The cover features a variety of whimsical alien characters. Some are fully colored with vibrant patterns and colors like purple, green, yellow, and blue. Others are black-and-white line drawings, intended for coloring. The characters have large, expressive eyes and unique body shapes, some resembling worms, some with multiple limbs, and some with wings or antennae. They are arranged around the central text, creating a playful and imaginative border.

PARTICLES of the UNIVERSE

**AN ATLAS EXPERIMENT
COLOURING BOOK**

EXPLORING THE UNIVERSE OF PARTICLES

Everything around you is made up of particles:
this book, your body... even your dog!

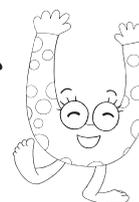
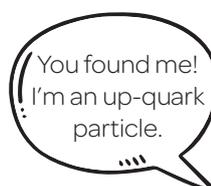


Particles are the **building blocks** of all matter and are responsible for forces.

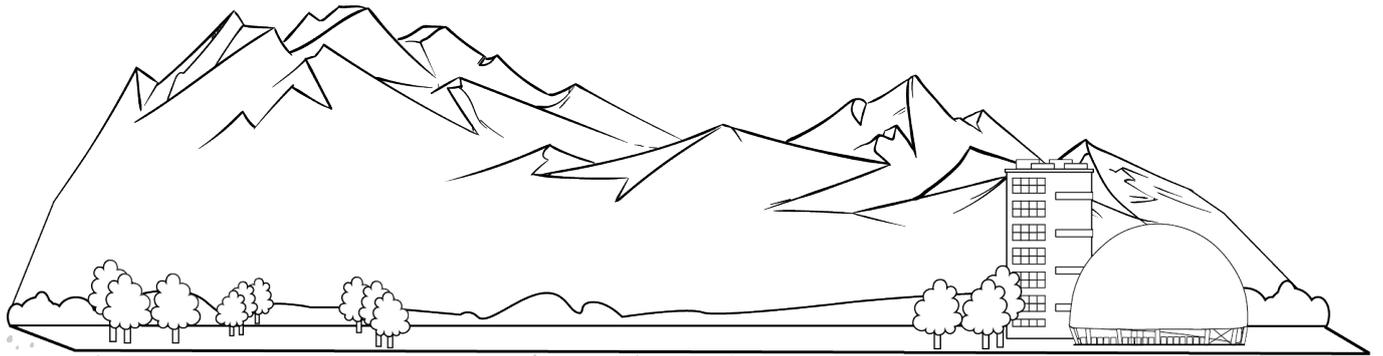
Because particles are so small, you cannot see them with your eyes.



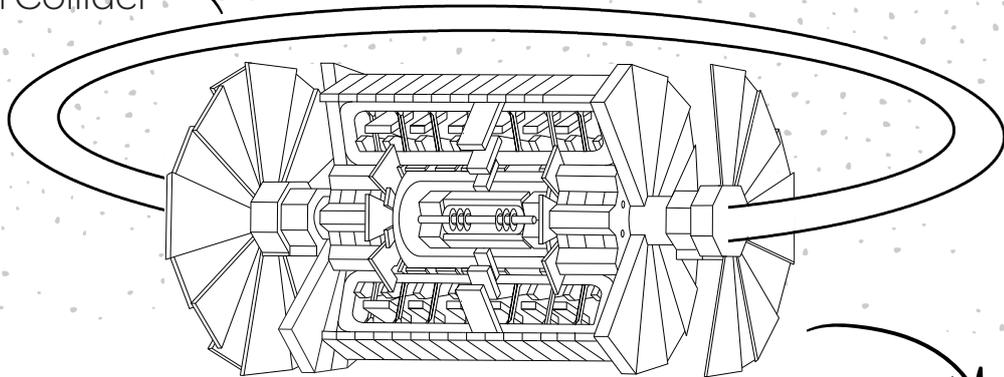
We have to use **enormous microscopes** – like the Large Hadron Collider – to find and study these particles.



The **Large Hadron Collider** is located in an underground tunnel, 100 metres below the French-Swiss Border.



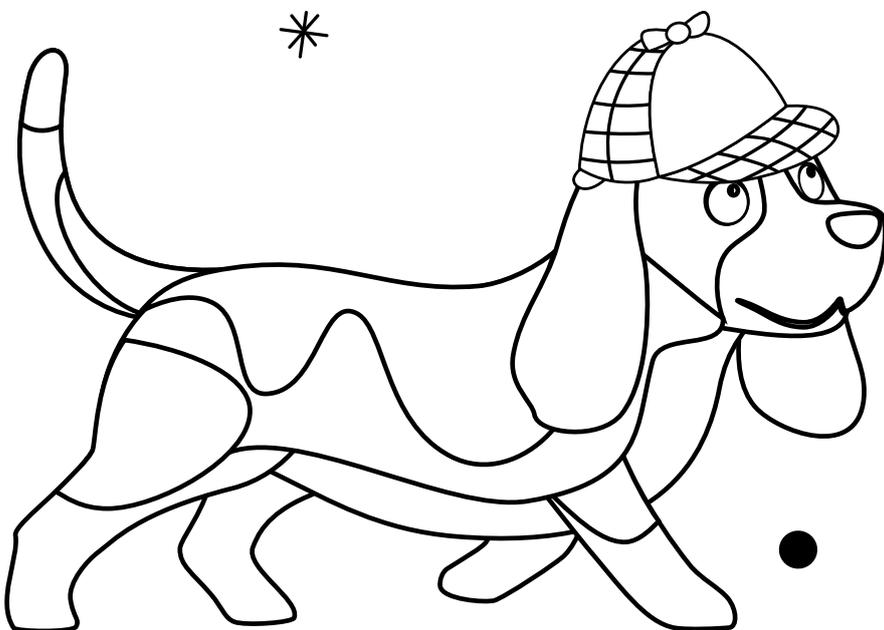
Large Hadron Collider



ATLAS Experiment



The **Large Hadron Collider** accelerates particles close to the speed of light before smashing them together. The collisions create new elementary particles that can be detected by the **ATLAS Experiment!**

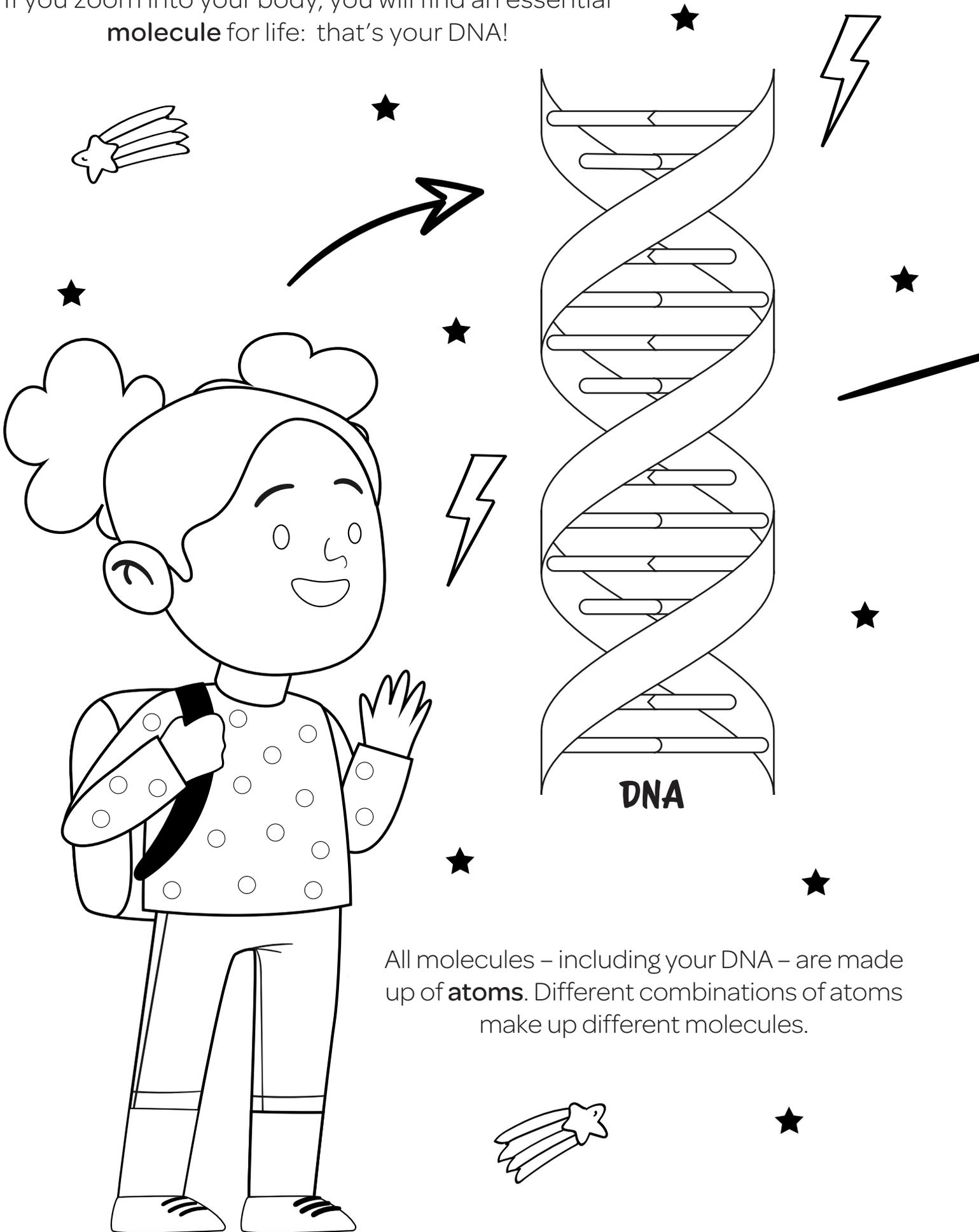


This colouring book will introduce you to all the particles we've found so far!



WHAT ARE WE MADE OF?

If you zoom into your body, you will find an essential **molecule** for life: that's your DNA!

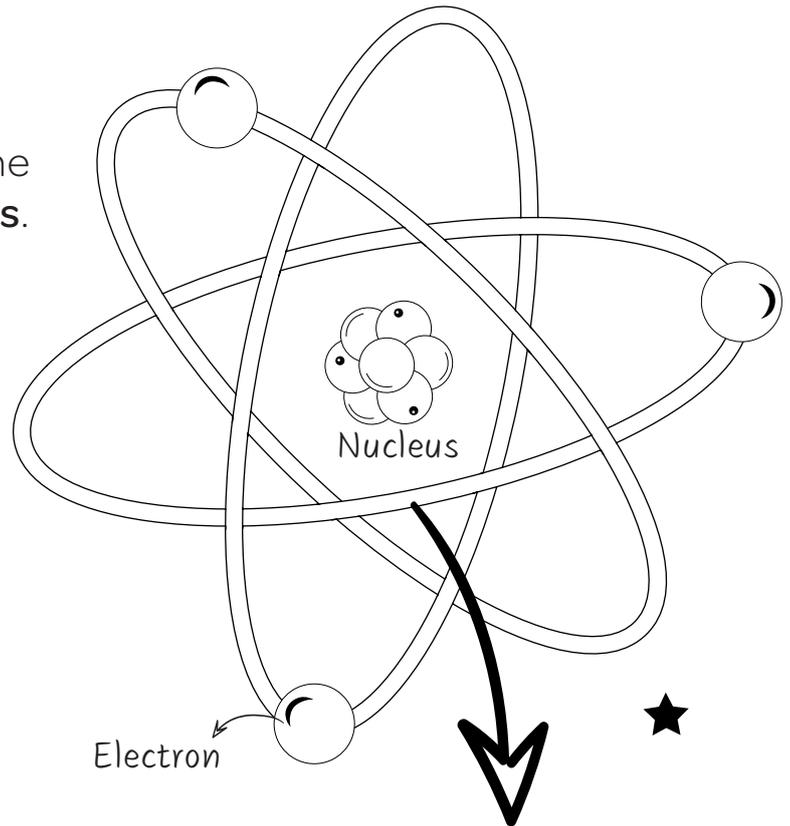


All molecules – including your DNA – are made up of **atoms**. Different combinations of atoms make up different molecules.

Atoms are made of even smaller particles.

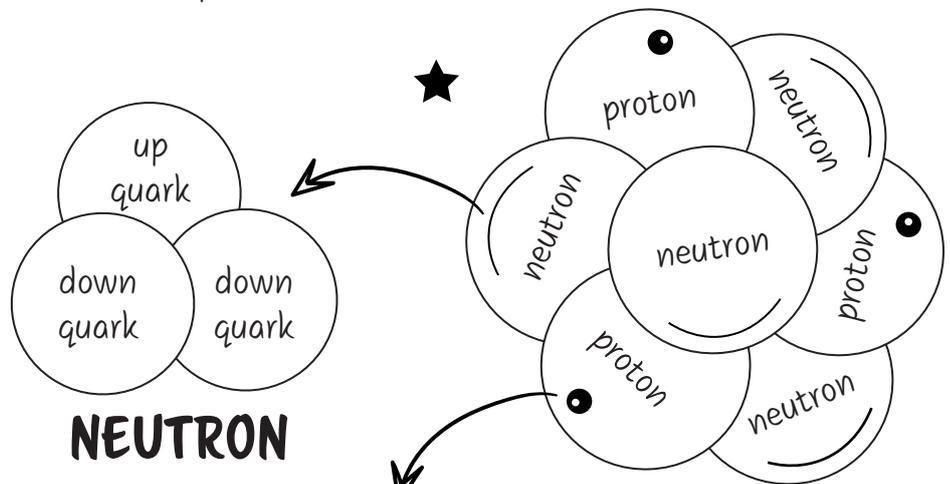
ATOM

At the centre, there is a nucleus made of **protons** and **neutrons**. The nucleus is surrounded by **electrons**.

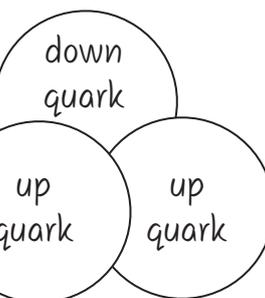
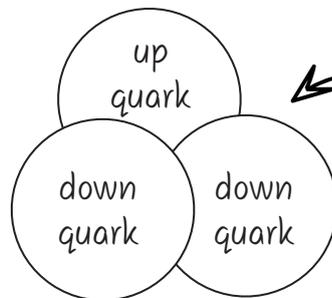


Zoom down even further and you'll find more particles!

NUCLEUS



NEUTRON



PROTON

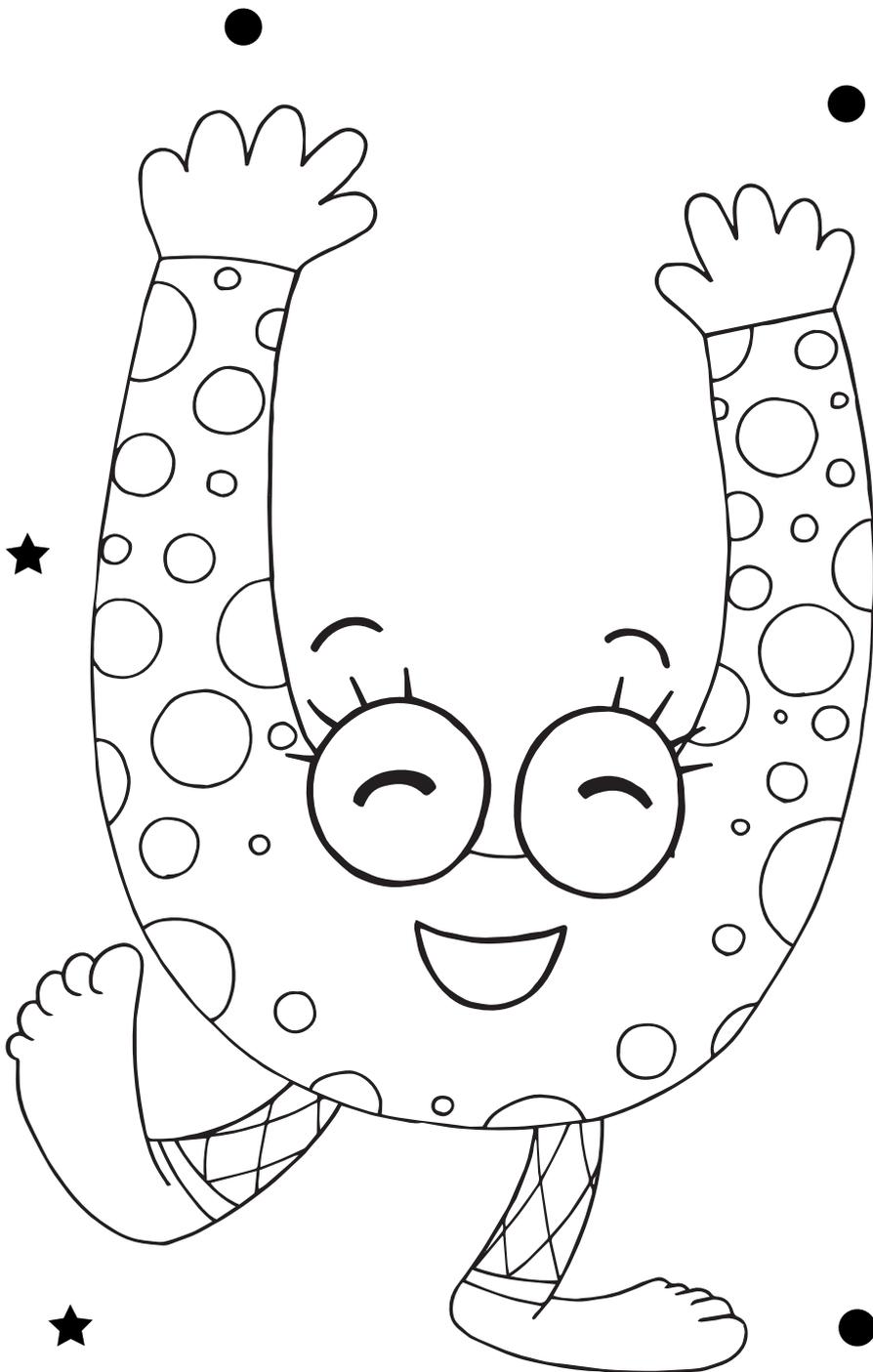
Protons and neutrons are made of **elementary particles** called **quarks**.

Elementary particles can not be broken down into anything else. We have found 3 types: **quarks**, **leptons** and **force particles**.

MEET THE QUARKS!

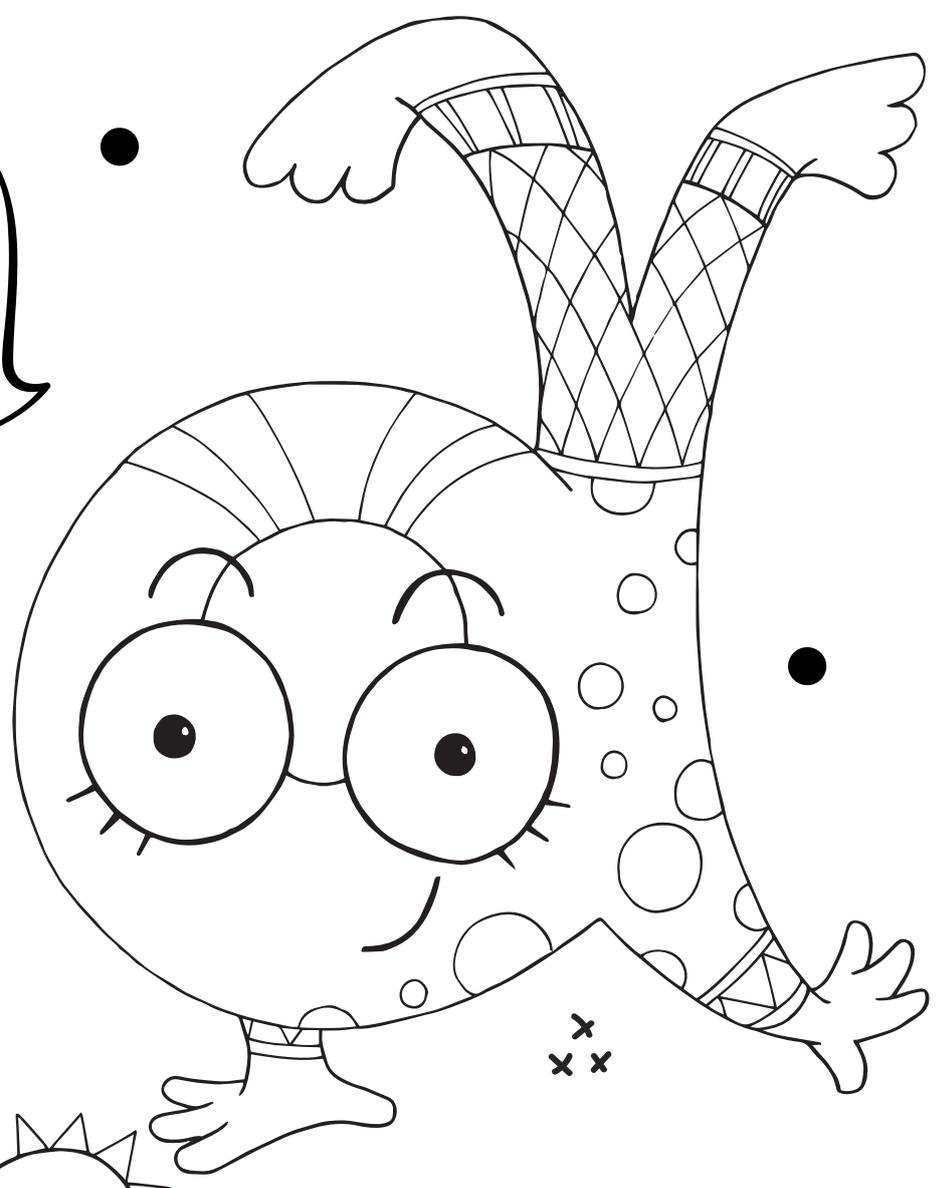
There are six types of quarks!
They are all **unique**.

Right after the Big Bang, the Universe was filled with quarks that moved around freely. Nowadays, quarks are **very social** and are never seen by themselves.



I am an **up quark** and I am the lightest of all quarks!

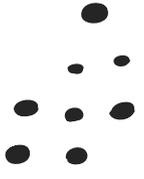
Atoms are only made of up and down quarks. Other quarks can be created and studied in **particle-physics experiments!**



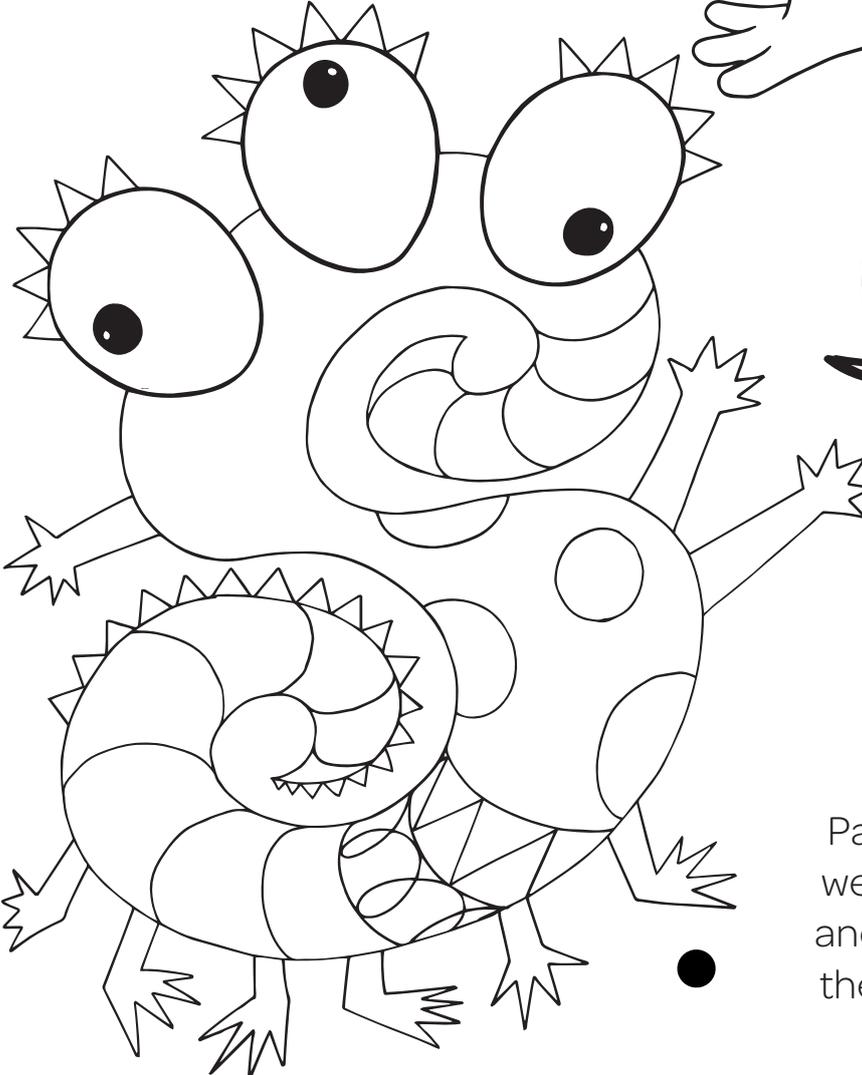
I am a
down quark
and I am
the second
lightest of all
quarks.

The down quark is slightly heavier than the up quark.

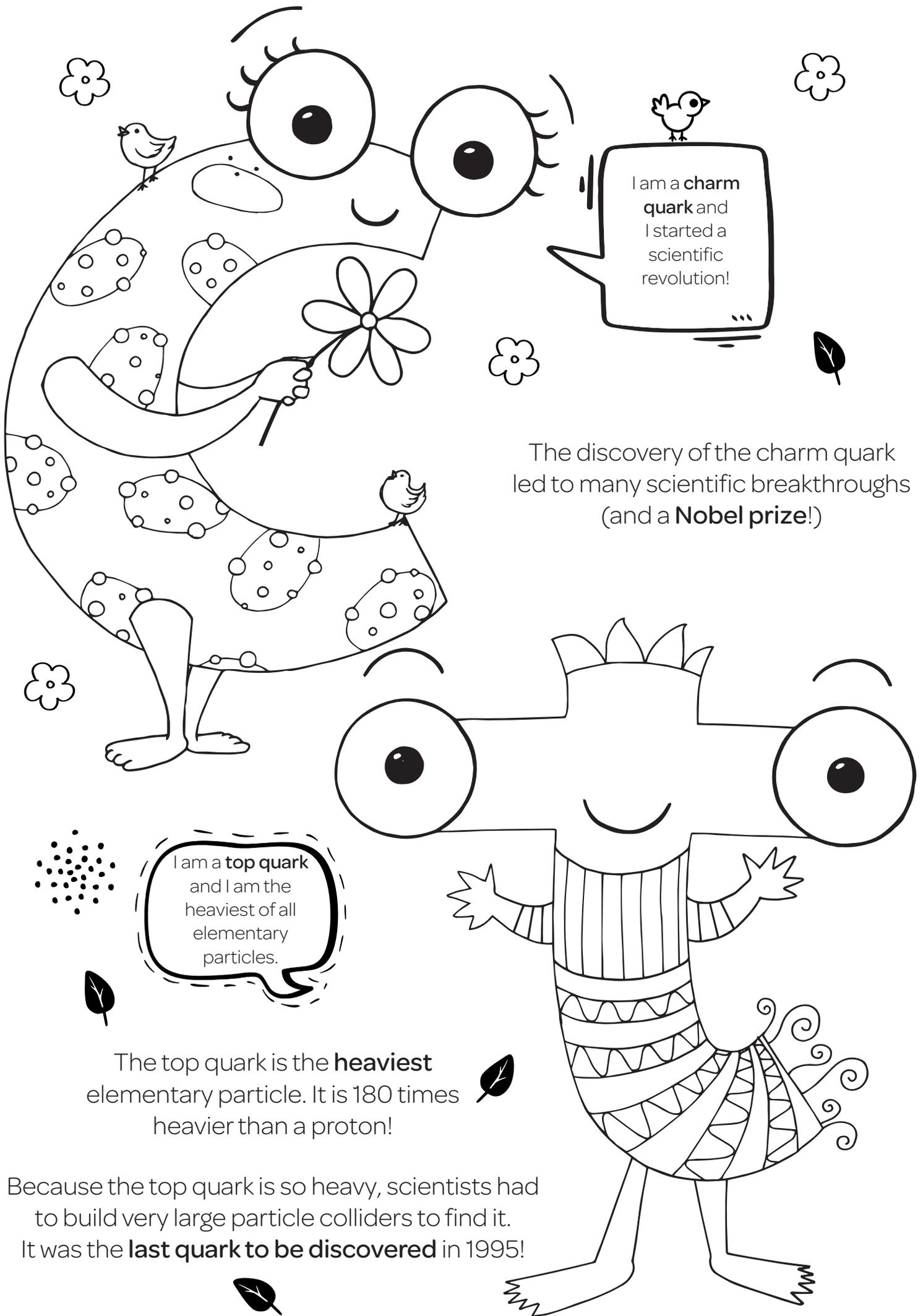
If it weren't, atoms as we know them **would not exist**. The Universe would look very different!



I am a **strange quark** and I confused a lot of scientists when I showed up!



Particles with a "strange" behaviour were found in 1947. It took scientists another **20 years** to learn that inside these particles were strange quarks!



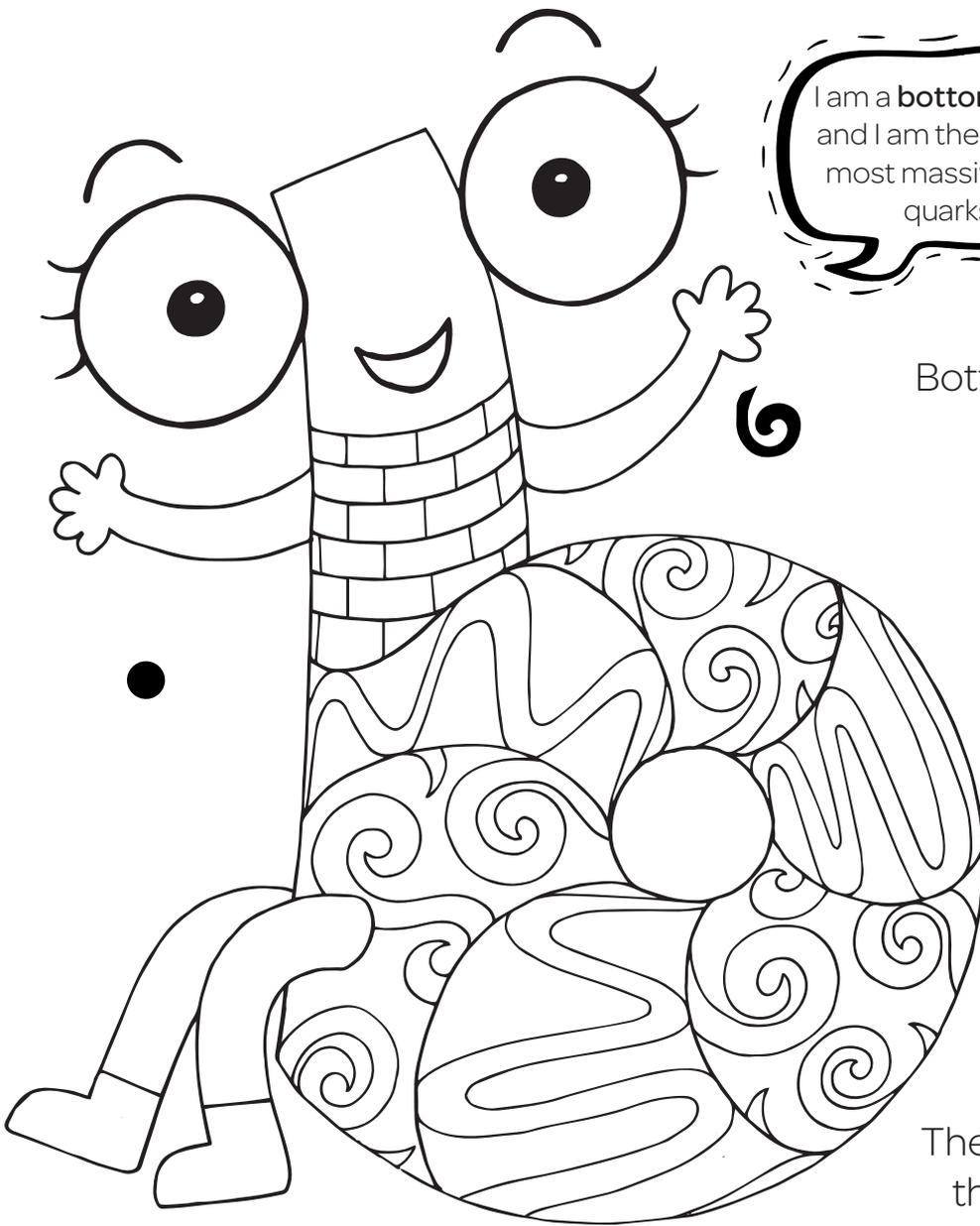
I am a **charm quark** and I started a scientific revolution!

The discovery of the charm quark led to many scientific breakthroughs (and a **Nobel prize!**)

I am a **top quark** and I am the heaviest of all elementary particles.

The top quark is the **heaviest** elementary particle. It is 180 times heavier than a proton!

Because the top quark is so heavy, scientists had to build very large particle colliders to find it. It was the **last quark to be discovered** in 1995!



I am a **bottom quark** and I am the second most massive of all quarks.

Bottom quarks are also known as “**beauty quarks**”.

There are several experiments that focus on studying how bottom quarks behave.

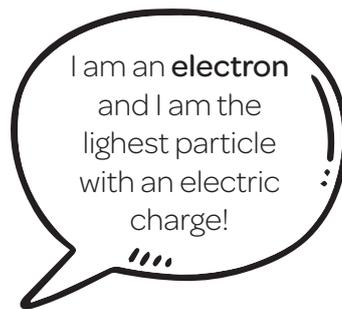
Quarks come in **three “colours”**: blue, green or red.

Quarks can **change colour charge** – a red quark can become a green or blue quark!

In a proton, you need one quark of each colour.

What colours are your quarks?

MEET THE LEPTONS!

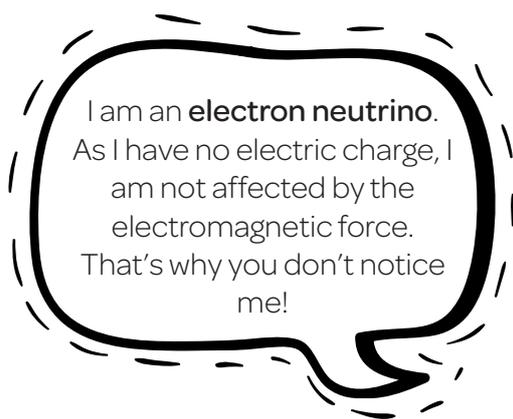


I am an **electron** and I am the lightest particle with an electric charge!

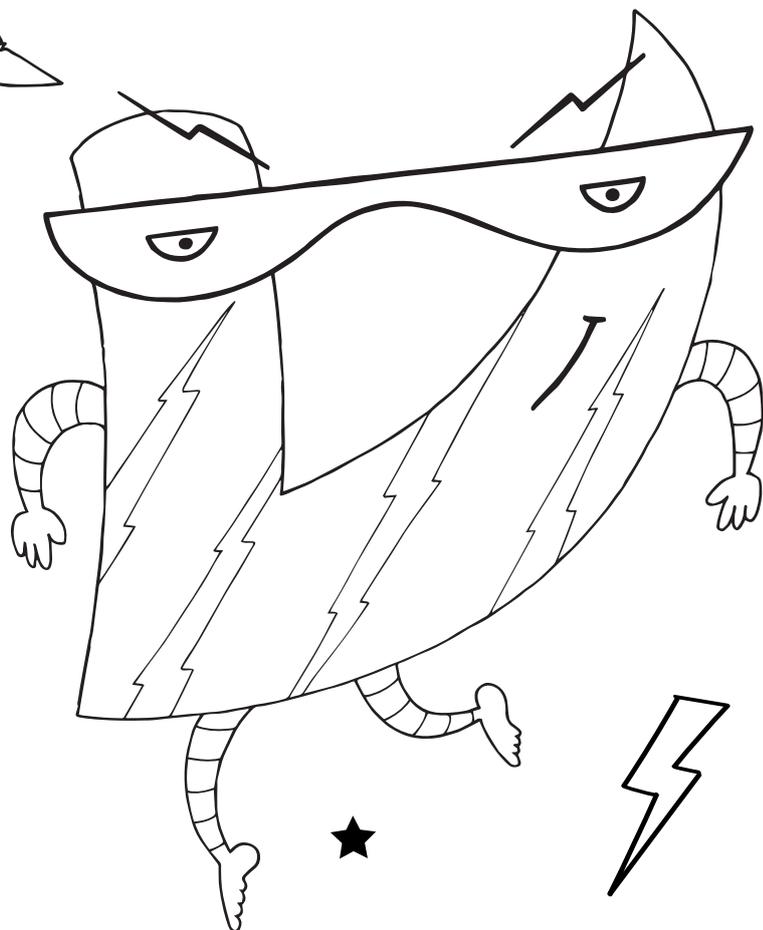
Electrons generate **electricity** when they move!



Electrons were the first elementary particles to be discovered – back in 1897!

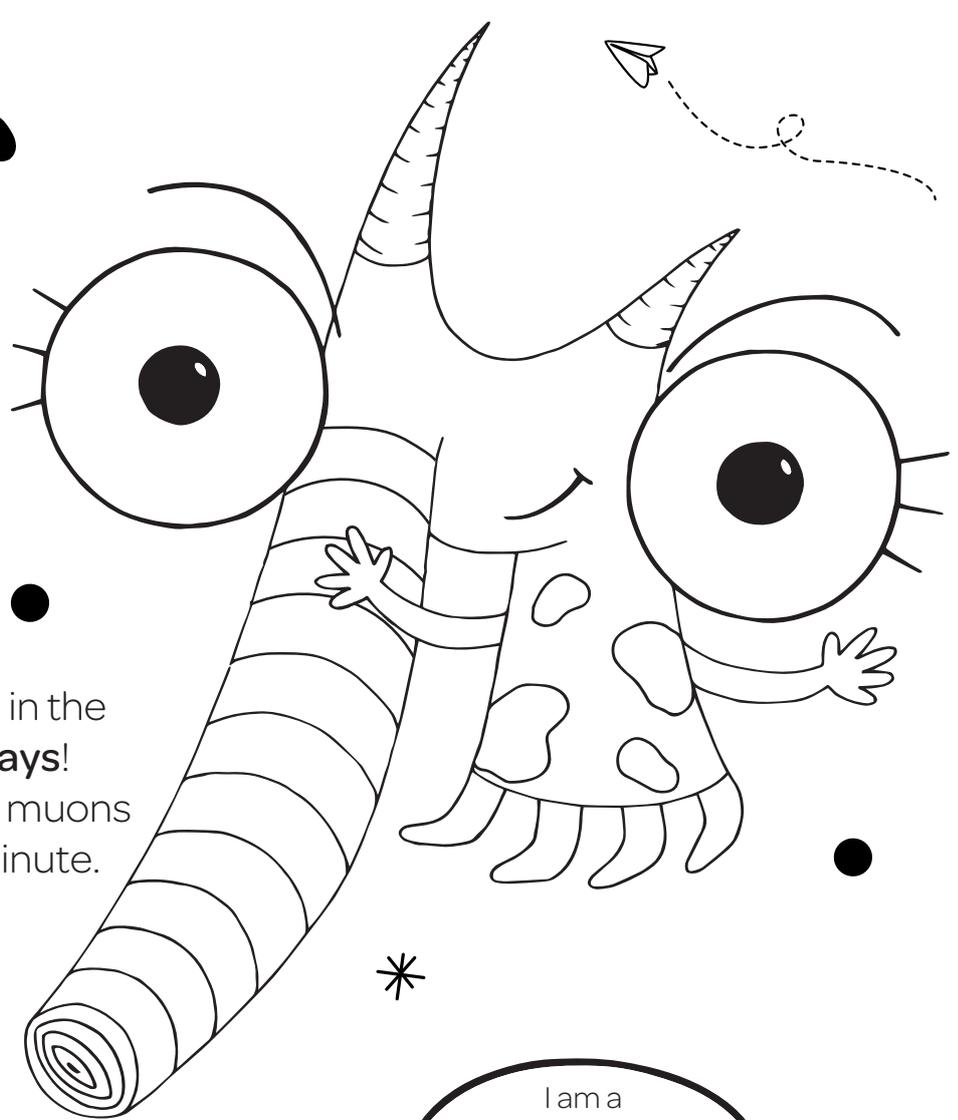


I am an **electron neutrino**. As I have no electric charge, I am not affected by the electromagnetic force. That's why you don't notice me!



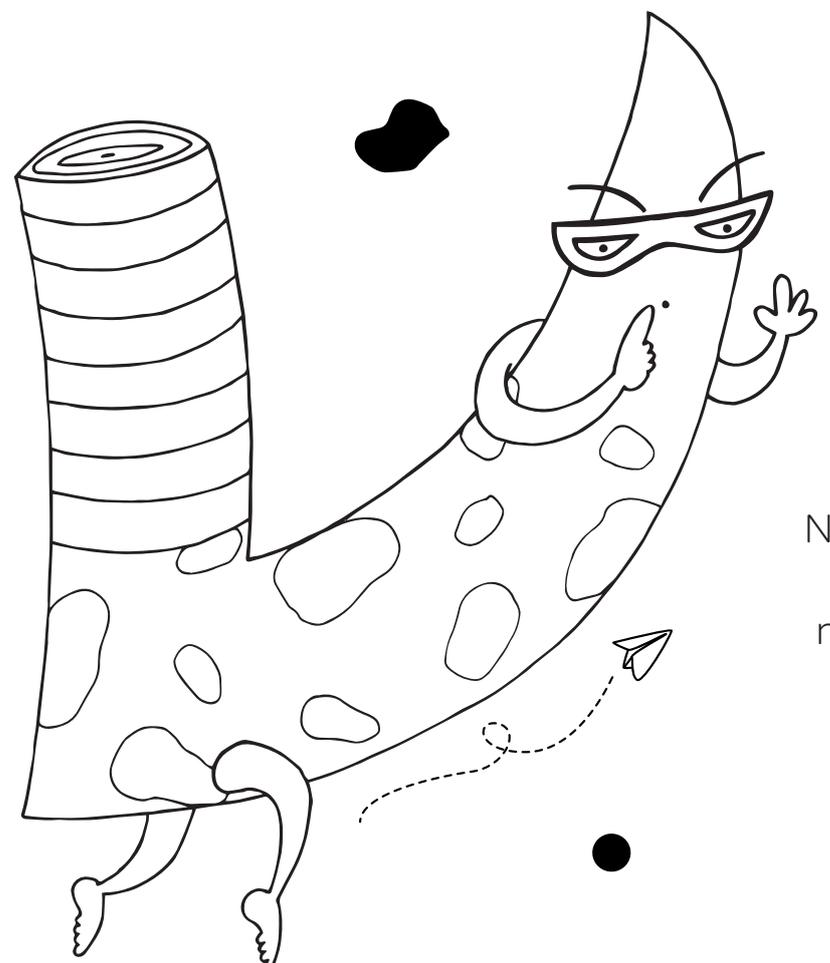
The Sun makes **a lot** of electron neutrinos – 500 billion pass through your hand every second!





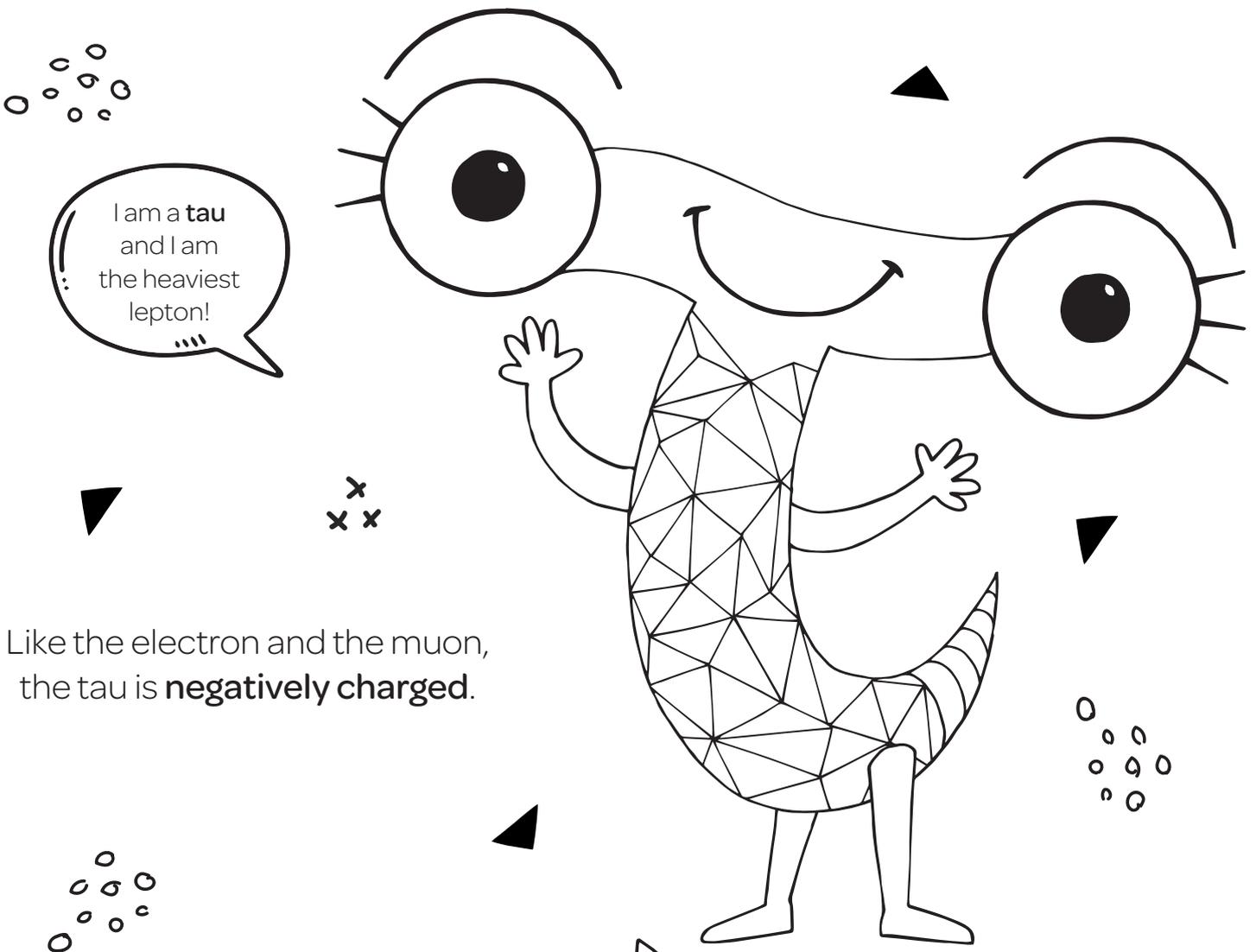
I am a **muon**
and I am
200 times
heavier than
the electron!

Muons are steadily created in the
atmosphere by **cosmic rays!**
If you stick out your hand, 25 muons
will pass through it every minute.



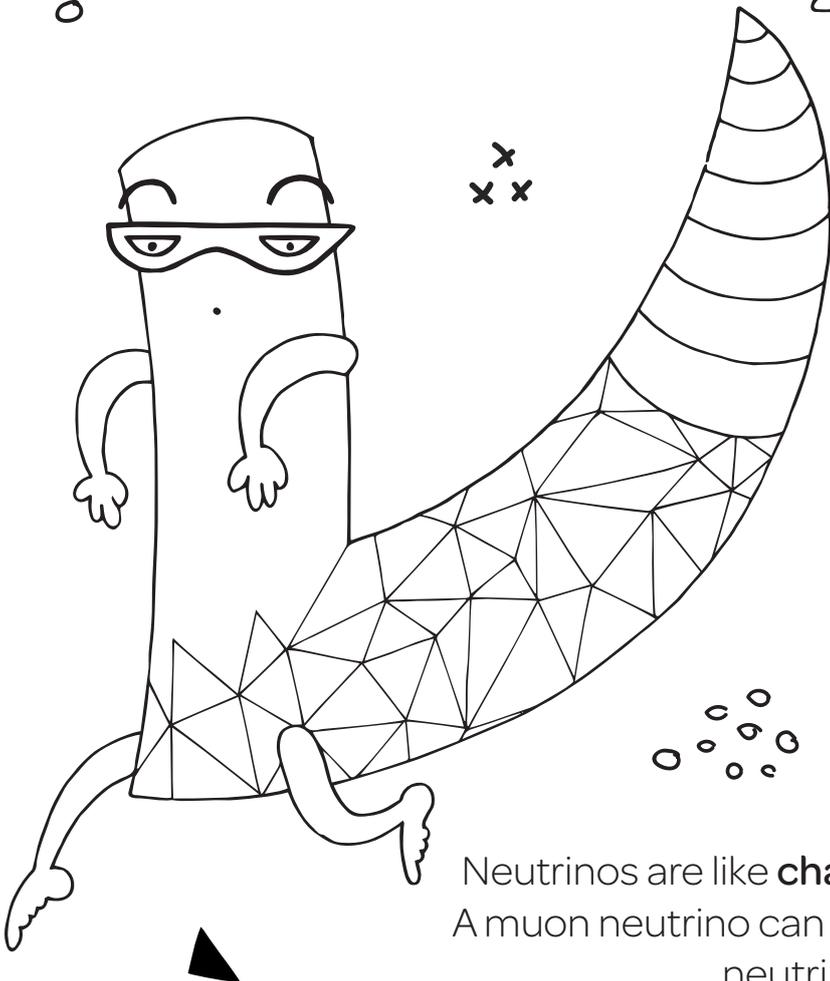
I am a
muon neutrino
and my discovery
proved that more
than one type of
neutrino exists!

Neutrinos are still **very mysterious**.
Why do they have mass? Which
neutrino is the heaviest? There's a
lot left to learn!



I am a **tau**
and I am
the heaviest
lepton!

Like the electron and the muon,
the tau is **negatively charged**.



I am a **tau neutrino** and
I was the last
matter particle
discovered
(in 2000)!

Neutrinos are like **chameleons**, they can change types!
A muon neutrino can become a tau neutrino or electron
neutrino – and vice versa.

MEET THE FORCE PARTICLES!

Gluons are the carriers of the strongest force in the Universe:
the **STRONG FORCE**.

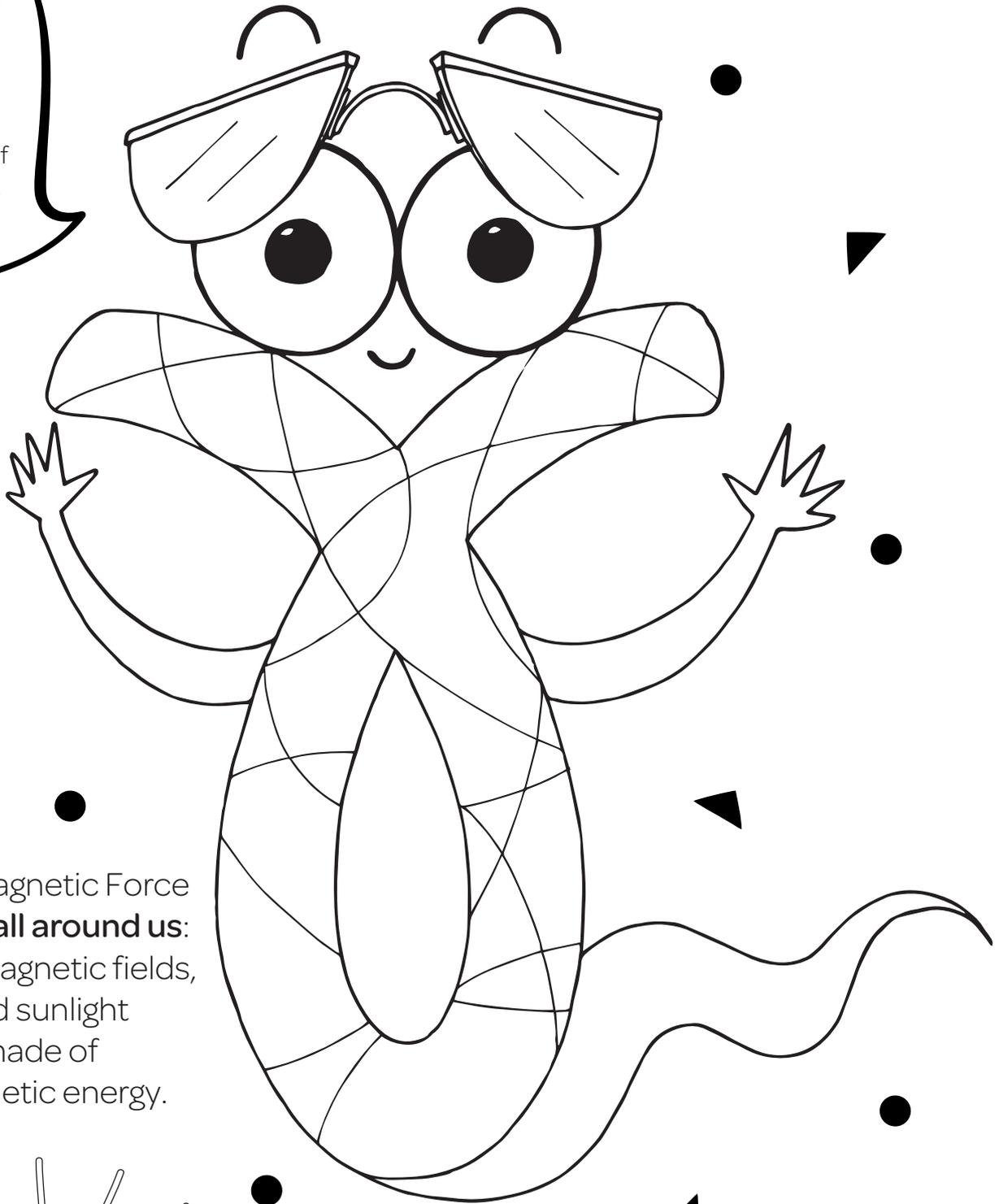


The Strong Force helps make the world around us! It **holds together** protons and neutrons to make the nucleus of atoms.

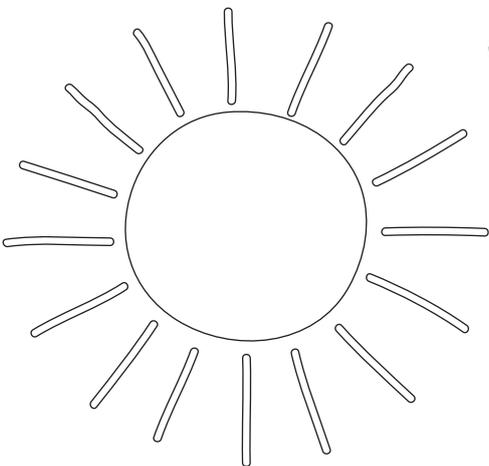
When quarks want to change colour, they **exchange gluons** between them.
Do you remember what colours quarks can have?

Photons carry the **ELECTROMAGNETIC FORCE**.

I am a **photon!**
I am the only elementary particle visible to the human eye – but only if I have the right energy.



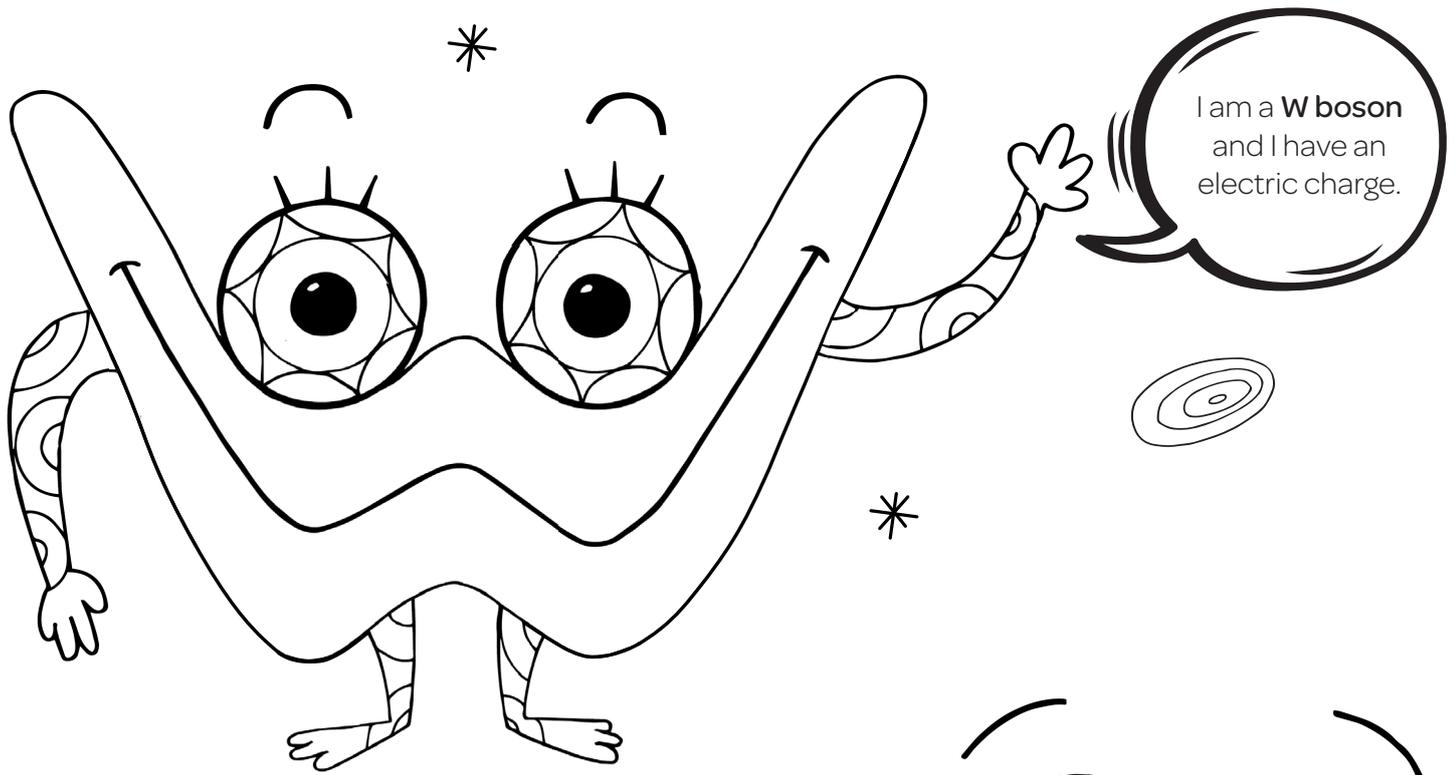
The Electromagnetic Force can be found **all around us**: radio waves, magnetic fields, X-rays and sunlight are all made of electromagnetic energy.



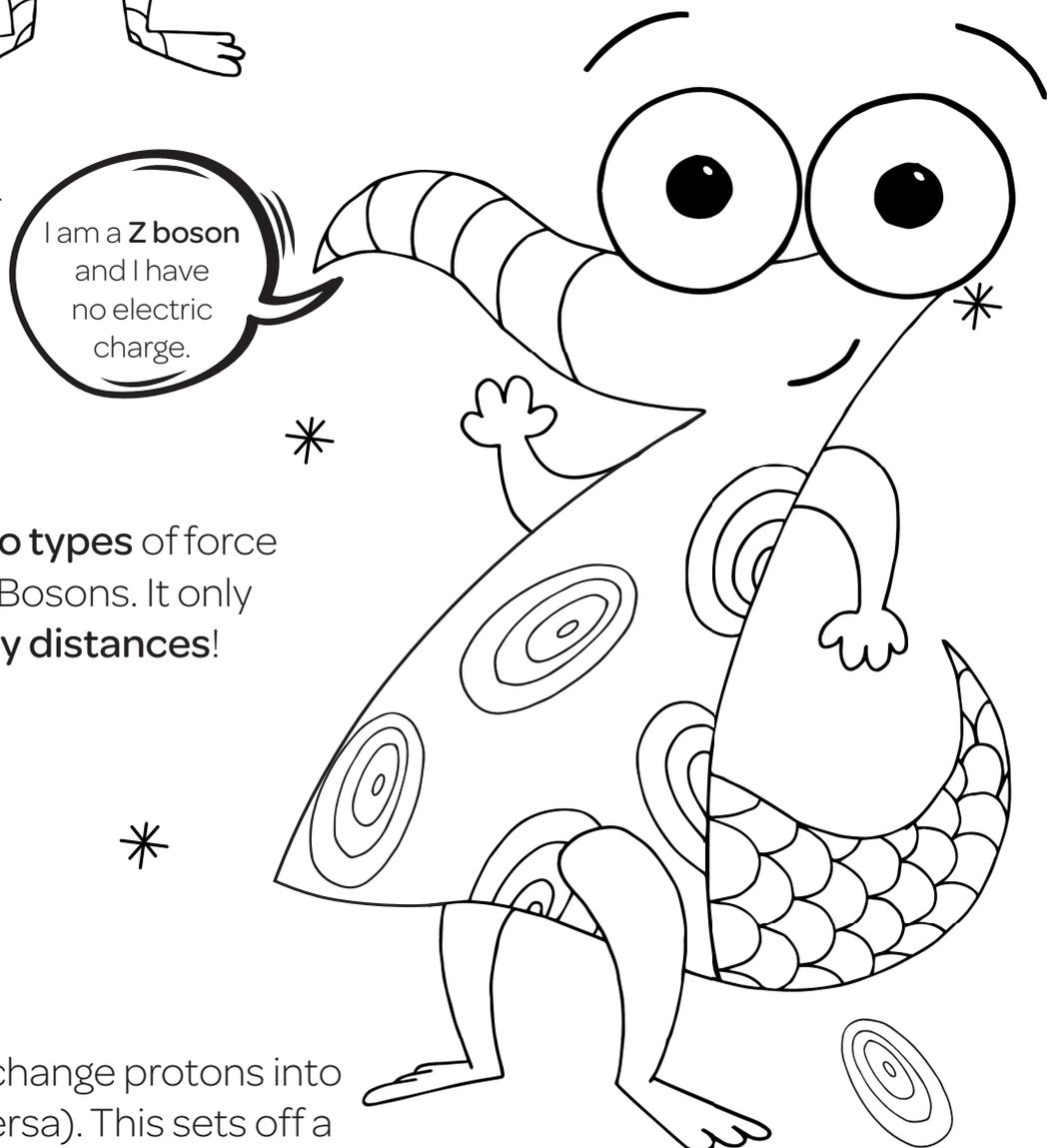
If you've used a magnet or rubbed a balloon against your hair, you have **felt** the Electromagnetic Force!

How many sources of electromagnetic energy are in your room?

The **WEAK FORCE** is the fundamental force responsible for many nuclear reactions and forms of radioactivity.



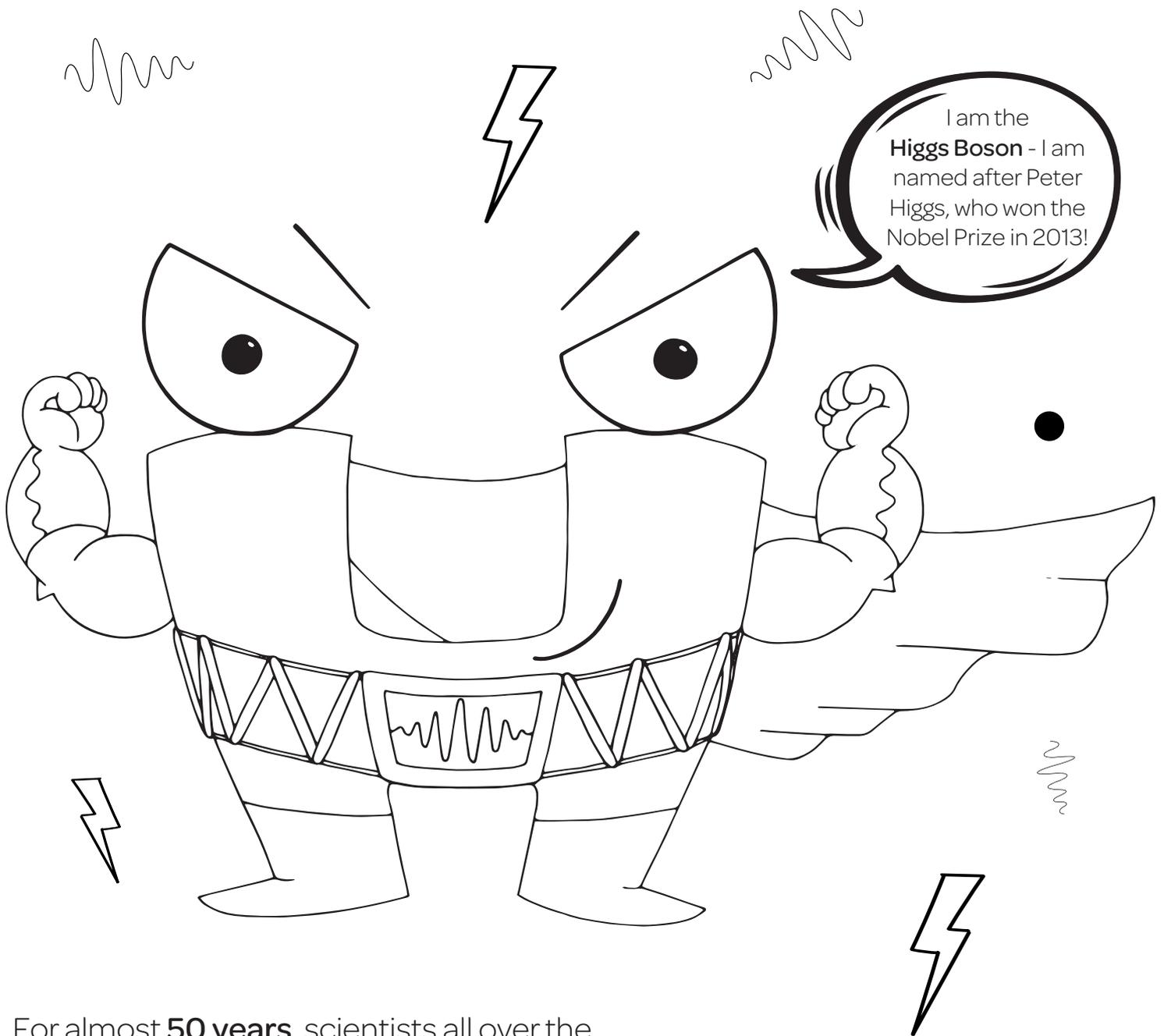
The W and Z bosons are about 100 times heavier than the proton.



The Weak Force has **two types** of force particles: the W and Z Bosons. It only works within **very tiny distances!**

The Weak Force can change protons into neutrons (and vice versa). This sets off a **chain reaction** that keeps the Sun burning.

The **HIGGS BOSON** is a different kind of particle – it is connected to an **energy field** that exists everywhere in the Universe!
When matter particles interact with this field, they are given mass.



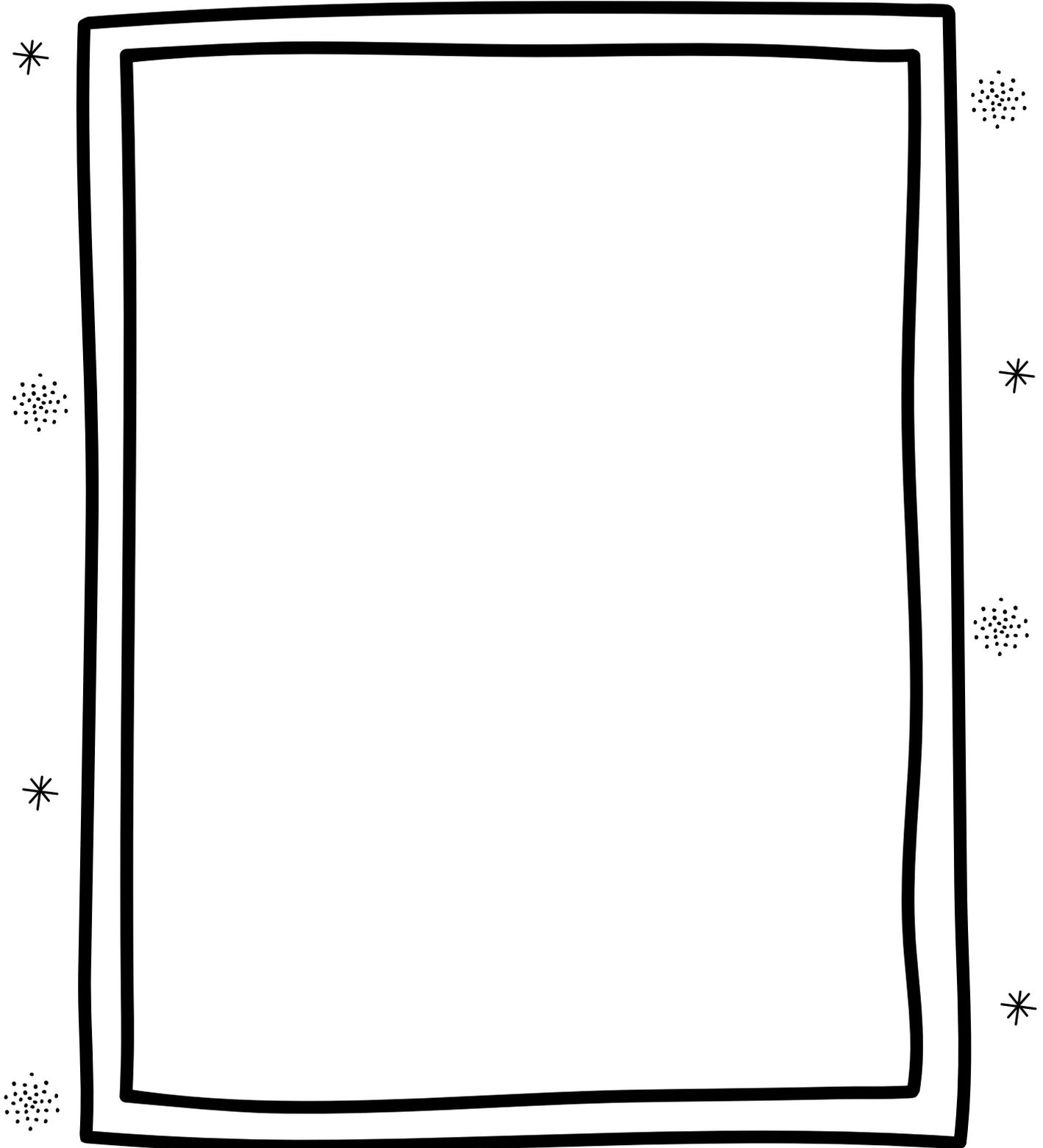
For almost **50 years**, scientists all over the world searched for the Higgs Boson.

It was finally discovered by the **ATLAS and CMS Experiments** in 2012!

The Higgs Boson discovery marked the end of one chapter of scientific discovery.

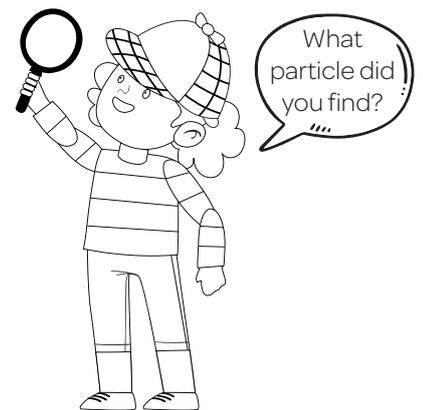
What do you think scientists will find next?

DRAW YOUR OWN PARTICLE!



Particle name: _____

Fun facts about your particle:





Particle Illustrations by Carolina De Luca
Additional Illustrations by Mariana Velho
Text and Project Development by
Katarina Anthony and Mariana Velho

Learn more at atlas.cern/colouring-book
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