What is the Universe made of?

For a fun start, take the test **"Which particle are you?"**

Prepare your **CERN badge** and get ready to access CERN

What's inside matter?

Have fun with the **quizzes**

Build your MATTERyoska

What happens when you smash particles travelling almost at the speed of light?

What are particle accelerators used for?

Explore CERN inside out, check out **CERN map** and "cook" the **primordial soup**

Hi! My name is Schrödy. Follow me!

These activity sheets accompany the gamebook "Your adventures at CERN", written by Letizia Diamante, and illustrated by Claudia Flandoli.
For info check: www.letiziadiamante.com

WHICH PARTICLE ARE YOU?

Cosmic rays

START

HOW DO YOU PREFER DOING YOUR HOMEWORK?

ALONE

WITH SOMEONE

DO YOU FEEL

LIGHT

HEAVY

DO YOU LIKE WRITING WITH

ONLY BLUE OR BLACK PENS

YOU ARE AN ELECTRON
The electron is responsible for magnetism and electricity

WHEN YOU PLAY HIDE-AND-SEEK

PEOPLE SEARCH FOR YOU AND FIND YOU

YOU ARE A MUON
The muon is the big cousin of the electron

YOU ARE A HIGGS BOSON
The Higgs boson was discovered in 2012, after many years of research

DO YOU PREFER TO STAY IN

A DARK ROOM

ARE YOU THE SMALLEST AMONG YOUR COUSINS?

YES

PEOPLE CAN NEVER FIND YOU

NO

COLOURFUL PENS

YOU ARE A GLUON
The name gluon derives from "glue". This particle hold quarks together

YOU ARE A PHOTON
It is the particle of light

A VERY LIGHT ROOM

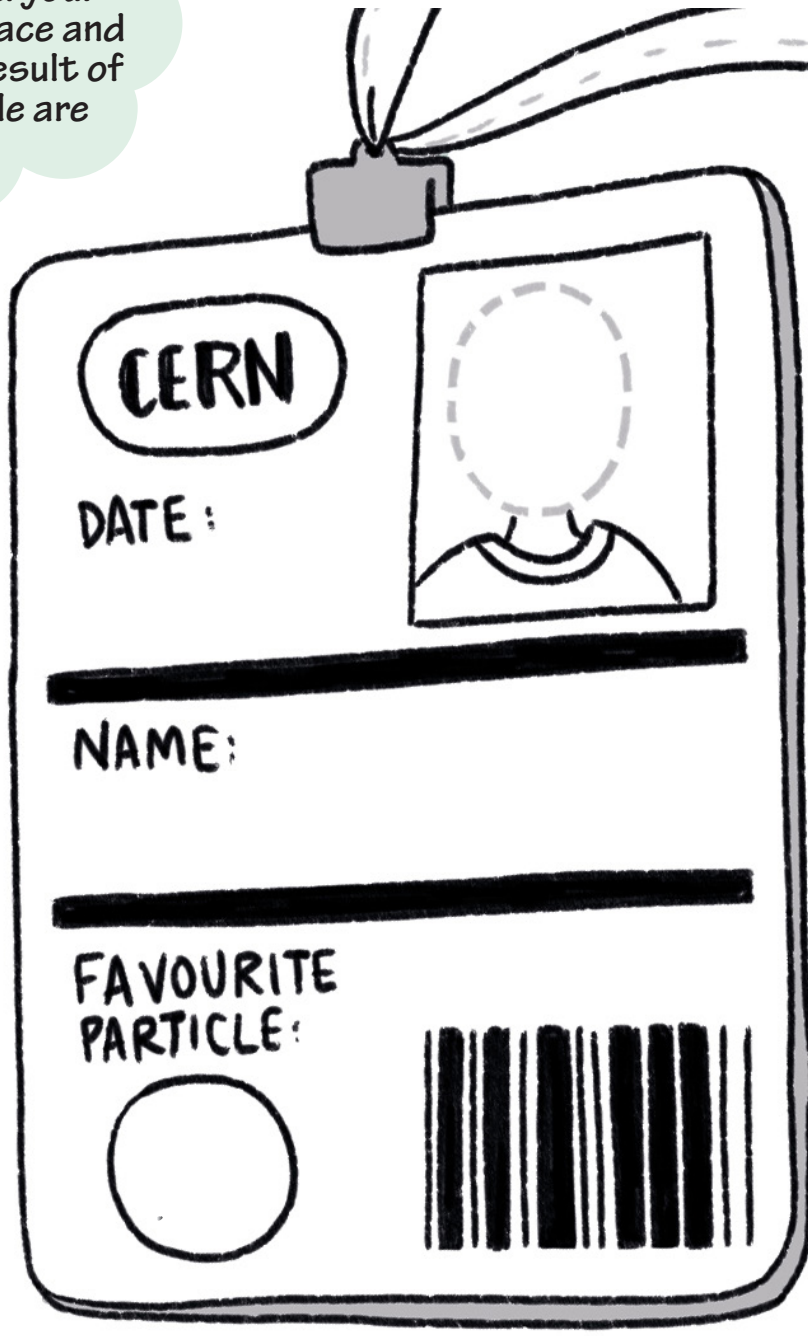
YOU ARE A QUARK
Quarks are painted in three colours (red, green and blue)

proton

YOU ARE DARK MATTER
Dark matter makes 25% of the Universe, but it's so mysterious and hasn't been seen so far!

"Your adventures at CERN" is a science gamebook with quizzes, games and recipes.

Write the date and your name. Doodle your face and your particle (the result of the "Which particle are you?" test).



Did you know?

The cat's name, Schrödy, comes for a German physicist called **Erwin Schrödinger** (1887-1961). He invented the paradox of the "zombie cat".

Did you know?

Atoms are mostly empty space and electrons are over 1,800 times smaller than protons and neutrons.

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Looking inside things

What's the smallest thing you can see? It is probably a bit thinner than a cat whisker. If you could look inside things, you'd discover that everything, including yourself, is made of super tiny atoms.

How small are particles?

Like Matryoshka dolls (or Russian dolls), matter can be disassembled into smaller and smaller parts until you reach a piece that you cannot divide any further. This is true for everything that you see around you.
Think about something and ask yourself
"**What is it made of?**" again and again.
For example, let's start with… Schrödy. What is a cat made of?
Build a **MATTERyoshka** doll to find out.

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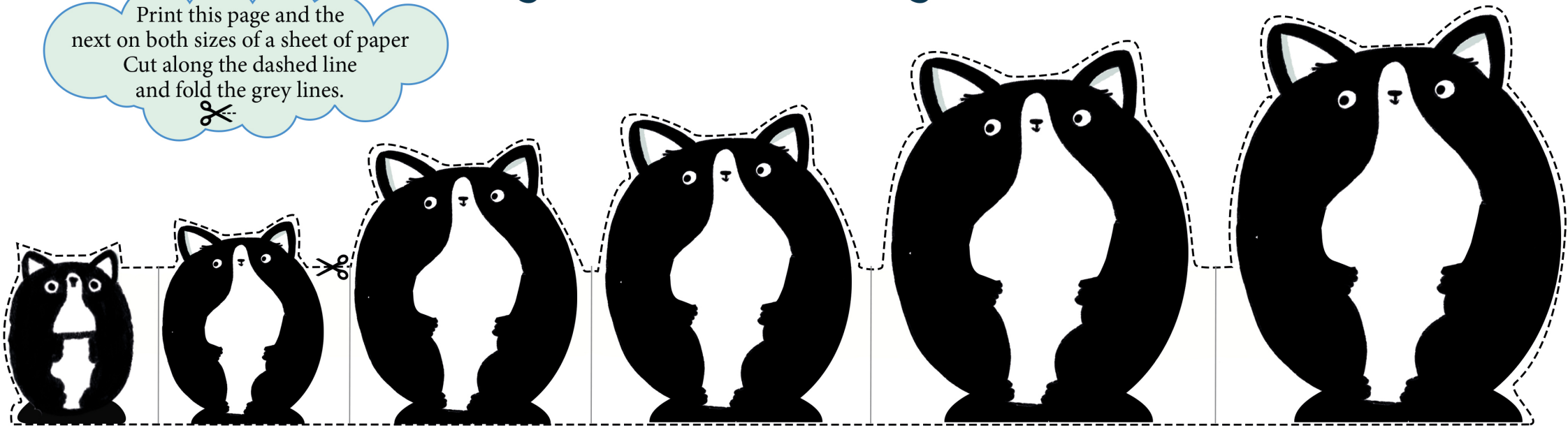
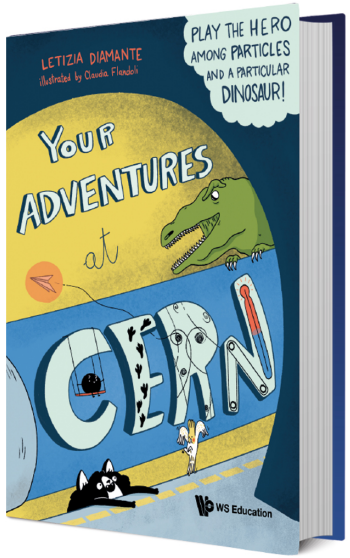
Build your Matteryoshka doll

Print this page and the next on both sizes of a sheet of paper
Cut along the dashed line and fold the grey lines.



Like Matryoshka dolls (or Russian dolls), matter can be disassembled into smaller and smaller parts until you reach a piece that you cannot divide any further.

Quarks are like the smallest doll of a Russian doll... but we do not know if they are made up of even smaller particles.



Your adventures at CERN
is a gamebook with a scientific twist

You can choose to play the role of a researcher, a student or a tourist, but keep your eyes open for a threatening dinosaur... Is it coming from the nearby Jura Mountains, the same place that gave Jurassic its name?

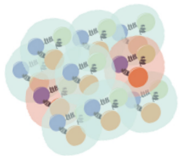
Find it here:

www.letiziadiamante.com

MATTER

MOLECULE

ATOM



NUCLEUS

PROTON

QUARK

www.letiziadiamante.com

What is a cat made of?
A cat is made of various **molecules**, but mainly **molecules** of water.

What are **atoms** made of? They are made of a **nucleus** and one or more **electrons**.

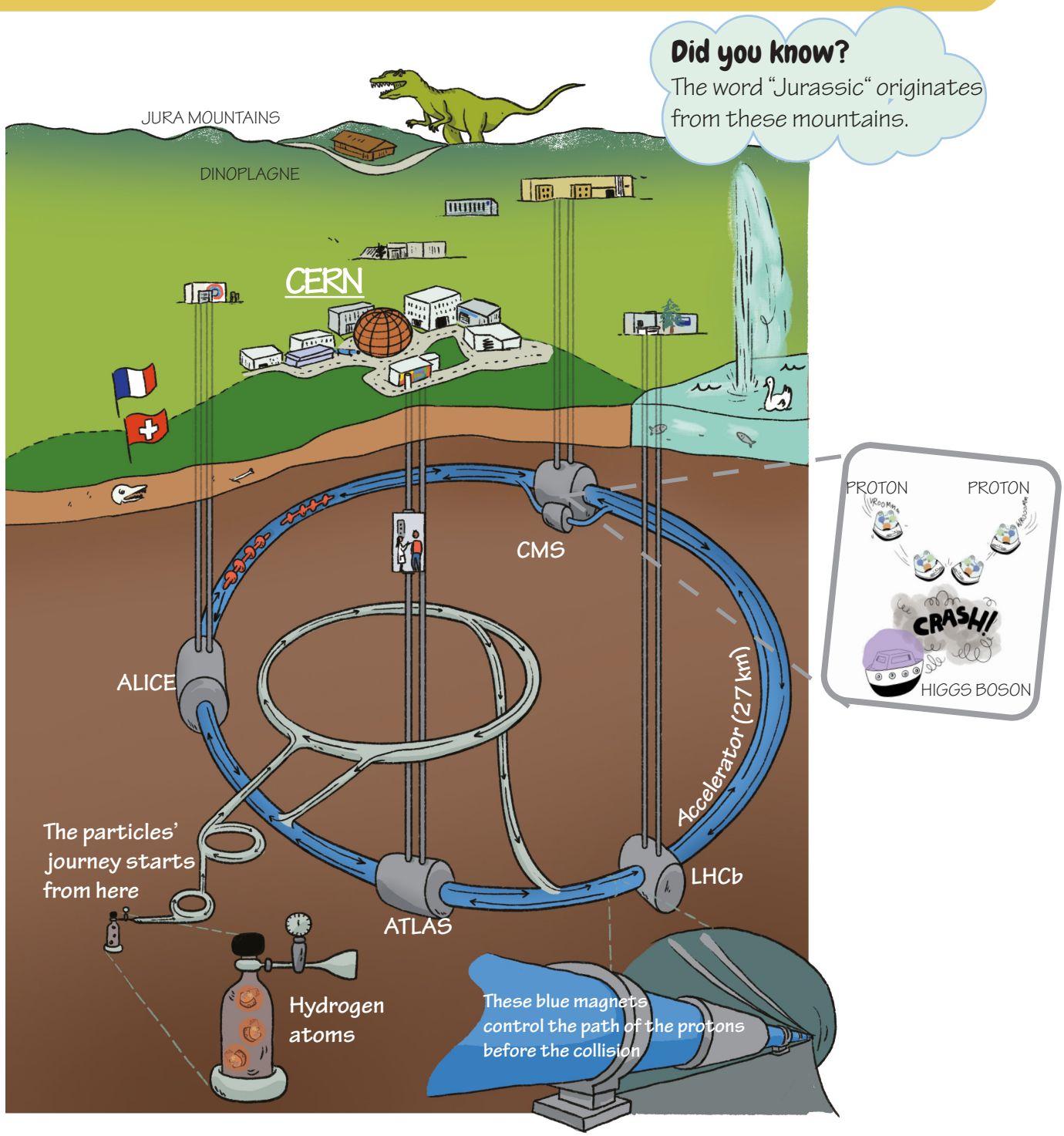
What is the **nucleus** made of? It is made of **protons** and **neutrons**.

Ok! Now you can stop because **quarks**, **gluons** and **electrons** cannot be divided any further... at least from what we know.

What are **molecules** made of? They are made of **atoms**.

What are **protons** and **neutrons** made of? They are made of **particles** called **quarks** and **gluons**.

Now you know which are the building blocks of today's matter and how they are organised like in a Russian doll, but **how did the Universe look like at the very, very beginning, just after the Big Bang?**
Let's go to **CERN** to find out!



Follow the journey of the particles, called **protons**, with your finger. Start from the hydrogen canister and **follow the black arrows**. Protons fly around and around at mind-blowing speeds, first inside the small accelerators and then in the biggest particle accelerator in the world (the blue ring)! Some protons (black arrows) fly clockwise, others anticlockwise. Their journey ends when they meet face to face and smash against each other inside the **detectors**: ALICE, ATLAS, CMS and LHCb. T**he very high temperature and density conditions** that existed immediately after the Big Bang are generated inside these detectors.

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Just after the Big Bang, the universe was so hot that matter was not structured like a Russian doll... It looked more like a **soup of particles**, the so-called **primordial soup**. CERN researchers are studying this "soup", the Higgs boson and many other particles!

Artistic interpretation of the primordial soup. Draw a lot of quarks, gluons and electrons.

Did you know?

Matter makes up only **about 5% of the Universe**, including all the stars and galaxies.
There is still so much to discover!

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Quiz time

QUIZ 1

How many particle accelerators have been built in the world?

A) Around 30,000
B) Only 1 (CERN)
C) Around 30

QUIZ 2

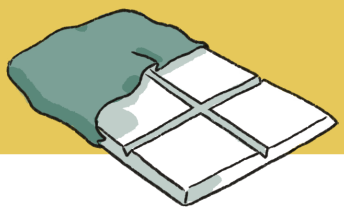
You can use particle accelerators to study dinosaurs.

A) True
B) False

QUIZ 3

You can use particle accelerators to make tastier chocolate and ice cream.

A) True
B) False



QUIZ 4

CERN was awarded the Guinness World Record for the highest man-made temperature ever reached (more than 100,000 times hotter than the centre of the Sun).

A) True
B) False

QUIZ 5

It was invented, discovered or created at CERN (3 correct answers)

A) The Web
B) The first anti-atom
C) The Higgs boson
D) Dinosaur fossils

QUIZ 6

Our Universe is mainly made up of

A) Matter
B) Dark matter
C) Dark energy

QUIZ 7

Atoms are

A) mostly full
B) mostly empty

QUIZ 8

Which particle is associated with light?

A) Neutron
B) Quark
C) Photon

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Teacher's notes

How to use these worksheets in the classroom?
These worksheets aim to explore concepts related to particles, the structure of the atom and the origin of matter in an accurate and engaging way.
Particles can be discussed when pupils/students become acquainted with the states of matter (solid, liquid and gas) and the fundamentals of the atom.

TEST - Which particle are you?
Pupils/students can familiarise with the name of some particles with this opening, fun test. The same particles appear on the following pages of these activity sheets and in the book. The questions of the test are related to the properties of the particles, for example, the first question of the test distinguishes particles that are "more solitary" (i.e. fermions, such as the electron).

How are particles illustrated?
Particelles have no volume, but they are represented with colourful illustrations in the book. For example:
- Gluons keep quarks together in the proton and are traditionally represented with little spiral lines
- Quarks are drawn as circles of three colours (red, blue and green).
- Protons are represented as little bumper cars, because they crash inside the detectors at CERN. You can see gluons and quarks inside the protons.
- Electrons and muons belong to the same family: they are represented as a paper plane and a hot air ballon respectively (to indicate that muons are more massive than electrons).
- The Higgs boson is quite massive (about 125 times more massive than the proton), so it is drawn as a cruise ship.

CERN map:
The protons that accelerate inside CERN accelerators originate from hydrogen atoms. Each hydrogen atom has one proton and one electron. Electrons are removed from the hydrogen atoms, while protons speed faster and faster inside the accelerator system. It might be useful to use the left index finger to follow the protons (black arrows) going clockwise inside the LHC, and the right index finger for the protons (black arrows) going anticlockwise. The two meet (and sometimes crash) inside the 4 detectors: ALICE, ATLAS, CMS and LHCb.

Quiz: 1A, 2A, 3A, 4A, 5ABC, 6C, 7B, 8C.

Videos to explore these topics further
- How does an atom-smashing particle accelerator work? - Don Lincoln (TedEd) https://www.youtube.com/watch?v=G6mmlzRz_f8
- Oxford Sparks: A quick look around the LHC: https://www.youtube.com/watch?v=BEnaEM-MAO_s&t=27s
- Voyage into the world of atoms (CERN): https://www.youtube.com/watch?v=7WhRJV_bAiE
- Just How Small is an Atom? (TedEd): https://www.youtube.com/watch?v=yQP4UJhNn0I

Please use the Contact Form that you can find at the bottom of the webpage https://www.letiziadiamante.com to write your questions, comments or suggestions