

# About your Physics and Chemistry ESO 3 book



Physics and Chemistry 3 is organised into three **blocks**. Each content block is divided into **units**.

## BLOCKS

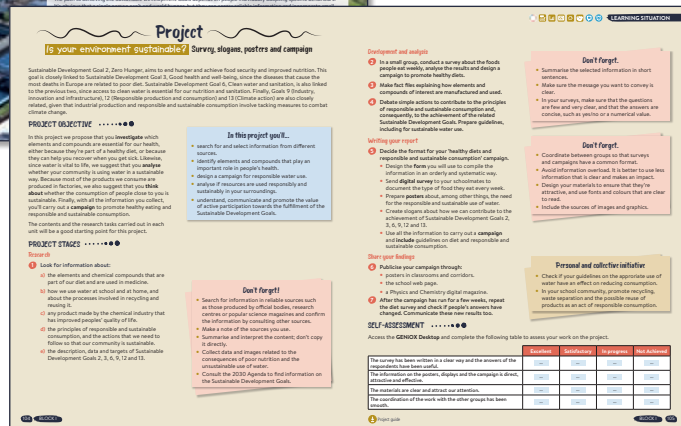
The **basic knowledge areas** are covered in three blocks called **Matter and how it changes**, **Interaction** and **Road safety for pedestrians, drivers and passengers**. The content is dealt with in the units of each block as well as in the **Work on your key competences** tasks at the end of each unit.



The block introduction includes an overview of the topics covered in the units in that block and the different **learning situations** in each of them. It also contains a brief presentation of the project that comes at the end of the block.

To end each block there's a **Learning situation**. Here you'll carry out a **project** that will allow you to put into practice what you've learned during the block as well as applying your **creativity**, working both **individually** and as part of a **group**.

The **Work on your key competences** tasks at the end of each unit will also help you with this project.



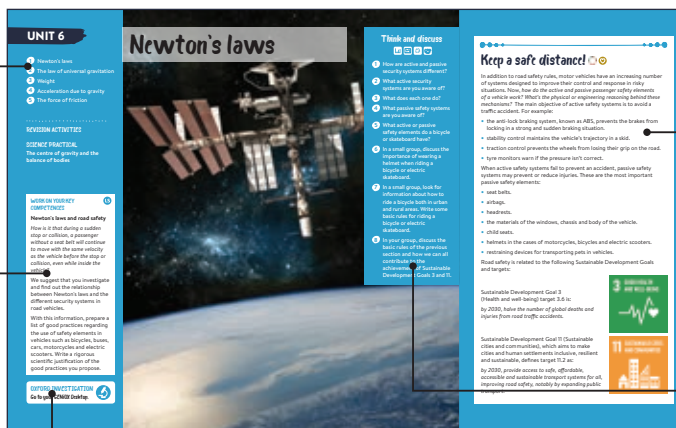
## UNITS

### Unit introduction

This is composed of a number of elements.

A list of the contents and sections that are in the unit.

An introduction to the **Work on your key competences** task, which is the **Learning situation LS** at the end of the unit.



The introductory texts have been selected to foster **individual growth** (emotional, social and academic) and to encourage you to respond to the **challenges facing the world today**: the achievement of the Sustainable Development Goals, children's rights, gender equality and digital competence. They'll also help you to develop the personal, academic and professional **competences** you'll need in the future.

In **Think and discuss**, there are activities that promote reflection on and debate about the content of the text.

In addition, we suggest that you go to your **GENIOX Desktop** to access **Oxford Investigation**. You can work with this digital resource, which includes tasks and simulators, throughout the unit.

# Development

These boxes introduce interesting facts or ask questions based on everyday life, experiments or images. This helps you to deduce what content will be covered in the section.

Key content is highlighted.

**Where are the protons and the electron positioned in the atom? The first atomic models**

The electrons are distributed and the protons are seen as concentrated with the rest of an individual atom, because these particles are located together in the nucleus.

**3.1 Thomson's Atomic Model (1904)**

J.J. Thomson proposed the **plum pudding atomic model**. The nucleus and electrons are embedded in a positively charged and dense positively charged sphere that is called the **plum pudding**.

**3.2 Rutherford's Atomic Model (1909)**

In 1909 Rutherford and his colleagues Geiger and Marsden conducted a series of experiments to determine the structure of the atom. They directed the particles to pass through the sheet with thin deflection.

This illustration shows their **hoppered model**.

**What did Rutherford's model propose?**

To explain the result of the gold foil experiment, Rutherford proposed a **nuclear atomic model** consisting of two different parts:

- A **central mass or nucleus** which is positively charged and where most of the mass of the atom is concentrated. The protons are in this.
- A **peripheral mass or electron cloud**, which negatively charged electrons enclose around the nucleus at some distance from it.

Observe the trajectory followed by the particles in Rutherford's experiment. How can he explain the result of the gold foil experiment?

- The particles pass straight through the nucleus.
- Some particles are deflected at an angle.
- Some particles are deflected at a large angle.
- Some particles are deflected back.

**3.3 The discovery of neutrons (1932)**

Rutherford's atomic model couldn't explain the mass of the atom because the sum of the masses of the protons and the electrons was smaller than that of the atom.

For example, the hydrogen atom has one electron and one proton, and the helium atom has two electrons and two protons, so the mass of helium should be four times that of hydrogen. However, it is four times greater.

Rutherford and other scientists proposed that another particle must exist in the nucleus, with mass but no electrical charge.

In 1932, James Chadwick discovered electrically neutral particles in the nucleus of atoms. He called them **neutrons** and their mass is similar to that of protons.

**The discovery of neutrons**

The alpha is made up of 2 protons and 2 neutrons. The mass of the alpha is 4. The mass of the neutron is 1. The mass of the proton is 1. The mass of the electron is 0.0005.

**3.4 The structure of the atom**

The atom is made up of a central nucleus which is positively charged and contains most of the mass of the atom. The nucleus is made up of protons and neutrons. The electrons are distributed around the nucleus in shells or energy levels.

In your notebook, calculate the atomic charge and the mass of an alpha particle.

Observe the expected path of a particle through the gold foil in Thomson's model and Rutherford's atomic model.

In the margins, there are **glossary boxes** with definitions of key vocabulary, as well as complementary texts that reinforce or extend the content.

Activities include **listening** and **speaking** tasks. Activities also cover various **key competences** and all activities cover the STEM and plurilingual competences.

# Revision activities

**Revision activities**

**Changes in matter**

- You have two different coloured liquids in two test tubes. There is a blue liquid in the first tube and a red liquid in the second tube. You pour the two liquids into a glass beaker. What do you observe? Explain your answer.
- You add a few drops of bleach to an orange acid solution. What do you observe? Explain your answer.
- Which of the following processes are physical and which are chemical transformations? Explain your answer.
  - The electrolysis of water which decomposes it into hydrogen gas and oxygen gas.
  - Water freezing.
  - Heating sugar until it forms caramel or brown sugar to make toffee.
  - Separating a mixture of oil and water by means of a separating funnel.
  - Separating a mixture of iron filings and sand with a magnet.
  - Cooking a piece of raw meat.
  - The evaporation of alcohol when you dry clothes.
  - Gasping food in the digestive tract.

**Chemical reactions**

- Write the chemical equation for the reaction of calcium metal with hydrochloric acid. Balance the equation.
- Write the chemical equation for the reaction of calcium metal with oxygen. Balance the equation.
- Write the chemical equation for the reaction of calcium metal with water. Balance the equation.
- Write the chemical equation for the reaction of calcium metal with carbon dioxide. Balance the equation.

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The **Revision activities** are organised by topic. They include a wide variety of different types of activity that cover the different key competences and all of them cover the STEM and plurilingual competences.

In the **Study skills** section, you'll make a summary of the unit, a concept map and a scientific glossary. You'll be able to use all of these resources to **review** the contents of the unit.

# Science practical

In this section you'll discover how to use laboratory instruments and carry out experiments following the steps of the scientific method.

**Science practical**

**Measuring the density of an irregular solid**

As you will remember from last year, if we want to measure the density of a solid, we need to know its mass and volume. Density can be calculated using the following formula:

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

To find the density of an irregular solid, first we need to find its mass and then its volume.

**OBJECTIVES**

- Work with materials and instruments in the Physics and Chemistry lab.
- Use the safety rules when using electrical devices.
- Apply the importance of systematic work in experiments.
- Use basic scientific units and quantities.

**MATERIALS**

- A digital scale and a weight.
- A measuring cylinder.
- A graduated cylinder and water.

**METHOD**

- Measure the mass of the solid with the digital scale. Write down the value.
- Fill the measuring cylinder with water. Write down the volume.
- Subtract the volume of the water from the volume of the solid plus water. Write down the value.
- Calculate the density of the solid by dividing the mass by the volume.

**ANALYSIS AND RESEARCH**

- Compare the density of the solid with the density of water.
- Calculate the density of the solid by dividing the mass by the volume.
- Calculate the density of the solid by dividing the mass by the volume.

# Work on your key competences

The **Learning situation** in **Work on your key competences** enables you to put the contents you've studied into practice in an integrated manner, as well as allowing you to relate them to the Sustainable Development Goals.

Throughout the unit there are **LS** activities, which are connected to the Learning situation.

On your **GENIOX Desktop** there's an **Experiment video** and a **Lab report**, which you can use to write up your experiment and record your results.

There's also a **Task guide**, which includes the self-assessment rubrics.

## Symbols used in your book

Some sections and activities in this book are specifically designed to develop the **key competences** and to **focus on** aspects of your **individual development** and the **challenges of today's world**. The symbols below help you to identify these sections and activities.

Remember that Physics and Chemistry mainly works on the STEM competence. This means that all of the activities in this book develop that competence, as well as the plurilingual competence.

### KEY COMPETENCES

- Linguistic competence
- Plurilingual competence
- Competence in science, mathematics, engineering and technology (STEM)
- Digital competence
- Personal and social competence and learning to learn
- Civic competence
- Entrepreneurial competence
- Cultural awareness and expression

### FOCUS ON

- Children's rights
- Gender equality
- Physical and emotional wellbeing
- Digital competence
- The world of work
- The Sustainable Development Goals

### OTHER SYMBOLS

- Learning situation
- Speaking activity
- Group activity and cooperative learning
- Listening activity
- STEAM task (interdisciplinary activity)
- Video
- Downloadable material

## The GENiOX Desktop

The **GENiOX Desktop** is a digital space where you can access your **digital book**, as well as a wide range of **resources** in different formats (such as video, HTML and PDF). These will help you with the tasks and processes that are the basis of your learning: observation, analysis, consolidating and expanding your knowledge, study skills and exam revision.

- Unit presentation**
- Oxford Investigation**, which works on the contents digitally through tasks, animations and simulators
- Animations** that help you to visualise processes and mechanisms in a dynamic way
- Passnotes**: summarised version of each content section with audio
- Simulators** that allow you to work in a virtual laboratory
- Experiment video** of the Science practical
- Digital revision activities** to test your knowledge in an interactive format
- Concept maps, dictionary worksheets** and **scaffolding worksheets**
- Weblinks** to expand your knowledge and find information for research tasks

## The Sustainable Development Goals (SDGs)

The UN launched the Sustainable Development Goals (SDGs) in 2015 for its member states to adopt. The SDGs aim to end poverty, reduce inequality and injustice and tackle climate change for everyone in the world.

To achieve the Sustainable Development Goals, we need to remember these three things.

- The **deadline**: This is 2030.
- The **targets** and **indicators**: the 2030 Agenda divides each goal into targets and provides indicators to measure progress.
- The **agents of change**: everyone on the planet has a role to play in meeting the Sustainable Development Goals. This includes governments, institutions and the whole of civil society.

These are the 17 goals established by the UN for **global development within planetary boundaries**.

Access your **GENiOX Desktop** to discover the aims of each of the Sustainable Development Goals.

