

Nuestros  
**ríos** son...la  
**vida**



**EXHIBITION AREAS LEAFLEF**

Nuestros ríos son...la vida  
Casa de las Ciencias. Logroño

**English** 



## FIELD 1

### Water. A very special substance.

Look around you... You see water everywhere, right? It comes out of our taps, it falls from the sky, it's in the sea, the lakes, the rivers, as clouds and inside the cells of all living things. There's even water on planets like Mars! Water played a key role in the origin and evolution of life on our planet and it's indispensable for its maintenance. We couldn't exist without water, but despite its apparent abundance, it is a chemical rarity. Our planet has an approximately 1.4 billion cubic kilometres of water, so the Earth is actually 70 per cent covered by water.

#### Its physical and chemical properties.

Water is a molecule made up of two hydrogen atoms and one oxygen atom, which are bonded together. The oxygen atom has higher electronegativity than the hydrogen atoms, which causes the molecule to have a special distribution of its electrical charge. This gives water a polar character, in other words, it has a negatively charged end and a positively charged end. Polarity allows water to interact with other polar substances, such as ions, sugars and proteins, and also with other water molecules. In this case, the hydrogen atom of one molecule is bonded to the oxygen atom of another molecule. These bonds are responsible for many of the physical and chemical properties of water that make it a unique substance essential for life. For example, water has a high surface tension, which allows it to form droplets and adhere to surfaces. It also has a high heat capacity, which means it can absorb or release a lot of energy without a major change in temperature. This helps regulate the climate or body temperature of living beings. Moreover, water has a high melting and boiling point, so it remains liquid at many different temperatures.

#### The colour of water.

Pure water is a substance without colour, odour and taste. However, water found in nature has several impurities that give it sensory characteristics. The colour of water depends on the chemical and physical composition of the aquatic environment, as well as the influence of sunlight. Water may have a whitish appearance if it contains micro-organisms or suspended particles. Some metals, such as copper, give it a greenish or bluish tinge; and others, such as iron, a reddish colour.

#### The smell of water.

Water is an odourless substance. However, due to the huge capacity of water molecules to be solvents for other substances, water can acquire the odour of the substances dissolved in it.

#### Water density.

The density of water is 1 gram per cubic centimetre, which means 1 kilogram of water equals 1000 cubic centimetres, or 1 litre. Density changes with temperature, pressure and salinity. Water is denser when it is cold and less dense when it is hot. The relationship between density and pressure is direct: the higher the density, the higher the pressure, and vice versa. The reason for this is that the higher the density, the more particles per unit volume. Salt water is denser than fresh water due to the content of dissolved salts. The density of water influences natural processes such as climate or ocean circulation and conditions the design and functioning of vessels.

#### Archimedes' principle.

Archimedes' principle (Syracuse 287-212 BC) is a physical law that explains the behaviour of objects immersed in a fluid. According to this principle, any submerged body experiences an upward thrust equivalent to the weight of the displaced fluid. This thrust is called buoyancy and it depends on the density of the fluid and the volume of the object.

#### The shape of Water.

The water that comes out of a tap or a hose is not a continuous mass, but a group of droplets. These droplets originate from the action of surface tension, which is the force that binds the water molecules on the surface of the liquid, giving them a rounded shape. The appearance and volume of water droplets change due to environmental conditions, such as temperature or pressure.

## Water, essential for living beings.

Water is essential for life due to its physical and chemical properties, which allow it to carry out vital functions such as structural, digestive, thermoregulatory and solvent.

- **Structural:** It gives form and function to cells. Water stabilises cell membranes, facilitates the exchange of substances and determines the volume.
- **Digestive:** Water, together with other compounds such as salts and acids, contribute to the digestion of food substances. They act as a powerful decomposer, increasing the diffusion and absorption of nutrients.
- **Thermoregulatory:** In most mammals, water keeps the body temperature constant by removing heat from the body to the skin, producing sweat.
- **Solvent:** Water is the physiological medium that transports nutrients, hormones and metabolites throughout the living organism.

## The states of water.

On Earth, water is found in its three states: liquid, solid and gaseous. The amount of water in each state depends on temperature, pressure and altitude. Most of our so-called blue planet's surface is covered by water, but this is only a very thin layer on the Earth's crust. Most of the water is found in the surface oceans and seas. The rest of the water is distributed in solid form at the poles and glaciers, or in gaseous form in the atmosphere.

- **Liquid:** Almost 98% of the water on the planet is liquid water. This is the most common form of water. In this state, its molecules are flexible and fluid, so its shape changes and adapts.
- **Solid:** 2% of the water on the planet is solid water. It is called ice and is produced when its temperature drops to 0°C.
- **Gaseous:** 0.001% of the water on the planet is gaseous water, also known as vapour. The change to the gaseous state happens at 100°C.

## How did water appear on our planet?.

One of the most fascinating questions in science is how water appeared on our planet. Although there are several theories, none have been definitively proven. It is possible that water comes from different sources, such as comets, asteroids or even the Earth's interior. These theories are not exclusive, and perhaps the Earth's water has a mixed and complex origin. In any case, water is an apparently simple molecule, made up of two elements: one atom of oxygen and two atoms of hydrogen. Two scientists, Lavoisier (1743-1794) and Cavendish (1731-1810), demonstrated that water was made up of these two elements.

## The origin of life.

Water played a key role in the emergence of life on our planet. More than 4 billion years ago, the planet was a hostile place. There were violent volcanic eruptions and rivers of magma raging across the Earth's surface. The atmosphere was poisonous and huge thunderstorms lit up the early skies. But as water accumulated and the first oceans appeared, so did life. The first proteins that would give rise to the huge diversity of living beings we know today originated around volcanic gases.

## The water cycle.

Water is a natural resource that is constantly renewing itself and moving around the planet. This movement is called the water cycle, or hydrological cycle, and it refers to the change in location and physical state of water, depending on environmental conditions. Water can appear in liquid form, such as in rivers and oceans; in gaseous form, such as vapour evaporating from water surfaces; or in solid form, such as ice in glaciers and clouds. The driving force in this cycle is solar energy, which causes water to evaporate and rise into the atmosphere, where it cools and condenses into droplets or crystals that become precipitation. The water cycle is crucial for life on Earth and for the balance of terrestrial ecosystems, and has a powerful influence on our planet's climates.

- **Evaporation:** It occurs when the sun heats the surface of rivers, lakes, ponds, seas and oceans. It also includes transpiration, which is a type of evaporation of water contained in plants.
- **Condensation:** Vapour in the atmosphere cools and condenses into particles that form clouds and haze.
- **Precipitation:** It occurs when water droplets, formed in clouds by condensation, are so heavy that they fall to the Earth's surface and causes precipitation.
- **Infiltration:** When water reaches the Earth's surface it penetrates the ground. Some of it is used by living organisms and some of it passes to the phreatic zone, where it is stored in reservoirs.



## FIELD 2

### Rivers. An oasis on life.

A river is water, usually fresh, that flows across land to a larger body of water, like the sea. Rivers are a necessary element for the vast majority of living beings, which require a supply of fresh water in order to survive. Rivers move, due to gravity, and in doing so produce energy that has been harnessed by humans for hundreds of years. They are also the sculptors of the landscape.

#### Parts of a river.

The spring of a river occurs when water from rain, snowmelt or underground sources comes to the surface and forms a small stream. This course combines with other streams to form a larger and faster flowing watercourse. Along its course, the river decreases in height and speed, and increases in volume due to the addition of other tributaries. Finally, the river reaches the low area, where the gradient is almost zero and the riverbed is very wide and shallow.

Rivers have different courses or stretches depending on the height, slope and erosion of the area they flow through. In the upper course, the river originates in high areas such as mountains or mountain ranges, and has a narrow and deep riverbed that forms a V-shaped valley. In the middle course, the river widens and increases its speed and flow. The water erodes the edges of the riverbed and creates bends called meanders. In the lower course, the river becomes wider and slower, and deposits the sediment it carries on the valley floor. The river may split into several branches and form river islands or deltas before reaching the sea, a lake or another river.

#### River modelling.

As they flow over the Earth's surface, rivers have a huge power to transform the landscape. The kinetic force of water determines the wearing and transport capacity of rivers, as well as the deposition of sediments on the riverbed or floodplains. Some of the geographical features created by the action of rivers include:

- **Meander:** is a sharp bend in the course of the river as its gradient decreases and its sinuosity increases. Erosion is higher on the outer bank and sedimentation is higher on the inner bank, causing the meander to move laterally.
- **River terrace:** is a flat, raised surface created by the erosion of the river over an old valley. It is produced when the river lowers its level and deepens its riverbed, leaving remnants of the old valley on both sides.
- **Delta:** is a fan-shaped accumulation of sediment that appears in the mouth of a river when its flow decreases as it reaches the sea or a lake. Sediments are deposited to create islands and islets separated by branches of the river.
- **Pebble:** a polished, smooth and rounded rock fragment, due to erosion caused by water, wind or ice. These natural agents wear away the edges and surfaces of rocks, making them smoother and rounder.
- **Rock with frost weathering:** water seeping into rock crevices expands as it freezes and exerts a force that can break them. Frost weathering is more common in high mountain or polar climates, with low temperatures and freeze-thaw cycles.
- **Limestone rock:** due to their carbonate-rich composition, limestone rocks are very easily eroded by the action of water, generating vast systems of caves and hollows, creating karst landscapes.

#### The Ebro river. Its source.

The Ebro river is a curious river, as it is born twice. The water of this river first issues from the spring of the river Híjar in the province of Cantabria, at an altitude of 1880 metres above sea level. However, further downstream, the water filters through the subsoil and flows a few kilometres until it emerges, now known as the Ebro, at the Fontibre spring, in the municipality of Hermandad de Campoo, also in Cantabria.

From there, it travels a long way to the Conchas de Haro gorge, where it flows through the rocks. Along the way, it receives the waters of several tributaries, such as the Izarilla, the Rudrón, the Oca, the Oroncillo, the Nela, the Jerea, the Omecillo, the Bayas and the Zadorra.

These first stretches were populated by shepherding societies more than 5,000 years ago, as evidenced by the megalithic complex of Los Lagos. The water of the Ebro river has been used to grind cereal in mills and fulling mills, to thicken wool and, more recently, to obtain electricity.

### **The giant became stronger.**

The Ebro river leaves Cantabria and enters Palencia and Burgos, where it shapes the landscapes that make up the Hoces del Alto and Rudrón Natural Park, a place created by the karstic modelling of the water. The river becomes wider as it receives the contribution of several tributaries that make it a powerful and fast-flowing river. The area, with its high rainfall, has created a labyrinth of unique forms. These first stretches were populated by shepherding societies more than 5,000 years ago, as evidenced by the megalithic complex of Los Lagos. The water of the Ebro river has been used to grind cereal in mills and fulling mills, to thicken wool and, more recently, to obtain electricity. The Hoces del Ebro are the most famous. The cliffs of Los Camellos, also called El Castillo, are a symbol of the place. Just like the Orbaneja del Castillo waterfall, which cascades between the houses of the village.

More peaceful, Hoces del Rudrón offer a quiet walk along a track that runs under its high rocks inhabited by thousands of vultures. At the top, on the road between San Felices and Sargentos, the viewpoint of the Rudrón offers a great lesson in geology and nature. Although the Ebro river is the main architect of the varied landscape of the region, creating a huge number of valleys, gorges, ravines and beautiful waterfalls, human action has also influenced the changes in this area, with dolmens, hermitages, manor houses, towers, Romanesque churches and charming villages.

### **The middle course.**

The middle area of the Ebro is characterised by the presence of wide plains or plateaus, known as muelas, which contrast with the banks of the river and the valleys of its tributaries. These landscapes have been deeply modified by human action, which has eliminated the natural vegetation and introduced various farming systems. The Ebro river has a winding course, with several meanders that generate bends and turns. The river bank is an area of wonderful landscapes, where the water creates a green and fertile environment, very different from the bare and eroded mountains of reddish, brown and ochre tones that surround it.

In this stretch of the river there is a wide variety of crops and land uses, from dry cereal, almond, vine and olive groves to irrigated areas for fodder and vegetables. These agricultural areas profit from the floodwaters that have brought soil and small pebbles from the higher areas. However, the same action can lead to flash floods which represent a risk for the inhabitants of the area, who have had to adapt to this situation over time. Although their frequency and magnitude have changed over time.

### **The Ebro river reaches La Rioja...**

The Ebro river has served as an integrating element between the plains and the mountain areas, unifying La Rioja. Its tributaries in La Rioja are very important in the configuration and identification of the territory, which is structured around seven valleys, which run practically parallel from west to east, formed by the rivers Oja, Tirón, Najerilla, Iregua, Leza, Cidacos and Alhama.

A large part of the richness of the landscapes of La Rioja is due to the variability of its natural conditions. In La Rioja, Atlantic, continental and Mediterranean climatic influences converge and are combined and nuanced in a geography marked by the contrast between the mountainous relief (the Iberian System and the Basque Mountains) and the plains (the valley in the Ebro Depression). As we move eastwards through these valleys, the climate becomes drier and drier.

### **...and crosses Logroño.**

Logroño is crossed by the Ebro river, which gives it a unique personality. To connect the two banks of the river, there are several bridges that allow pedestrians and vehicles to cross: the Stone Bridge and the Iron Bridge, which connect the Old Town with the left bank; the Circunvalación Bridge, which is located at the east of the city; and the Sagasta Bridge, also known as the Fourth Bridge, which is located in the western part of the city. The truth is that the river shines with incomparable splendour as it crosses this city and forms part of its history. In fact, it is the protagonist of its emblem.

### **The decline of a giant.**

After crossing La Rioja, the Ebro river comes into Navarra and Aragón, where it gets wider and meeky. The final part of the course of the Ebro river includes the area from the confluence with the Martín river to its mouth at the Mediterranean Sea, where the river flows mainly from north to south. This area has an extension of more than 3,800 square kilometres and a flow of around 215 million cubic metres per year, which is distributed in Catalonia, mainly in Tarragona and, in smaller quantities, in Lleida. This impressive flow is the main factor responsible for forming the third largest delta in the western Mediterranean, in which all the eroded materials that have been transported here are deposited.

## The ecological pyramid of the Ebro river.

Rivers are ecosystems with a complex trophic chain in which each link depends on the existence of the others in order to exist and maintain equilibrium. In the following pyramid you can see in order the different strata of the trophic chain in a river such as the Ebro.

- At the upper levels of the trophic pyramid, we find carnivorous mammals such as otters and some bats, and birds such as herons and kingfishers, which eat insects and fish.
- Predators such as fish and amphibians eat directly the micro-organisms, algae and larvae at the base of this trophic pyramid. In turn, they are the prey of higher carnivores.
- At the base of the trophic pyramid, as primary producers, we find aquatic plants, algae that produce oxygen for the water and are food for a large number of species. Microorganisms, phytoplankton and insect larvae are the basis of the diet for dozens of animals in the ecosystem.

The last stretch of the Ebro is characterised by the impressive mouth that forms the Ebro Delta Natural Park. Here we can distinguish three main ecosystems: the mobile dunes, the brackish areas and the riverside forest. The mobile dunes are covered by plants adapted to the sand, such as the cat's claw and the marram grass, and by lizards such as the Hispanic lizard and the large psammodromus. The brackish areas have vegetation typical of these soils, such as salicornia, and are home to aquatic species such as frogs, common toads and eels. The riverside forest is made up of white poplars and tarays, and there are a great variety of aquatic birds such as shovelers, night herons, herons and little bitterns. Mammals such as foxes, water rats, mice, shrews and bats can also be seen.

In the middle stretch, the Ebro flows through a transition zone between the Atlantic and Mediterranean climates, with a more varied vegetation that includes Portuguese oak, holm oak and Spanish oak. The riverside forests are extremely rich and shelter species such as the otter, the European mink and the kingfisher. The water is also home to Graells, endemic to the Ebro, and crayfish. The meadows and hedgerows are the habitat of badgers, hedgehogs, wildcats and birds of prey such as the Bonelli's eagle, the Egyptian vulture, the eagle owl and the red-billed chough. The crags and caves are a refuge for bats and birds.

In the first stretch, the Ebro flows through high mountain areas, with alpine pastures, scrubland and temperate deciduous forests. Among the aquatic fauna, the native trout and amphibians such as newts and salamanders stand out. We can also find mammals such as the Iberian desman, the Cabrera shrew, the white-footed shrew and the bear.

## Its landscapes, fauna and flora.

The river Ebro is one of the most important rivers in Spain, as it flows over 930 kilometres from its source to its mouth at the Mediterranean Sea. Along its course, the Ebro creates diverse ecosystems that are home to a rich biodiversity of flora and fauna species, many of which are endemic or endangered. These ecosystems include riverside forests, wetlands, steppes, lagoons and coastal wetlands, among others. We can get an idea of this richness due to the existence of more than 500 natural spaces with some type of protection, such as Reserves, Special Protection Areas for Birds, Sites of Community Importance and Natural Parks.

## Invasive exotic species.

25% of the water in the Ebro basin has been colonised by exotic species of flora and fauna. An invasive exotic species is one that settles in a habitat that is not its own, whether naturally, accidentally or intentionally, and manages to adapt, generating an alteration in that habitat. A sport boat that is not properly cleaned and disinfected can inadvertently transport an exotic or invasive species from one place to another, altering the ecological balance and causing irreversible damage to native ecosystems.

Forty-three of the 173 invasive species included in the catalogue of the Ministry for Ecological Transition and the Demographic Challenge have been found in the Ebro river. Some of the most important cases are the zebra mussel, the catfish and the American red crab. And how have these species reached the Ebro? The main reason is sport fishing and navigation, trade, accidents and imprudence. However, invasive flora has usually been introduced for ornamental reasons.

## Vegetation in the Ebro depression.

The Ebro river flows through La Rioja during its middle stretch, when plateaus and riverbanks predominate. Linked to these environments, we find a very varied, adapted and changing vegetation, which generates ecosystems of great biodiversity.

- On the banks of the Ebro river there is a lush forest of poplars, black poplars, brambles, honeysuckles and willows.
- Thicket-islands: islands in the river bed that are mainly occupied by vegetation.
- On the plateaus and on the slopes of the hillsides we find copses of Aleppo pines, kermes oaks, holm oaks and savins.



## FIELD 3

### Rivers and humans.

Humans and water have been closely linked since ancient times: the Tigris and Euphrates in Mesopotamia, the Nile in Egypt and the Indus in India. The relationship between humans and water over the centuries is deeply related in the culture, history and life of our territories. However, just as rivers leave a deep imprint on us, human management of these waters also has a great impact on the morphology, flow, ecosystems and quality of river water.

#### Water and energy.

Hydropower is one of the oldest ways of harnessing nature to improve people's living conditions. Since ancient times, different devices using moving water have been used to perform tasks such as grinding grain, irrigating crops or forging metals. These devices, such as waterwheels, mills or hydraulic hammers, used very simple but very efficient mechanisms. With wheels, turbines and simple pulleys, they converted the flow of water from the rivers into power for their daily work. Around 1902, there were 22 electric and mixed (steam and hydraulic) power stations in La Rioja, including the "Electra de Haro" (1890), "Central el Sotillo" Sociedad Logroñesa de alumbrado eléctrico (1891) or "La Electra Recajo" (1896), which was located in Navarre, but whose energy illuminated the city of Logroño, barely 10 km away. Later in the 20th century was built another power plant in Logroño called "El Cortijo", by the "Salto del Cortijo" anonymous society.

#### Trades linked to the Ebro river.

##### Millers and mills.

To transform wheat into flour, the water of the Ebro was used to move huge stones used to grind the grain. The operation was very simple. A wheel with blades, moved by the force of the water, turns a stone wheel that rotates on top of another, the grain falls between the two, and is transformed into flour by friction. With the introduction of electricity, these traditional mills gradually passed into oblivion. Of the 325 mills that were registered in La Rioja in 1752, today only four are still working, and hundreds of ruins are scattered throughout La Rioja.

##### Laundress.

Washing clothes at home has always been one of the main domestic concerns. This work depended on hundreds of women who, every day, gathered in public washing places or on the banks of the river Ebro to wash the clothes by hand.

Crockery and household utensils were also cleaned in the Ebro, when very few houses had the luxury of running water. There are graphic documents that show women washing clothes in the Ebro until the 1950's. In the Ebro, it was not only clothes that were washed. For hundreds of years, sheep's wool was also washed by hand to clean it so that it could be used as stuffing for mattresses.

##### Boat owners.

All the peoples who have lived on the banks of the Ebro have tried to cross the largest river in the Iberian Peninsula. To do so, they built bridges or used what are known as crossing boats. Bridges are expensive constructions, so only the most important cities such as Logroño or Zaragoza had this luxury. The rest of the towns had to cross the two banks using platforms or mobile boats. In its heyday, there were more than 300 boats at different points along the Ebro. In La Rioja, there were only bridges at Logroño, San Vicente de la Sonsierra, Haro and Assa, that is why boats such as the ciego became so important for the passage of people, animals and goods. Nowadays only a few examples remain for recreational use.

### **Pasti's old boats.**

People used to have a walk by the Ebro river, admiring the views and feeling the fresh breeze when the good weather allowed it. Pasti's boats was a fantastic way to have fun and make friends among the young people and couples used to have romantic boat trips too. Pasti's boats became a part of Logroño's culture from 1934 to 1990 becoming a fond memory .

### **Purification.**

Water pollution is a change in the nature of water, making it unfit for life or consumption. In order to solve this problem, there are a number of wastewater treatment plants whose function is to treat wastewater.

The Logroño WWTP is located in Logroño. This plant, located on the left bank of the Ebro river, receives wastewater from Logroño and from towns such as Iregua, Lardero, Villamediana, Alberite, Albelda and Nalda, and can treat the wastewater of 466,560 inhabitants. The treatment system used by this plant is that of activated sludge and ultraviolet rays for disinfection. Part of the treated water is discharged back into the Ebro river, and another part is used in the facilities. The resulting sludge and silt are used in agriculture and the gas obtained feeds two motor-generators that produce part of the electricity consumed by the plant.

### **Pollution.**

Rivers are under increasing human pressure affecting their quality and health. Among the main factors of pollution in rivers are discharges of chemical substances, urban and industrial waste, pathogenic micro-organisms, heavy metals, faecal water, plastics and other waste. The Ebro river, the largest in the Iberian Peninsula, is not free of these problems, especially mercury pollution and the waste generated by agricultural and livestock farming activities, such as animal liquid manure, pesticides and fertilisers, which infiltrate the river due to the action of rainwater.

### **Ebro Hydrographic Confederation.**

The Ebro Hydrographic Confederation has been managing and looking after the water of the river for 95 years. In general, the objectives of the EHC are caring for and preserving the great biological heritage of the Ebro basin, fighting against invasive species, water deterioration, starting up treatment plants, modernising irrigation, improving supply systems for water supply, new reservoirs and improving efficiency in water use, reducing diffuse pollution from agricultural sources, intensifying research and development in water management, investing in research and development to create jobs.

### **The Ebro Hydrographic Confederation is committed to five areas of work:**

- 1 Knowledge of the Ebro basin, divulging and raising awareness.
- 2 Greater efficiency in water management.
- 3 Reducing pollution.
- 4 Understanding rivers as ecosystems with rich biodiversity.
- 5 Guarantee supply, irrigation and energy.



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