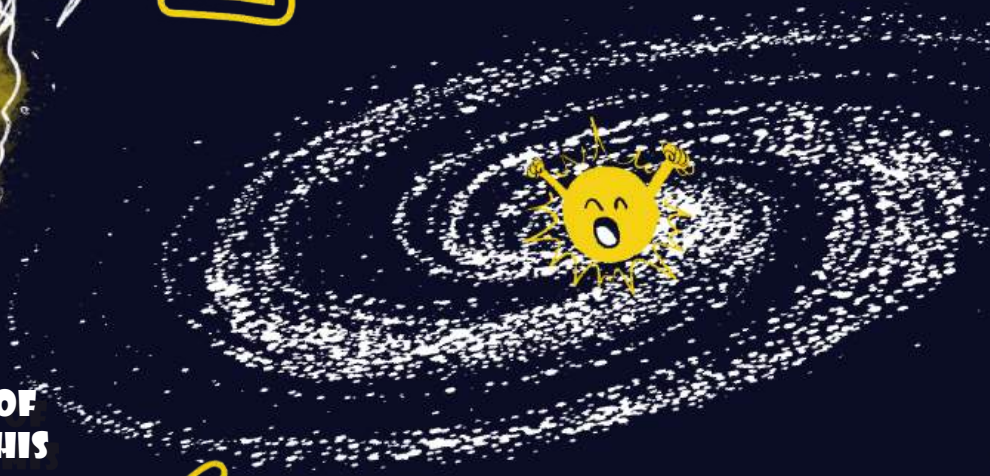


BUT, WHAT IS THE BIG BANG THEORY?

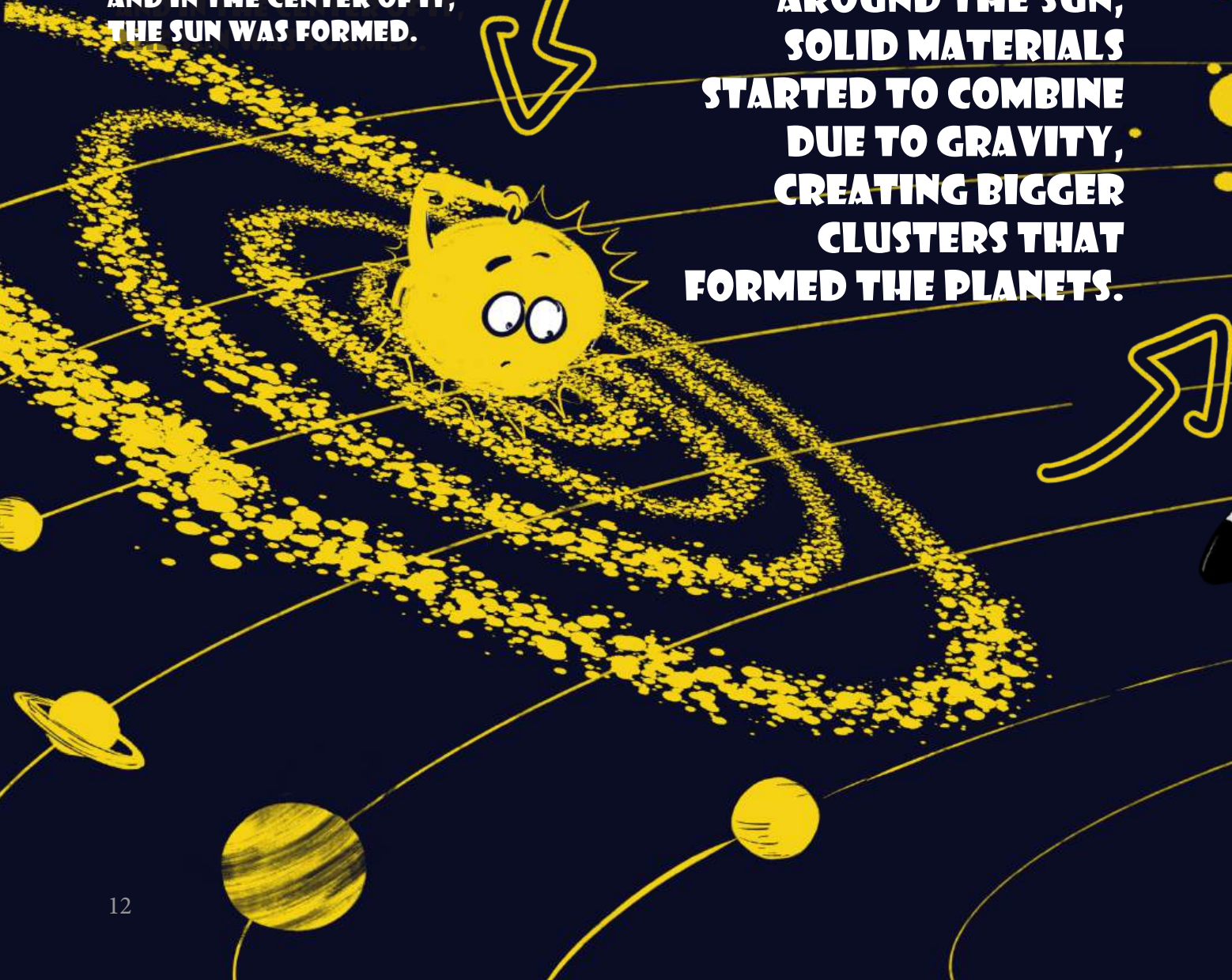
IT IS A THEORY CREATED BY SCIENTISTS TO EXPLAIN THE ORIGIN OF THE UNIVERSE. IT SAYS THAT ALL MASS AND ENERGY WERE CONCENTRATED IN A SINGLE POINT AND FROM THIS POINT. THE ENERGY BEGAN TO EXPLOSIVELY EXPAND, FORMING, OVER BILLIONS OF YEARS, THE CHEMICAL ELEMENTS, THE STARS, PLANETS, SOLAR SYSTEMS, GALAXIES, AND EVERYTHING THAT EXISTS TODAY.



OUR SOLAR SYSTEM WAS CREATED FROM A CLOUD OF COSMIC GAS AND DUST. THIS CLOUD COMPRESSED SO MUCH, LIKE PIZZA DOUGH, AND IN THE CENTER OF IT, THE SUN WAS FORMED.



AROUND THE SUN, SOLID MATERIALS STARTED TO COMBINE DUE TO GRAVITY, CREATING BIGGER CLUSTERS THAT FORMED THE PLANETS.



BUT HOW DO WE KNOW ABOUT ALL OF THAT?



GREAT SCIENTISTS DEDICATED THEIR LIVES TO STUDYING, SO WE COULD UNDERSTAND THE UNIVERSE TODAY.

NICOLAUS COPERNICUS, FOR EXAMPLE, CREATED A THEORY CALLED HELIOCENTRISM.

What does Heliocentrism mean?



THE SUN IS THE CENTER OF THE UNIVERSE.

I DID IT WRONG!



NICOLAUS COPERNICUS WAS BORN IN 1473 AND DIED IN 1543.

Copernicus was wrong, the Sun isn't the center of the Universe, but it is the center of our Solar System.



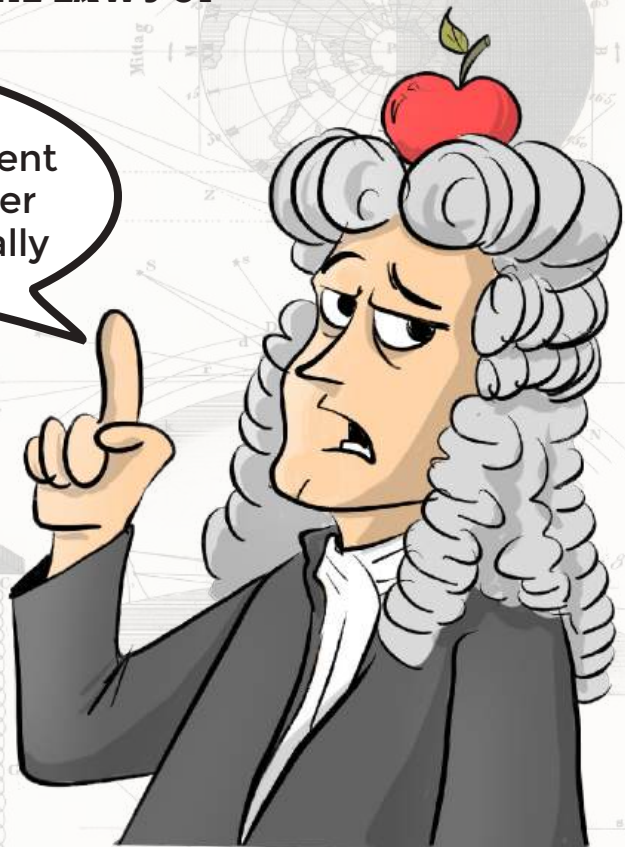
EXACTLY! THE UNIVERSE DOESN'T HAVE A CENTER.

Fig. 19

UNICENTRO.

ANOTHER SCIENTIST CALLED ISAAC NEWTON DISCOVERED SOMETHING REMARKABLE FOR THE WORLD OF SCIENCE: THE LAWS OF GRAVITY.

Gravity is a force of attraction that pulls different bodies towards each other (anything you can physically touch).



NEWTON WAS BORN IN 1643 AND DIED IN 1727.



ALBERT EINSTEIN WAS BORN IN 1879 AND DIED IN 1955.

$$E=M.C^2$$

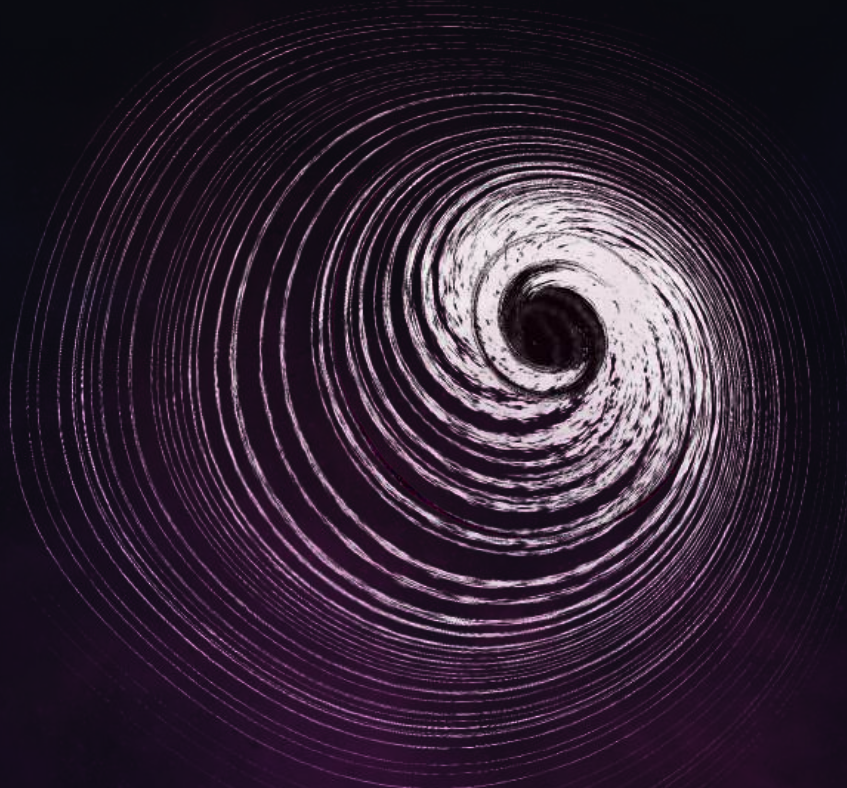
ALBERT EINSTEIN WAS ANOTHER FAMOUS SCIENTIST WHO DESCRIBED THE THEORY OF RELATIVITY. HE ALSO INVENTED THE WORLD'S MOST FAMOUS EQUATION: $E=M.C^2$ E=ENERGY, M=MASS C^2 =SPEED OF LIGHT SQUARED.

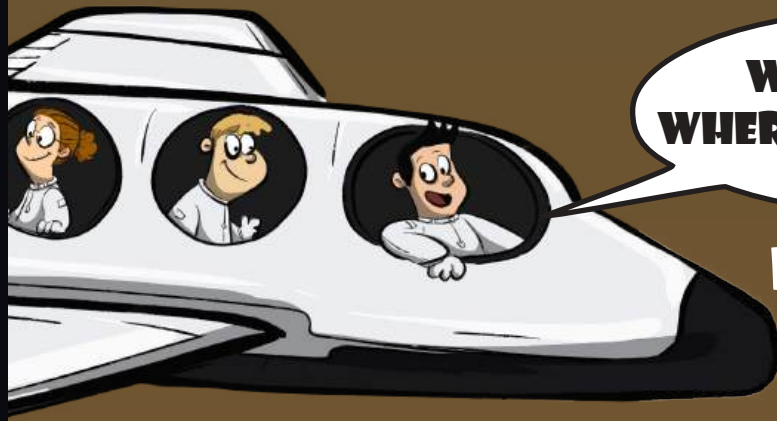
AND THE VERY FAMOUS STEPHEN HAWKING DID IMPORTANT RESEARCH RELATED TO BLACK HOLES.



**HAWKING WAS BORN IN 1942
AND DIED IN 2018.**

Black holes are areas in space that have a huge concentration of mass, and as a consequence, they have a very strong gravitational force. So, anything that approaches a black hole cannot escape and is “swallowed” by it. Not even light can escape a Black Hole’s gravitational pull.





**WHAT'S NEXT?
WHERE ARE WE GOING?**

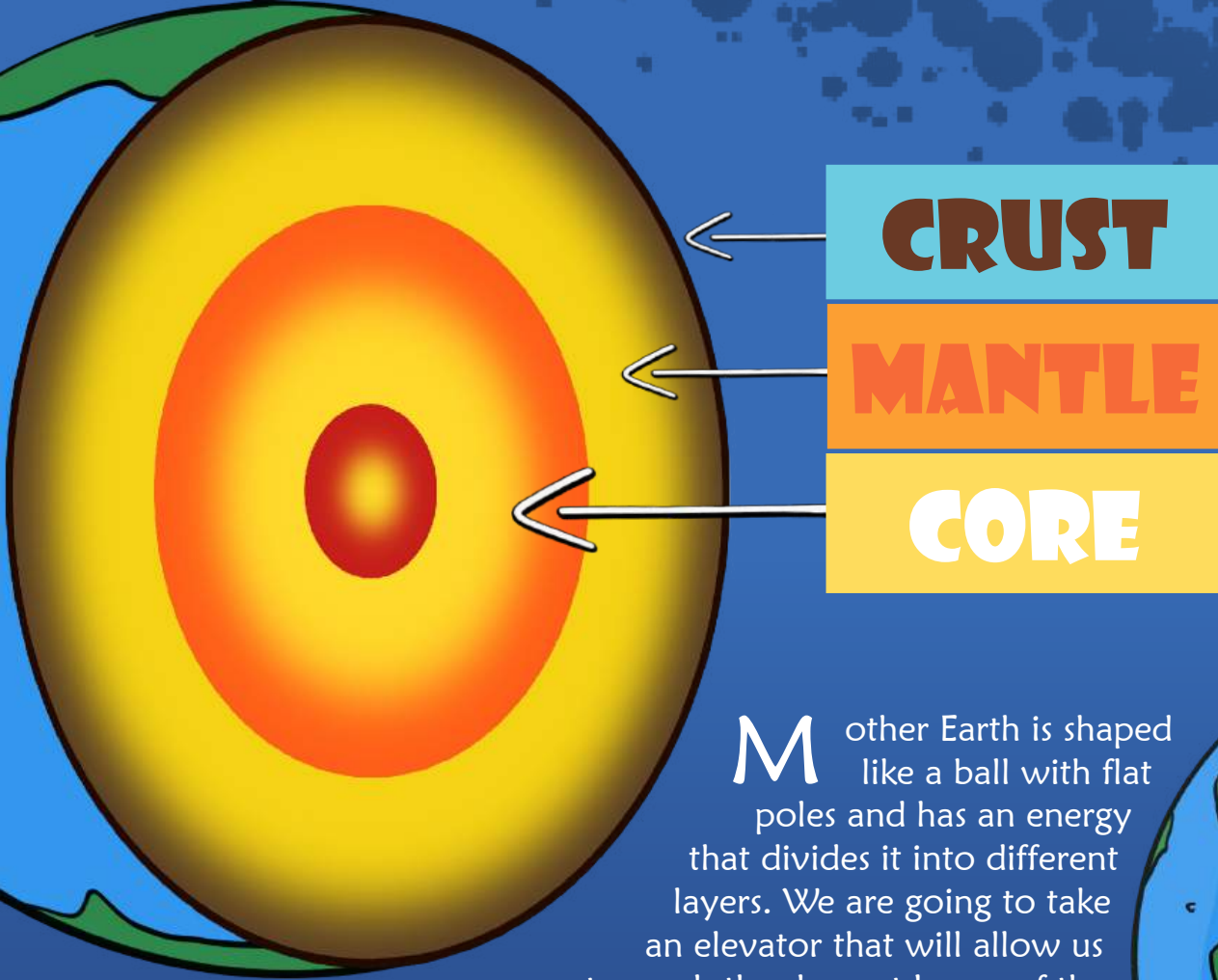
**DO YOU REMEMBER THE
QUESTIONS WE ASKED
YOU AT THE BEGINNING
OF THIS ADVENTURE? NOW,
TRY TO ANSWER THEM!**

Scientists started to come up with explanations, facts, and ideas to answer those questions.... And in that way, Geology was born: the science that studies Planet Earth. Let's get to know more about Geology and the history that the rocks tell us! And who will guide us on this trip? is our buddy Lady Rock!

Hey, my friends,
I'm Lady Rock, and today
we're going to travel in time to
learn about the history of our
Planet, my Mother Earth.
Are you ready?



Many years ago,
people had a lot of questions on their minds, like:
How are mountains made?
What is Earth made of?
Where does the Volcano's lava come from?
What causes an Earthquake?

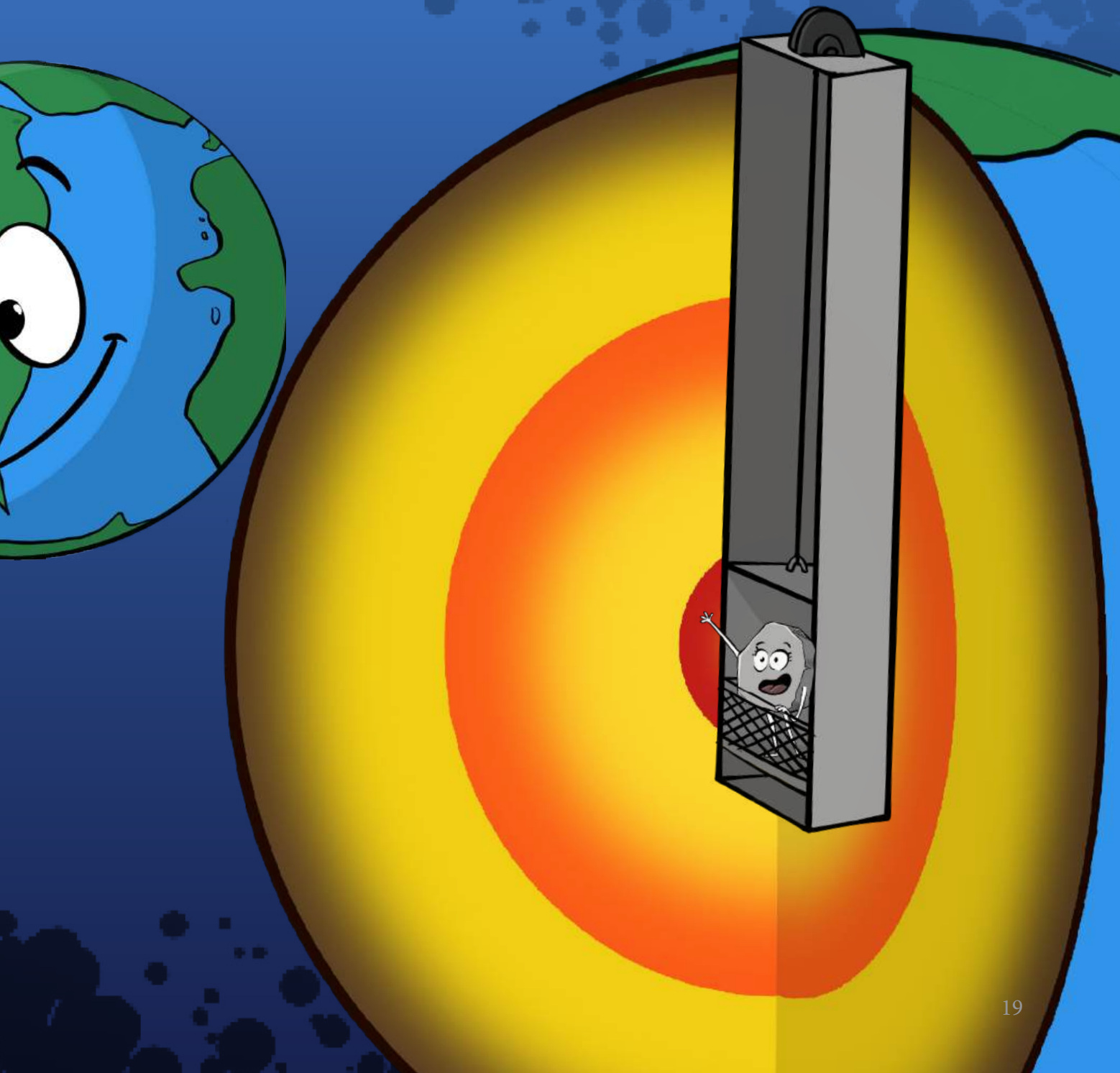


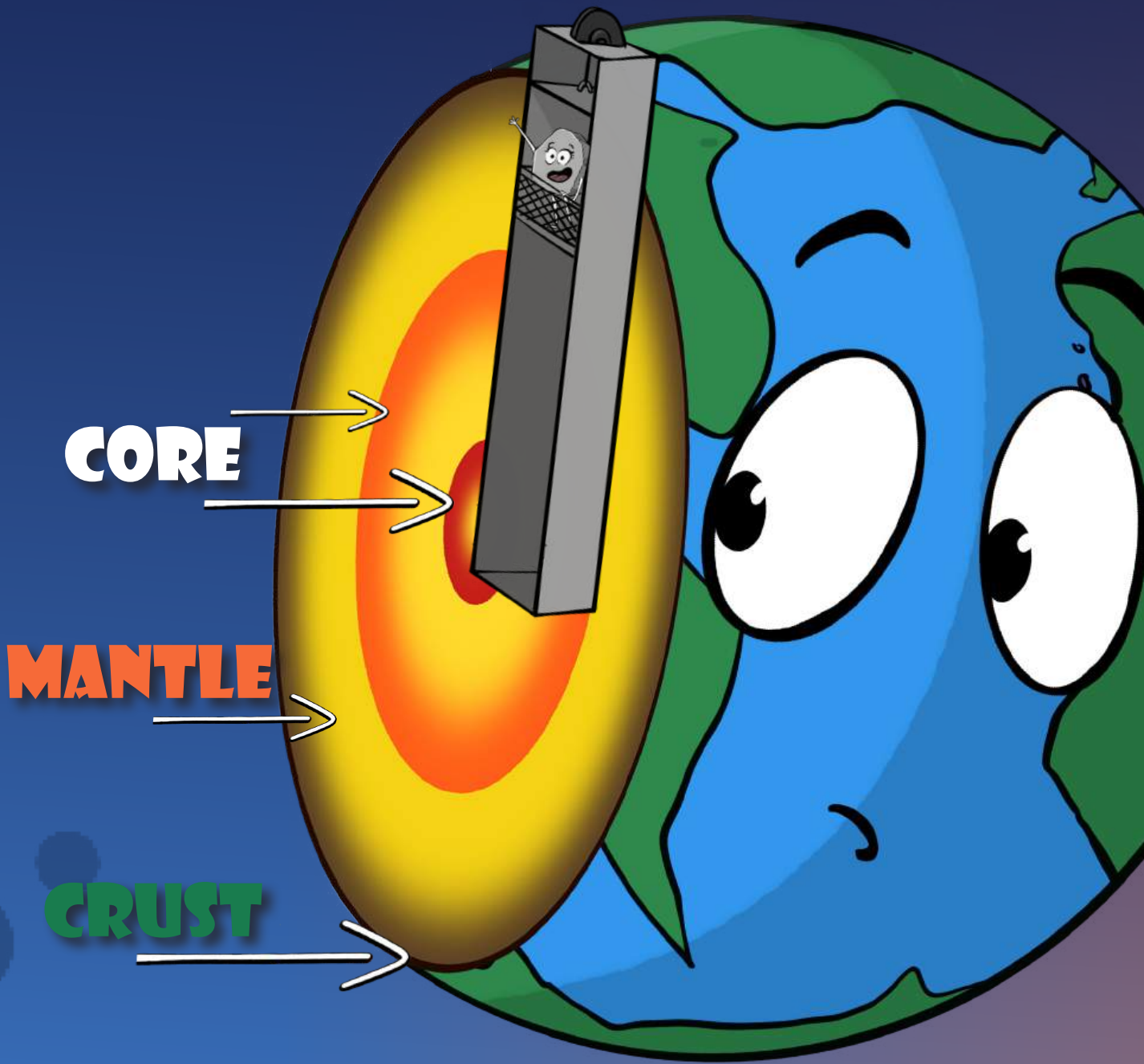
Mother Earth is shaped like a ball with flat poles and has an energy that divides it into different layers. We are going to take an elevator that will allow us to reach the deepest layers of the Earth. Come with me!



LET'S GO STRAIGHT TO THE MIDDLE TO SEE ALL THE LAYERS THAT PLANET EARTH HAS.

Now we are in the Core, the center of the Earth, more than 6,000 Km away from the surface. It's very hot here, around 6,000 °C. This part of Earth is full of Iron and Nickel. Let's go up a little bit. We just arrived at the Mantle, made of a viscous fluid called magma and the temperatures can reach 4,000°C.



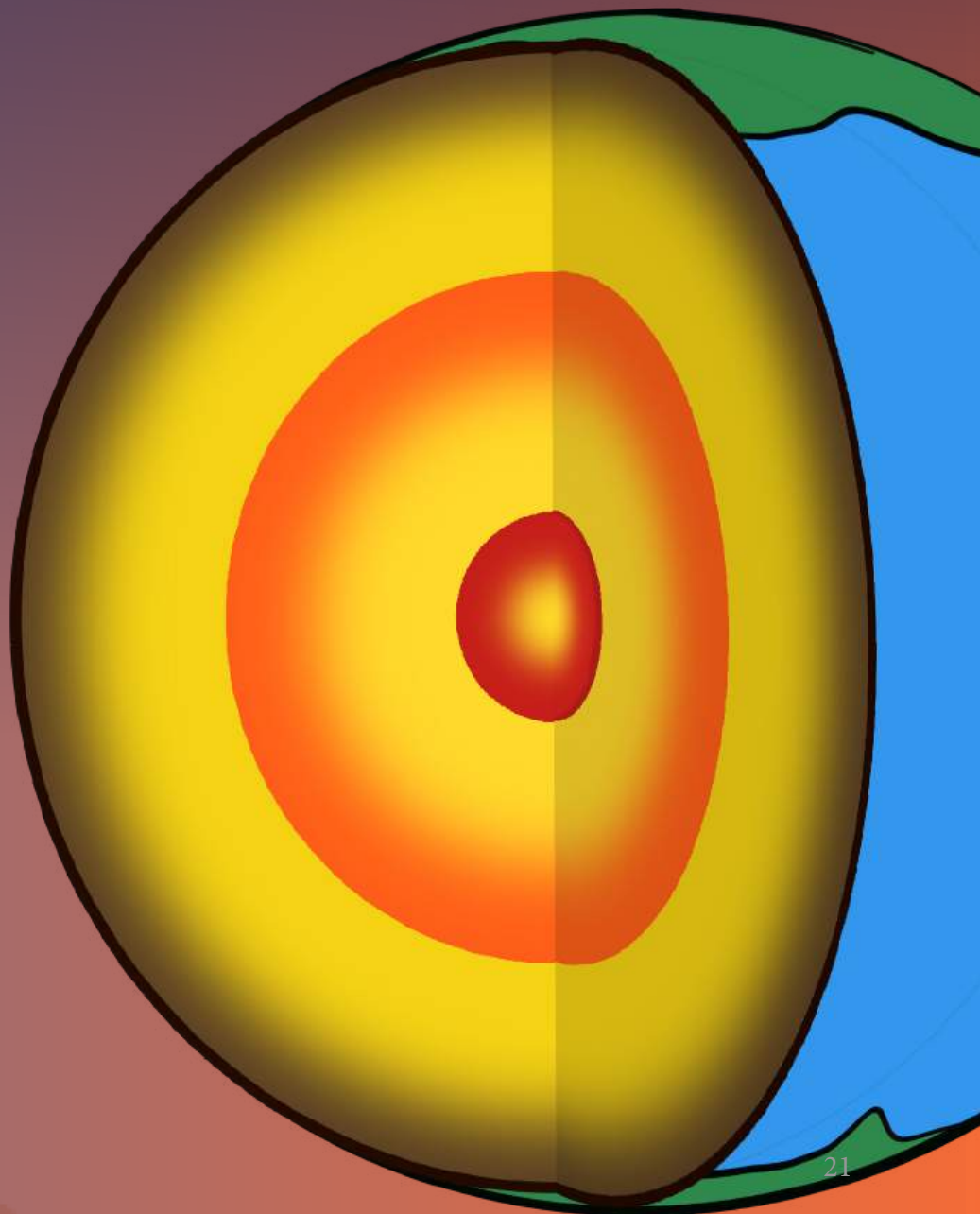


Now we are at the Crust, the most external layer of the Earth. The temperatures and conditions here are mild because this is where we live! The Crust is rocky, like me, and divided into large blocks that move on the Earth's Mantle.



SO DO YOU MEAN EARTH'S CRUST AND ALL THE LARGE BLOCKS □ LOAT ON TOP OF THE MANTLE BECAUSE OF THE SEA OF MAGMA?

That's right! These blocks are called Tectonic Plates. They don't just stand there and keep still. Even though we cannot feel it, the plates are constantly moving.



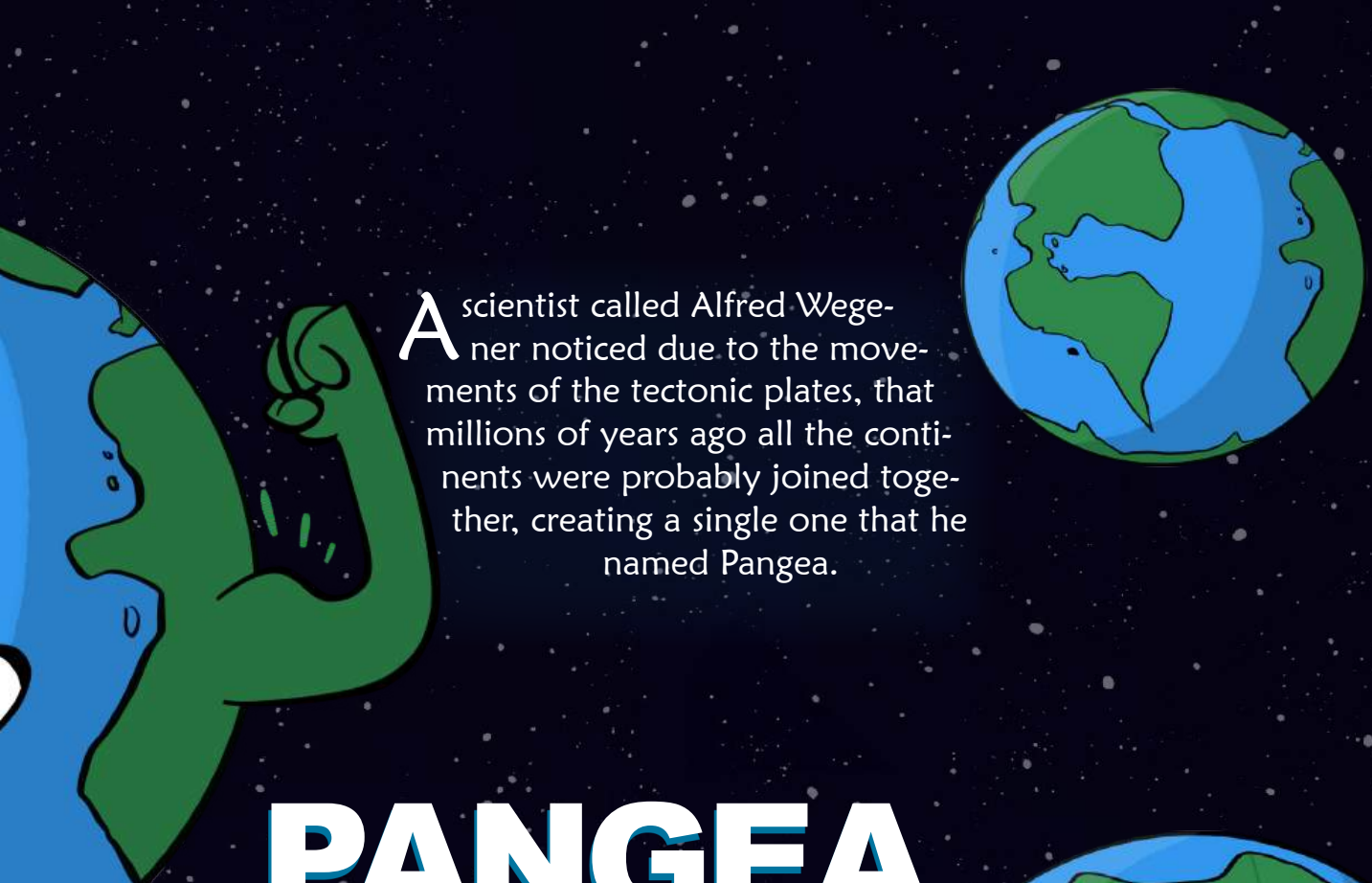
**COME HERE AND TAKE A
LOOK, MY FRIEND.
SEE HOW STRONG OUR
PLANET IS!**

Why are you
going away from
me?! Come back
here!

Ughh!
I can't...

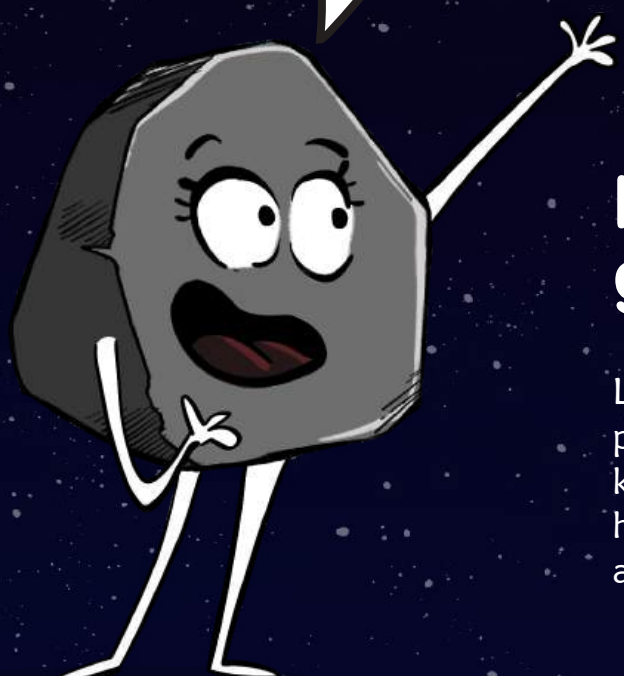
PANGEA

I remember millions of years ago when they were together
like this. I miss it so much...




A scientist called Alfred Wegener noticed due to the movements of the tectonic plates, that millions of years ago all the continents were probably joined together, creating a single one that he named Pangea.

PANGEEA



Can you imagine if South America and Africa were still together...!

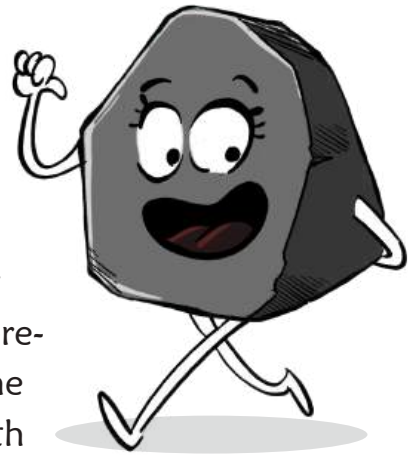


pan=all/whole
gaea=mother earth

Listen, my friends: millions of years ago our planet had a different shape from the one we know and see today, and the Earth was also home to animals and plants that don't exist anymore.

DO YOU KNOW WHY THE EARTH SHAAAAAAAKES?

Do you remember that tectonic plates are constantly moving? Inside Mother Earth, there is a lot of tension and pressure because of the magma and its high temperatures. The tectonic plates are neighboring each other and conflicts happen between them along the borders. These tensions occur inside the Earth and when they reach the maximum intensity they can handle, the rocks break apart...this rupture causes seismic waves that spread the energy throughout the entire planet! That's when the Earth shakes, and it is called an Earthquake.

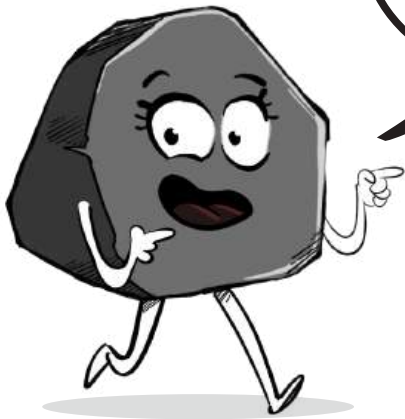


When this tension is released and spread through the Earth's crust, vibrations happen that can cause major damage.

The hypocenter of the earthquake is the point at which the rupture and release of tension occur, and the epicenter is the projection of the earthquake on the Earth's surface. There is a scale that measures how much energy has been released by earthquakes, called the Richter Scale.



**HEY, MY FRIENDS,
LET'S KEEP GOING?**



I'm pretty sure you've already heard about **VOLCANOES**, so now we're going to learn more about them!

The pressure that happens inside the Earth's Mantle causes a volcano to erupt. We can say that volcanoes are ruptures or cracks in the Earth's crust that allow ash, lava, and gases to escape.

There are different types of volcanoes, and I'm going to show you two of them...

THIS IS THE LAVA CONE



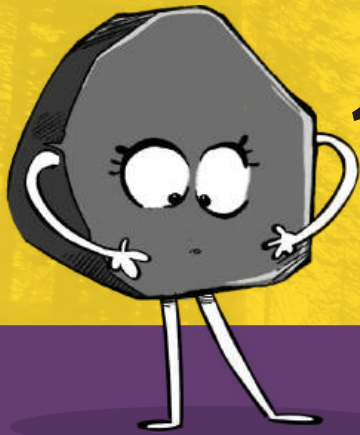
AND THIS IS THE FISSURE VENT,

the shyest one and the least popular in Brazil.

**BUT LISTEN, MY FRIENDS, VOLCANOES AREN'T
THE BAD GUYS THEY SEEM TO BE.**



Even though volcanoes can cause a lot of damage and destruction, they also have benefits, like providing soil nutrients and minerals, shaping landscapes, creating rocks, and many other important things to our lives.



Do you know what I'm made of?

I'M MADE OF MINERALS.



BY THE WAY, DO YOU KNOW WHAT MINERALS ARE?

They are famous crystals that we see in nature. Would you believe that our Mother Earth could create something beautiful like this? Of course, she can! The minerals are so important to me, as they are to you!

Look around you and try to see the presence of minerals in our daily life.



In our cell phones...



In the plaster to build houses...

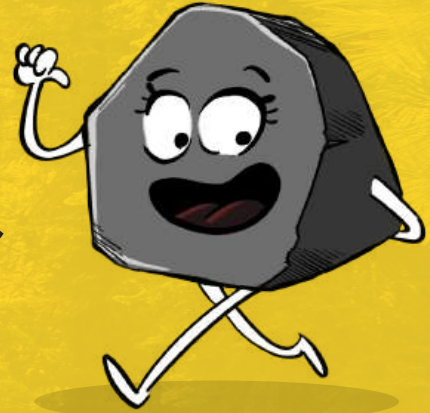
Tools...





I'm made of minerals of different colors and sizes, my first name, as you already know, is Rock, and my second name is **IGNEOUS OR MAGMATIC.**

Now I will introduce you to my sisters.



This is the **METAMORPHIC** rock, my middle sister and the most organized one.



This is the **SEDIMENTARY** Rock, my older sister and the most fragile one.



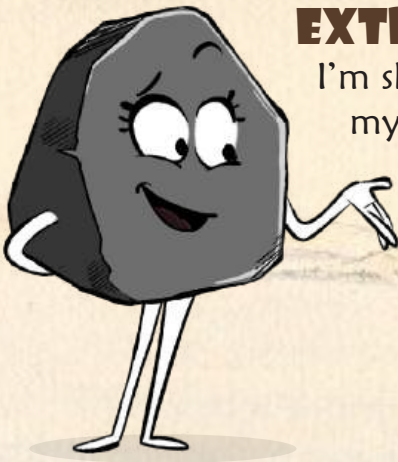


So, my friend,
now that we are more
familiar with each other,
I'll tell you more about
my life.



I have a twin brother, we came from the magma in the
Mantle. We were created after it was solidified. I got out
of Earth's mantle faster than my brother Gabbro.

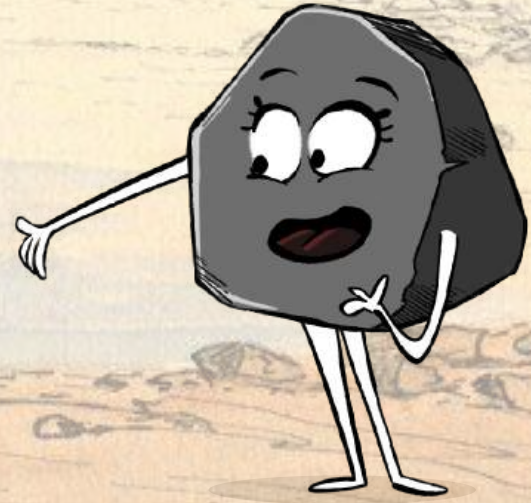
Because I spent less time inside the Earth than
my brother, I'm known as **BASALT** or
EXTRUSIVE IGNEOUS ROCK.



I'm shy and introverted, and I hide
my minerals from others un-
der lock and key!!



He has beautiful crystalline minerals
that everyone can see, and it makes him super
handsome. My twin brother is an Intrusive
ROCK CALLED GABBRO.



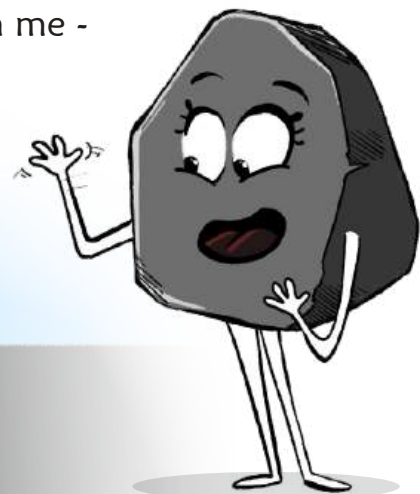
NOW WE ARE GOING TO TALK ABOUT MY MOST ORGANIZED SIBLING, THE METAMORPHIC ROCK.

One day when I was still young, when I had just left my mother Earth, I was under a lot of pressure and high temperatures that lasted for millions of years. After that, I changed my appearance. My crystals that were mixed up before, became more organized in layers as you see in me today.



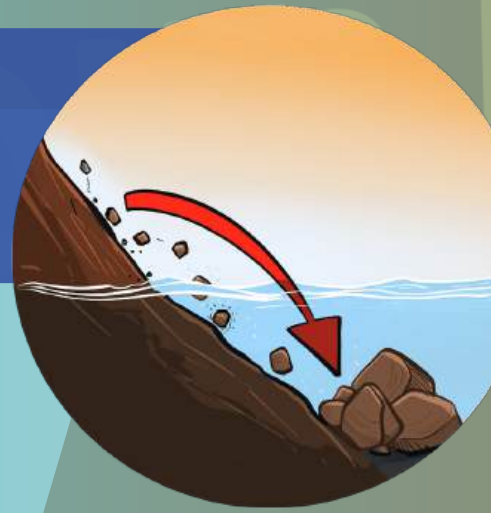
And how about your **SISTER SEDIMENTARY?**

My life story is not that simple. Over millions of years, Mother Earth experienced lots of wind and rain causing small pieces of sand and rocks to break off and accumulate. At the bottom of rivers and the ocean under great pressure, these tiny pieces stuck together and compressed to form me - Sedimentary Rock!



AS YOU CAN SEE, MY SIBLINGS WENT THROUGH A LOT OF CHANGES, RIGHT?

All of these transformations that occur over millions of years need specific conditions for them to happen and create a cycle, called the Rock Cycle.



SEDIMENTS



ENDOGENOUS PROCESSES

IGNEOUS ROCK



MAGMA SOLIDIFICATION

SEDIMENTARY ROCK



**HIGH PRESSURE
AND TEMPERATURES
FOR SO MANY
YEARS**

ENDOGENOUS PROCESSES



METAMORPHIC ROCKS



FUSION

This cycle is like if we were going through a recycling process from time to time, and this is very important to our Mother Earth.

And now that you know the life story of my family and me, can you understand the importance of Geosciences?



I also would like to ask you, my friend, to pay more attention to the geological processes happening around you. Our mother earth is constantly changing and understanding Geosciences helps you see it everywhere.

Studying Geosciences is a way of understanding what is happening to the place where we live, our home. Learning about Geosciences helps us find better ways to take care of Mother Earth so future generations can enjoy everything she has to offer.

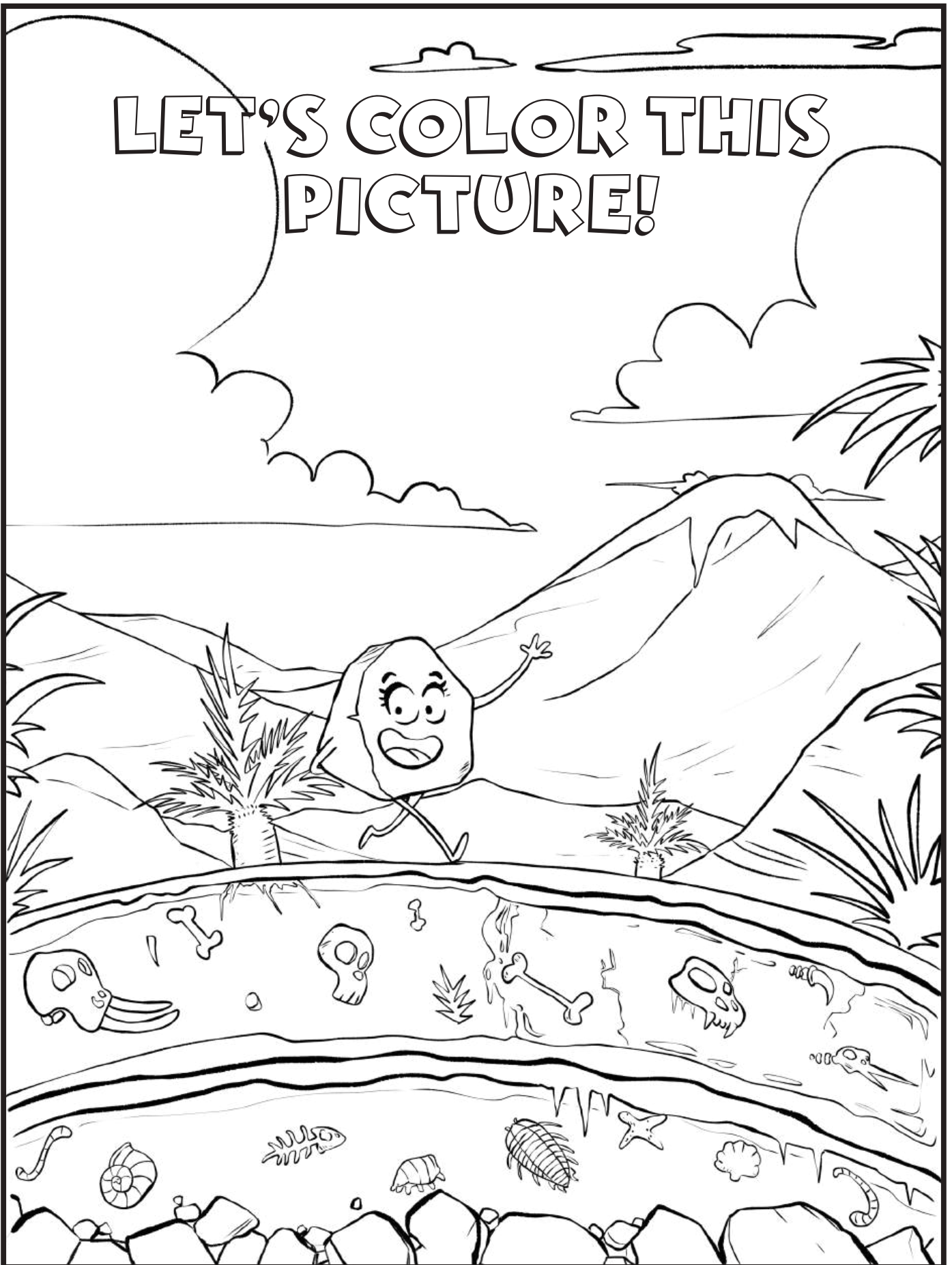


Look at the previous picture and use your knowledge of Geosciences to identify what you see.



1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

LET'S COLOR THIS
PICTURE!





The Geoscience storybook background and how it came to life

This first volume of Geoscience illustrated series has begun during my professional experience at Federal University of Technology – Parana (UTFPR -DV). I have supervised a few students in promoting Geosciences (called Geology and Paleontology at School) while I was working there. Among those students, Lara and Kamille assisted me to develop a small outreach course. We were able to apply the course at a private local school where four students were interested. After we completed this activity, I supervised them writing the texts that culminated in this storybook. Initially it was illustrated by Renan de Bastos Andrade that was supported by Thiago Luiz Brites, who also worked at the campus, and to whom I am immensely grateful, as they took part of the initial conception of the project.

In a second phase, I started working at the Institute of Geosciences at UNICAMP, and the booklet was reviewed by some colleagues, including Prof. Frésia Ricardi Branco and Prof. Ana Elisa Silva de Abreu. I also appreciate the forementioned professors who ensured the scientific accuracy of the work.

A third phase of the project emerged with the development of another outreach project (which is now a program) that I coordinate, called Deep Time Program. We aimed to create an exhibition with the Deep Time theme, and in partnership with Exploratory Museum of Science of UNICAMP, we launched a crowdfunding campaign to make it possible. Although the campaign did not meet the fundraising goals to make the exhibition possible, it allowed us to hire a professional for designing the layout and illustration of this storybook. The designer Claudinei Fernandes was responsible for creating the beautiful images in this edition. Finally, through a PEC PROEC Unicamp (FAEPEX 519.298) grant, we were able to publish this storybook as the initial volume in a series about Geosciences.



With love, Carolina

ILLUSTRATED BOOK ABOUT



ProEC
Pró-Reitoria de
Extensão e Cultura



FAEPEX
Edital Extensão