

## What is the Earth?

*It is our planet and the only inhabited. It is in the Ecosphere, a space that surrounds the Sun and has the necessary conditions so that there is life.*



The Earth is the largest of the Rocky planets. So that you can retain a layer of gases, the atmosphere, which disperses the light and absorbs heat. Day prevents that the Earth is too hot, and night, which is cool.



Seven of every ten parts of the Earth's surface are covered with water. The seas and oceans also help to regulate the temperature. The water that evaporates form clouds and fall as rain or snow, forming rivers and lakes. At the Poles, who receive little solar energy, water freezes and forms the polar icecaps. The South is larger and concentrates the largest reserve of fresh water.

The Earth is not a perfect sphere, but it has pear-shaped. Calculations based on perturbations in the orbits of artificial satellites reveal that ecuador is thickened 21 km; the North Pole is 10 m long and the South Pole is sunk about 31 meters.

Basic data	The Earth	Order
Size: radio Equatorial	6.378 km.	5th
Distance to Sun media	149.600.000 km.	3rd.

Day: period of rotation about the axis	23.93 hours	5th.
Year: orbit around the Sun	365,256 days	3rd.
Mean surface temperature	15 ° C	7th.
Surface gravity at the Equator	9.78 m/s <sup>2</sup>	5th.

### Formation of the Sun and planets

According to scientists, some 15,000 million years ago there was a huge explosion, the Big Bang. Unleashed force pushed the matter, extremely dense, in all directions, at a speed close to that of light. Over time, and to measure that moved away from the Center and reduced his speed, masses of this area were closer to later, form the galaxies.



We don't know what happened in the place now occupied during the first 10 billion years, if there were other Suns, other planets, empty space or, simply, nothing. Towards the middle of this period, or perhaps earlier, he should form a Galaxy.

Near the limit of this galaxy, which today we call milky way a portion of matter is condensed in a denser cloud some 5,000 million years ago. This happened in many parts, but this is particularly interested us. The gravitational forces did most of this mass to form a central sphere, then his side-stepping around, turning much smaller masses.

The central mass became an incandescent sphere, one star, our Sun. Small is also condensed while they described orbits around the Sun, forming the planets and some satellites. Among them, one was a fair distance and size to have water in liquid state and retain a significant gaseous envelope. Naturally, this planet is the Earth.

## Formation of the Earth

The Earth was formed about 4650 million years, along with the Solar System. Although most ancient stones of the earth do not have more than 4 billion years, meteorites, which geologically correspond to the core of the Earth, give dates of about 4,500 million years, and crystallization of the nucleus and the precursor bodies of meteorites, believed that it occurred at the same time, about 150 million years after forming the Earth and the Solar System.

After condense from the cosmic dust and gas by gravitational attraction, the land was almost homogeneous and quite cold. But the continued contraction of materials and radioactivity of some of the heaviest elements made it gets.

Later, he began to melt under the influence of gravity, producing lighter moving upwards to form the crust and mantle and the heavier elements, mostly iron and nickel, falling toward the center of the Earth to form the core differentiation between the crust, mantle and core, with silicates.

**At the same time, the eruption of numerous volcanoes, caused vapors and gases, volatile and light output. Some were trapped by the Earth's gravity and formed the primitive atmosphere, while the condensed water vapor formed the early oceans. Formation of the Earth**

The land we know today has a very different aspect of which had shortly after his birth, Lee 4,500 million years ago. It was a mass of conglomerate rocks whose interior was heated and fused around the globe. Over time the bark was dried and became solid. In the lower parts built up water while that, above the Earth's crust, formed a layer of gases, the atmosphere.

Water, land and air began to inteactuar quite violently as that, meanwhile, the lava flowed in abundance by multiple cracks of the bark, which has enriched and transformed thanks to all this activity.

## Solid, liquid and gaseous



After an initial period in which the Earth was an incandescent mass, the outer layers began to solidify, but the heat from the inside melted them again. Finally, the temperature fell enough to allow the formation of a stable crust. At first it had no atmosphere, and received many impacts of meteorites. Volcanic activity was intense, what motivated that masses of lava out abroad and increase the thickness of the cortex, to cool and solidify.

This activity of the volcanoes has generated a large amount of gas that ended up forming a layer over the crust. Its composition was very different from the current one, but was the first protective layer and allowed the emergence of liquid water. Some authors call it "Atmosphere I".

In the eruptions, from oxygen and hydrogen generated water vapour, which is condensed, giving rise to the first rains to climb through the atmosphere. At the end of the time, with the cooler crust, water from rainfall could keep liquid in the deeper areas of the cortex, forming seas and oceans, i.e., the hydrosphere.

## Geological history of Earth

*Since its inception to the present day, the Earth has undergone many changes. Early, since the beginning of the solidification of the incandescent mass until the appearance of a permanent crust, left no evidence of their passage, since rocks were generated, are returned to melt, or were simply "swallowed" by a new eruption.*

These early stages are still a mystery to science. In addition, the passage of time, the erosion, the various changes have... been erasing signals, making it the oldest is the period that is intended to analyze, major difficulties are going to find. The Earth, lest we forget, is still evolving and changing.

## Eons, Eras, periods and geological times



Eon is the largest geologic time unit. It is divided in different geological eras. Each era includes some periods, divided into epochs.

The more recent is a geological period, more data can have and, consequently, it is necessary to divide it into smaller groups.

Obtained records of the geology of the land of four major classes of rock, each produced in a different kind of cortical activity:

- 1.- **erosion and transport** enabling further sedimentation resulting compaction and lotification, successive layers of sedimentary rocks.
2. **expulsion**, from deep magma chambers, of molten rock that cools the surface of the Earth's crust, giving rise to volcanic rocks.
3. **geological structures** formed in pre-existing rocks that underwent deformations.
- 4.- **plutonic or magmatic activity** in the interior of the Earth.

Age (years)	Eon	Era	Period	Time
4,500,000,000	Precambrian	Azoica		
3.800.000.000		Archaic		
2.500.000.000		Proterozoic		
560.000.000	Phanerozoic	Paleozoic	Cambrian	
510.000.000			Ordovician	
438.000.000			Silurian	
408.000.000			Devonian	
360,000,000			Carboniferous	
286.000.000			Permian	

248.000.000		Mesozoic	Triassic	
213.000.000			Jurassic	
144.000.000			Cretaceous	
65,000,000		Cenozoic	Tertiary	Paleocene
56.500.000				Eocene
35.400.000				Oligocene
24,000,000				Miocene
5.200.000				Pliocene
1,600,000			Quaternary	Pleistocene
10,000				Holocene

### Dating, dates from the past

The divisions of the geologic time scale resulting are based, firstly, on the variations of the fossil forms found in the successive strata. However, the first 4,000 to 600 million years of the Earth's crust are registered in rocks that do not contain almost no fossil, i.e. There are only fossil of the past 600 million years.

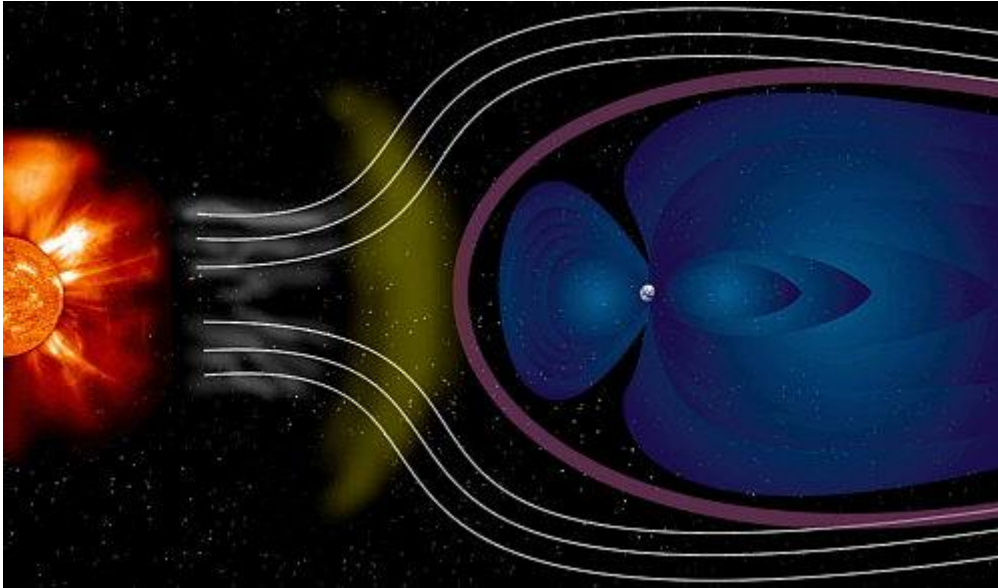


For this reason, the scientists divided the extensive existence of Earth into two large divisions of time: the Precambrian (which includes the archaic and proterozoic Eons) and the Phanerozoic, which starts in the Cambrian and goes up to the current time.

The discovery of radioactivity allowed 20th century geologists to devise new dating methods, and can thus assign absolute ages, in millions of years, divisions of the time scale.

## Magnetism of the Earth

The terrestrial magnetism means that the Earth behaves like a huge magnet. The English physicist William Gilbert was the first who pointed out, in 1600, although the effects of terrestrial magnetism had been used much earlier in primitive compasses.

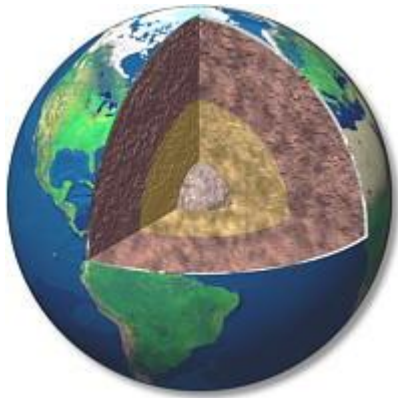


The Earth is surrounded by a strong magnetic field, as if the planet had a huge magnet inside the South Pole is near the geographic North Pole and vice versa. By parallelism with the geographical poles, terrestrial magnetic poles are called magnetic north pole and South magnetic pole, although his real magnetism is opposite which indicate their names.

The magnetic north pole stands today near the West coast of Bathurst Island in the Northwest Territories in Canada. The magnetic South Pole is on the edge of the Antarctic continent in Adélie.

The positions of the magnetic poles are not constant and show notable changes from year to year. Variations in the Earth's magnetic field include the change in the direction of the field caused by the displacement of the poles. This is a periodic variation that repeats every 960 years. There is also a smaller annual variation.

## Structure of the Earth



The crust of the Earth is formed by plates floating on the mantle, a layer of hot and sticky materials that, sometimes, go by a crack forming volcanoes.

The density and pressure increases toward the center of the Earth. At the core are the heavier materials, metals. The heat keeps them in the liquid state with strong movements. The inner core is solid.

The internal forces of the Earth are noticeable on the outside. Fast movements cause earthquakes. The slow form folds, as those who created the mountains.

Quick rotary movement and the metal core generates a magnetic field which, along with the atmosphere protects us from harmful radiation from the Sun and other stars.

### Layers of the Earth

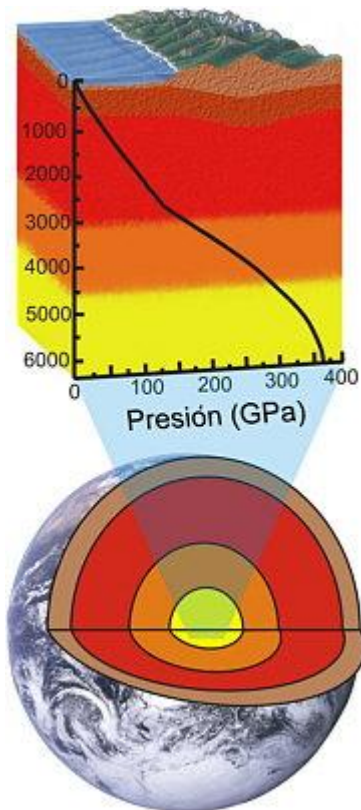
From the outside to the inside we can divide the Earth into five parts:

**Atmosphere:** Is the indoor gas that surrounds the solid body of the planet. It has a thickness of more than 1,100 km, although half of its mass is concentrated in the lower 5.6 km.

**Hydrosphere:** Is mainly composed of oceans, but in the strict sense includes all the world aquatic surfaces, as inland seas, lakes, rivers and groundwater. The average depth of the oceans is 3.794 m, more than five times the average height of the continents.

**Lithosphere:** Composed primarily by the Earth's crust, extends up to 100 km depth. The rocks of the lithosphere has an average density of 2.7 times the water and are made up almost entirely of 11 elements, which together form the 99.5% of its mass. The most abundant is the oxygen, followed by Silicon, aluminum, iron, calcium,





sodium, potassium, magnesium, titanium, hydrogen and phosphorus. In addition, other 11 elements appear in lesser amounts of 0.1: carbon, manganese, sulfur, barium, chlorine, chromium, fluorine, zirconium, nickel, strontium and vanadium. The elements are present in the lithosphere almost entirely in the form of compounds than in its free State.

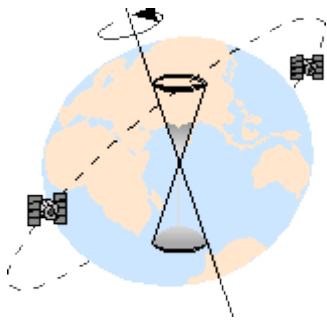
The lithosphere comprises two layers, the crust and the upper mantle, which are divided into twelve rigid tectonic plates. The upper mantle is separated from the cortex by a seismic discontinuity, the discontinuity of Mohorovicic and lower mantle through a weak area known as the asthenosphere. Plastic and partially molten rocks in the asthenosphere, from 100 km thick, allow the continents move by the Earth's surface and the oceans open and close.

**Cloak:** Extends from the base of the crust to a depth of about 2,900 km. except in the area known as the asthenosphere, is solid and its density, which increases with depth, ranging from 3.3 to 6. The upper mantle is composed of iron and silicate of magnesium olivine and the bottom of a mixture of oxides of magnesium, iron and Silicon.

**Core:** Has an outer layer of some 2,225 km in thickness with an average of 10 Kg relative density per cubic meter. This layer is probably rigid, its outer surface has depressions and peaks. On the contrary, the inner core, whose RADIUS is about 1,275 km, is solid. Both layers of the nucleus are composed of iron with a small percentage of nickel and other elements. The temperatures of the inner core can reach the 6,650 °C and its average density is 13. Your pressure (measured in GigaPascal, GPa) is million times the surface pressure.

The inner core continuously radiates a heat to the outside, through the various concentric layers that form the solid portion of the planet. The source of this heat is the energy released by the decay of uranium and other radioactive elements. Within the mantle convection currents move most of the heat energy from the Earth to the surface.

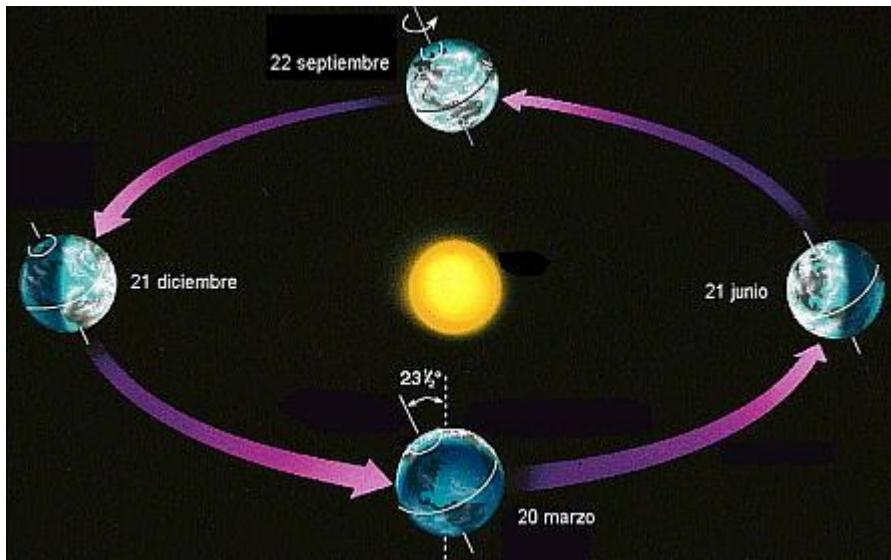
### Movements of the Earth



The Earth's orbit is elliptical: there are moments in which is closer to the Sun and others that is farther away. In addition, the axis of rotation of the planet is slightly inclined to the plane of the orbit. At the end of the year, it seems that the sun rises and falls.

The apparent path of the Sun is called ecliptic, and passes over the equator of the Earth at the beginning of the spring and autumn. These points are the equinoxes. In them day and night last equally. The farthest from the Equator points of the ecliptic are called solstices, and point to the beginning of the winter and summer.

Near the solstices, the Sun's rays fall more vertical on one of the two hemispheres and hotter it. It's the summer. Meanwhile, the other hemisphere of the Earth receives more inclined rays, they cross more piece of atmosphere and cooled before reaching land. It is the winter.



Like the Solar system, the Earth moves through space at about 20.1 km/s or 72,360 km/h towards the constellation of Hercules. However, the milky way as a whole, is moving toward the constellation Leo at 600 km/s.

**Translation:** The Earth and the Moon revolve together in an elliptical orbit around the Sun. The eccentricity of the orbit is small, so much that the orbit is almost a circle. The approximate circumference of the orbit of the Earth is 938.900.000 km and our planet travels along it at a rate of about 106,000 km/h.

**Rotation:** The earth revolves on its axis once every 23 hours, 56 minutes and 4.1 seconds. Therefore, a point from the Equator rotates to little more than 1,600 km/h and a 45 ° altitude N Earth point, rotates 1.073 km/h.

Other movements: in addition to these primary movements, there are other components in the total movement of Earth as the precession of the equinoxes and nutation, a periodic variation in the inclination of the axis of the earth caused by the gravitational attraction of the Sun and the moon.

### The Earth's atmosphere

*The outer layer of the Earth is gaseous, composition and density very different layers of solid and liquid below. But it is the area in which life develops, and also has a hugely important in erosion processes which are which have shaped the current landscape.*

The changes produced the atmosphere contribute decisively in the processes of formation and sustenance of living beings and determine the climate.

### Composition of air



Basic gases that make up the atmosphere are: nitrogen (78.084%), oxygen (20.946%), Argon (0.934%) and dioxide of carbon (0.033%). Other gases of interest present in the atmosphere are water vapor, ozone and various oxides.

There are particles of dust in suspension, as for example, inorganic particles, tiny organisms or remains of them and sea salt. Many times these particles can serve as condensation nuclei in the formation of highly polluting mists.

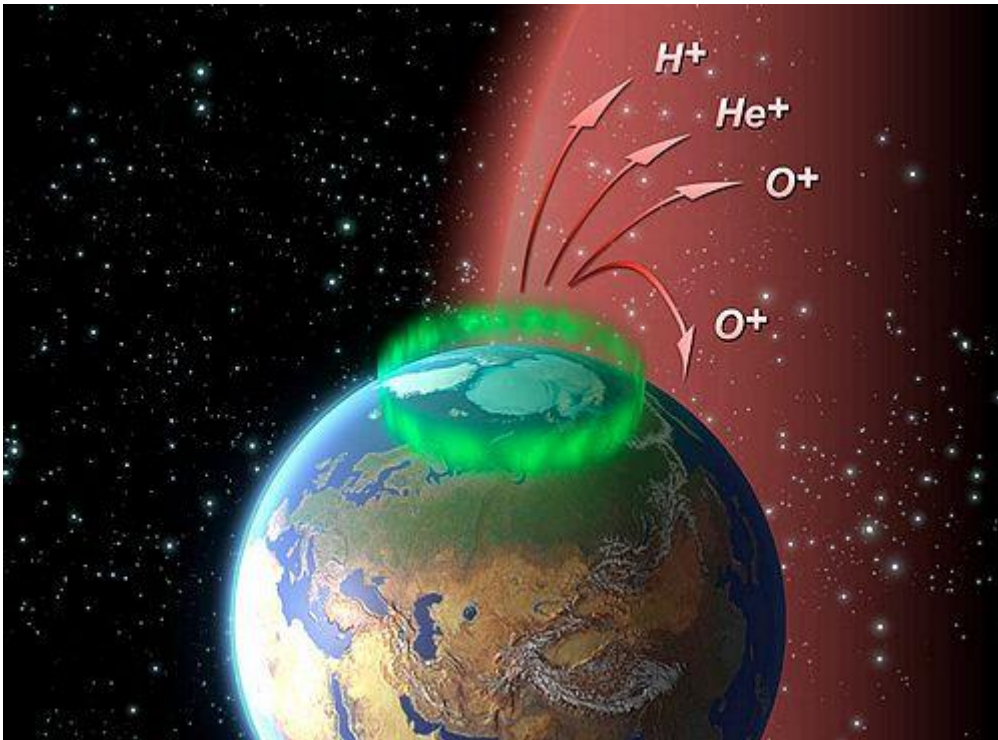
Volcanoes and human activity are responsible for the emission into the atmosphere of different gases and particulate pollutants which have a great influence on climate change and the functioning of ecosystems.

The air is concentrated near the surface, compressed by the attraction of gravity, and as the height increases, the density of the atmosphere decreases rapidly. Half of the total are in the 5.5 kilometers closer to the surface and before the 15 kilometers of height is 95% of all atmospheric matter.

Gas mixture we call air keeps the proportion of its different components almost invariably up to 80 km, although increasingly rarefied (less dense) as we are climbing. At 80 km the composition becomes more variable.

### **Formation of the atmosphere**

The mixture of gases that form the current air has developed over 4.5 billion years. The primordial atmosphere should be composed only of volcanic emanations, i.e. steam from water, carbon dioxide, sulphur dioxide and nitrogen, without trace of oxygen.



To achieve the transformation they have had to develop a series of processes. One of them was condensation. Cooled, most of the volcanic water vapour is condensed, giving rise to the ancient oceans. Also chemical reactions occurred. Part of carbon dioxide should react with the rocks of the Earth's crust to form carbonates, some of which are disolverían in the new oceans.

Later, when evolved primitive life capable of photosynthesis, it began to produce oxygen. About 570 million years ago, the oxygen content of the atmosphere and the oceans increased enough to allow the existence of marine life. Later, about 400 million years ago, the atmosphere contained sufficient oxygen to allow the evolution of terrestrial animals capable of breathing air.

### **What is special our planet?**

Our planet is very peculiar in many ways. It has a concentric structure formed by layers that encompass others and who are in different States. From the inside out, part of the nucleus is located in the molten state surrounded by the geosphere, consisting of different rock layers. The hydrosphere, composed of all the liquid water on the planet is located on them. Above this is to turn the atmosphere consists of different gaseous layers.



In regards to the geosphere, our planet is currently the only one in the Solar system which continues to present an active tectonic plates. Venus and Mars seems to be that once they had it, but currently it has ruled out. This active tectonics is responsible for, among other things, clear surface of the meteorite impact craters, as well as alter the distribution of oceans and seas.

In the classification of the planets, the Earth is considered to be *a rocky planet*, since possessing different layers in its internal structure (core, mantle and crust), unlike the so-called *gaseous planets*. You can visit the chapter about the [Layers of the Earth](#) if you want to know more details about this issue.

Applying the laws of universal gravitation-gravitational acceleration - Newton, that the mass of the Earth is considered  $5.98 \times 10^{24}$  Kg, while possessing a  $5.52 \text{ g/cm}^3$  density. I.e. it is the densest planet in all the of the Solar System. This is because it has abundant quantities of elements such as Si, Ca, Mg, or Fe-heavy or, which are combined together to form stable structures in the Rock-forming minerals.



However, and given that the planet has different layers of different composition, would not be appropriate say that the Rocky or solid part on Earth (Geosphere) has an average of  $5.52 \text{ g/cm}^3$  density, since none of its layers has such value. In fact, from the surface to the planet's core density is increasing, so that the crust has an average density of  $2.7 \text{ g/cm}^3$ , the mantle of  $4 - 6 \text{ gr/cm}^3$  and the inner core of up to  $11 \text{ g/cm}^3$ .

The Earth as Venus or Mars, presents an atmosphere that manages that the surface has an average temperature of  $15^\circ \text{ C}$ , so the water is in its three States (solid, liquid and gas).

If that weren't enough, Earth has a magnetism bipolar character, which is believed due to the movement of pinkcolored loads from the interior of the planet, particularly in the Earth core and very intense.

#### BIBLIOGRAPHY

<http://www.astromia.com/solar/tierra.htm>

<http://www.astromia.com/tierraluna/orientierra.htm>

<http://www.astromia.com/tierraluna/erasgeologicas.htm>

[www.astromia.com/solar/estructierra.htm](http://www.astromia.com/solar/estructierra.htm)

<http://www.astromia.com/solar/estatierra.htm>

<http://www.astromia.com/tierraluna/atmosferatierra.htm>

<http://www.astromia.com/solar/comoestierra.htm>

[This work was done by 2 students in "Colegio San Miguel" highschool:](#)

[Felipe Besozzi](#)

[Francisco Rico](#)