

Amazing Nature



Celedonio García-Pozuelo Ramos

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This book shows us some of nature's lessons and will interest both children and adults, since one can never learn too many interesting and unusual facts

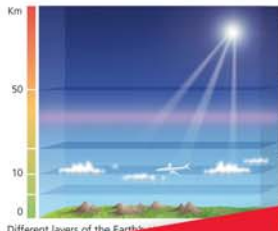
Amazing Nature



A shield over our heads

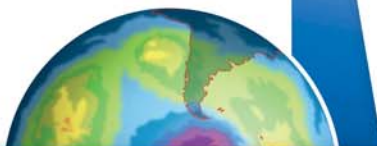
About 19 miles above our heads there is a layer of **ozone** gas that surrounds the entire Earth. This is truly a protecting shield to keep us from the harmful ultraviolet rays of the sun. If there were no barrier to this radiation, the earth's surface would become practically sterilized, that is, without life.

The ozone layer is being destroyed by human action, and the number of persons suffering illnesses caused by excessive ultraviolet rays has already begun to increase. The number of skin cancer and eye cancer cases has increased. This is happening to both people and animals in certain regions of the planet.



UV radiation
Mesosphere
ozone layer
Higher stratosphere
Lower stratosphere
Higher troposphere
Lower troposphere

Different layers of the Earth's



Eyes

The sense of sight is the sense that human beings consider to be the most important.



The eagle's eye is a real telescope and can see a rabbit at over one mile away (two kilometres).

Insect Builders II

Wasp constructions are authentic works of engineering. Geometry, space distribution, and even the choice of materials for their nests confirm that they are complex living beings. But if these homes astonish us, the homes built by social insects such as **ants**, **bees**, or **termites**, may amaze us even more. There are people dreaming about building an edifice 3,300-foot (one-kilometre) tall. Termites are already doing it, if we scale things to their size.

Termite mounds of this size may house up to five million termites.

The enormous tower growing from the soil is a part of these insects' air conditioning system. It is full of galleries going up from the tower base to the upper zones, carrying hot and dirty air, full of CO₂ from the lower parts, where termites live, to the exterior.

Work is perfectly distributed in the termite farm. The queen is in charge of laying the eggs. There are workers in charge of building, of getting food, and of taking care of the queen. There are still others like this soldier, *Heterotermes*, (see below), which protect the colony using their powerful jaws.



The theory of evolution can explain how vertebrate animals...

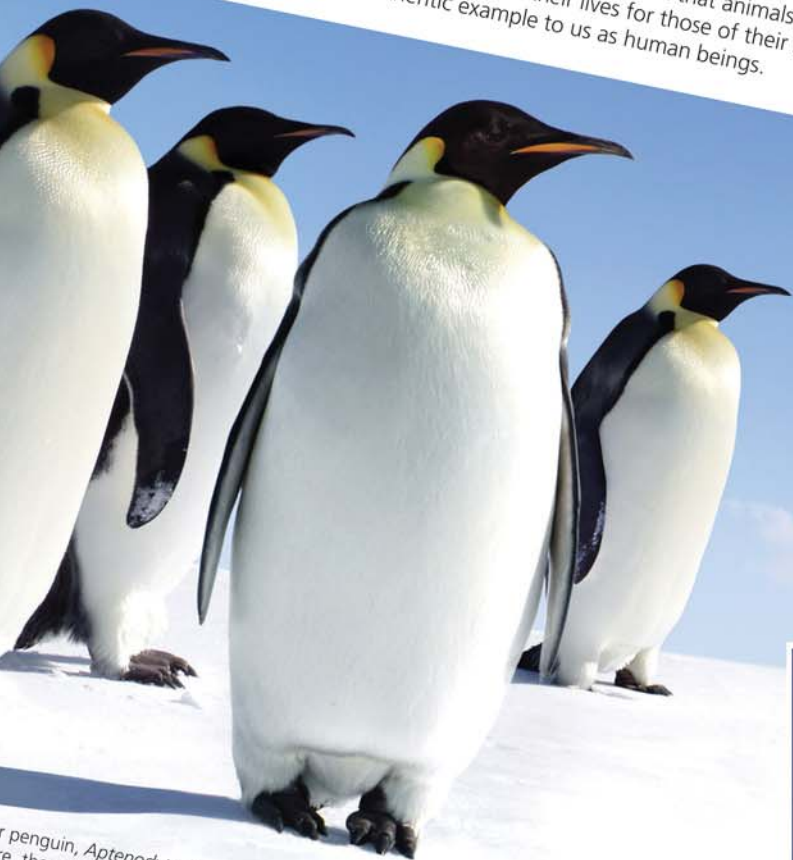


The book is over 80 pages in length, and is full of illustrations, a multitude of charts and truly amazing photography

Amazing Nature

There Is Nothing Like the Family

Caring between members of the same family is frequent in the animal kingdom. When this happens we cannot but compare it with the protecting behaviours of human beings. And we do this because of the amazing fact that animals take care of ill or disadvantaged members or even give their lives for those of their same blood. In this way, they become an authentic example to us as human beings.



King penguin, *Aptenodytes forsteri*, is touching. They travel over 50 miles. The male incubates it while the female lays one. The temperature is minus 40°F (-40°C).

Cold and Hunger

...digrades, and a lot of other relatively simple organisms resist. However, it is amazing that vertebrates such as frogs and ... extremely low temperatures and even dwell in ...

...ce under extreme conditions, life manages ... Reptiles, for example, are masters in the ... can spend years without eating.

...k, the hair follicles ... and there is a camera ... when the hairs providing ... protection and insulation.

Hairs are transparent allowing the light to pass through. And the skin is dark, thus retaining heat.



9

Nature Mathematics

Surely you have already been told that mathematics is very necessary for education, and that it is very useful in many facets of life. It is true. There are more maths we learn, and the more we study nature, the more we find even within the inanimate world. The same thing is repeated over and over again. Shapes, besides, life, for the most part, is a beautiful and signature upon the development. Indeed, it is a mathematical.



Nature has many engineers,
but the Beaver holds a very special
place among them



This is a storehouse of vegetables for the winter. Since the surface is frozen, it can only be accessed from the burrow.



Beavers are an example of a stable family and it is very frequent that siblings born in different years remain together. They all work on group tasks until they become independent. Once the parents are gone, the lodge can continue to be occupied by the offspring. Reproductive couples are generally monogamous and remain together until one of them dies.

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One Living Being and Many Lessons

Any living being may become a source of multiple lessons to those who wish to approach it with curiosity. It would not be the first time that someone utilises an animal or plant to illustrate a lesson. **Fables** are full of animals whose behaviour we believe we know and try to apply to our lives. Stories such as the diligent ant and the lazy grasshopper or the cunning fox are well known.

Other times, movie productions depict animals as main characters in a human story emphasizing animal characteristics. As you can imagine, hyenas do not get to play good characters.

It is very interesting to note that the Bible, very far from such literary examples because of its seriousness, teaches lessons through nature. Fig trees, lilies, sheep, seeds, or plants are some of the protagonists of these lessons.

A main character of this chapter is the **beaver**—just an example of the many lessons this animal can teach. The rest of the chapters will show many other animals and curiosities from nature, living creatures and even the inanimate world. All possess secrets who want to know their hidden wonders.



The Giants that Inhabited the Earth

There are many stories from the past about giants. The Bible also talks about them. It says in Genesis 6:4: "There were giants in the earth." Although the passage refers to human beings whose remains have not been found, we can find many animals with traces back to giant relatives of the past. The beaver is one.

There have been giant vertebrates and invertebrates. Today, there are large insects in that category. One example is the dragonfly. Dragonfly fossils with a 30-inch (75-centimeter) wingspan have been found in strata from the Carboniferous period. They are called Meganeura.

One of the giant crocodiles of the past was the Sarcosuchus imperator. It was nearly 12 yards (11.2 metres) long and 6 feet (1.8 metres) high. It had a head size similar to the Indian gaur, which reaches a length of 6 yards (about 6 metres).

The great white shark, *Carcharodon carcharias*, is the greatest of all predator sharks in the oceans today. But his prehistoric relative, *Carcharodon megalodon*, must have been something awesome... He even fed on whales.

This is the comparison of the actual size of today's beaver, *Castor canadensis*, and that of his giant relative of the past, *Castoroides ohioensis*. This animal would be as big as an average bear, surpassing 2.5 yards (2.3 metres) in length, including the tail, and weighing 550 pounds (250 kilos).

There are very big kangaroos today. But this *Procoptodon* was 8.2 feet (2.5 metres) tall.



Engineers Learning from Nature

Our artificial world often imitates the natural world. Many times engineers seek inspiration from nature.

Flying Machines

Learning to fly has always been one of the most cherished dreams of humankind. A handful of animal types enjoy this privilege: some insects, bats, and fowl. Many of the birds' qualities are only possible thanks to their incredibly complex design. Hollow bones to lighten the weight, extremely powerful muscles, and feathers—these are the gems of design and beauty.

Leonardo
to copy
he was
those
mach



The web fabric is woven in a systematic manner, but when spiders are given drugs, such as marijuana or caffeine, they are only able to produce a set of disorganised threads.

Familiar, yet amazing

We are surrounded by wonders we do not see, or just do not recognise. There are hidden events in our daily world that, once discovered, astonish us.

Velcro was visible to anyone, but until Mr. Mestrel paid attention to it, we could not see beyond those annoying burs that got stuck to our socks. In the microscopic world we can find out that what we believe to be inventions of the superior human mind were conceived before we could even imagine them.

These are but a few examples of things you can find in your surroundings... if you look attentively.



Electricity is present in many physiological processes of living organisms. This is the case of information transmission across neurons, or nerve cells. In certain fish, electric impulses are used for such amazing activities as hunting or "seeing".

Feathers are not only useful for flight but also excellent for serving the body's feather jacket.



The characteristics of this silk are incredible. A 1/2-inch (1-centimetre) thick fabric woven with spider thread would be able to stop a flying Boeing 747 aircraft.

Nature, Our Protector

Nature is the source of all we have. It does not matter if we utilise things from outside the Earth, such as light or heat from the Sun, or what Earth itself produces. We are unable to create or possess anything from nothing. But nature offers even more than this. It provides us with food, water, air to breathe, and

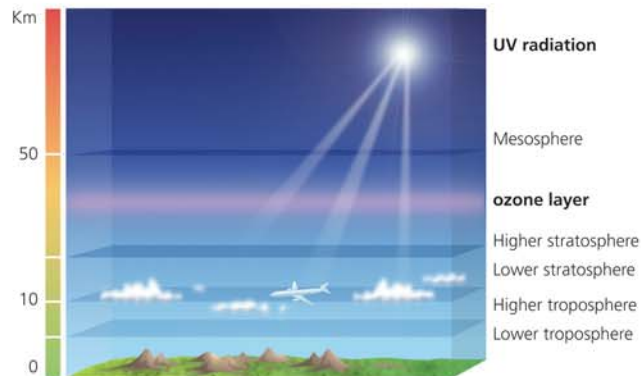
Nature gives us food, water, the air we breathe, materials for sheltering and clothing ourselves, and also protects us from the dangers that can come from nature itself

The Great Marine Wall

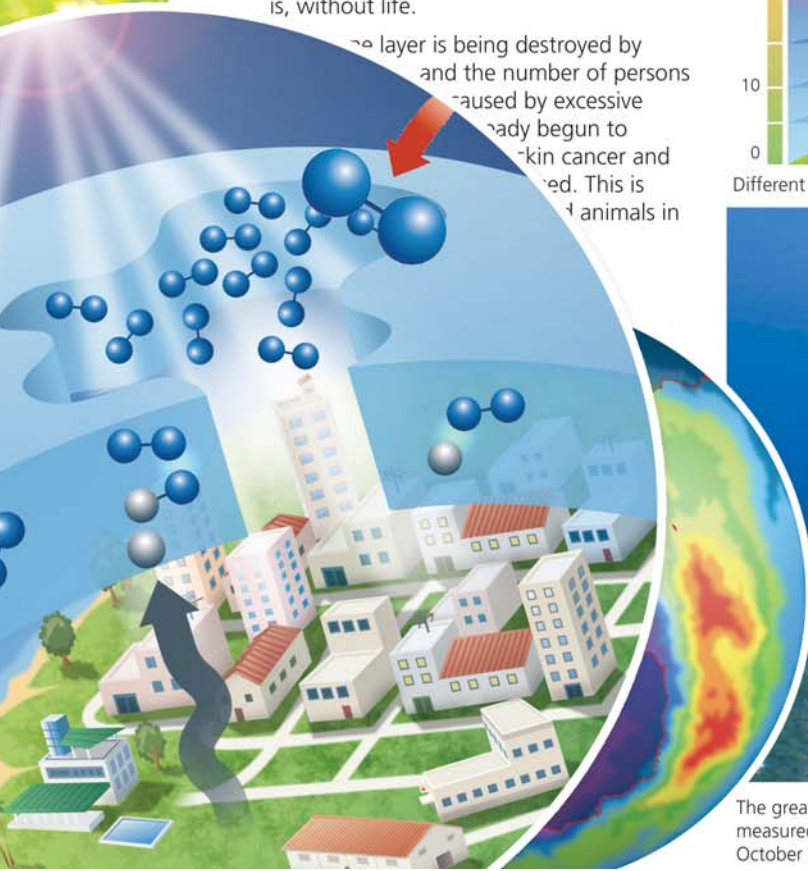
A shield over our heads

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The layer is being destroyed by and the number of persons caused by excessive already begun to skin cancer and ed. This is animals in



Different layers of the Earth's atmosphere.



The greatest hole in the ozone layer was measured and recorded in Antarctica in October 2000.

any are used for human on. The reef capacity is the Australian Great Barrier ces 100 million tons of bonate a year. It would be o build 17 pyramids like ps, in Egypt.

solid barriers to stop the t striking the shores. y, they join forces with the in their protective role.



Supernatural Senses

In the chapter devoted to nature engineers we already talked about how impressive the senses of some animals are. In this chapter you will find details on senses you already know and others that you may not know.

Senses are the means by which living beings know what happens in their surroundings, in the world they inhabit. Feeling hot or cold is something we may consider normal and with no relevance, but there are persons or animals that, due to an

illness, do not have these feelings and they may freeze to death or suffer from burns without realizing it. Other senses help animals or even you to know what are happening inside the body. When you feel thirsty, this means that there is lack of water in your body. The information about this need will reach your brain, which makes you feel the urge to have a refreshing glass of water—the best drink to quench your thirst.

Ask an adult to hold two sharp toothpicks.

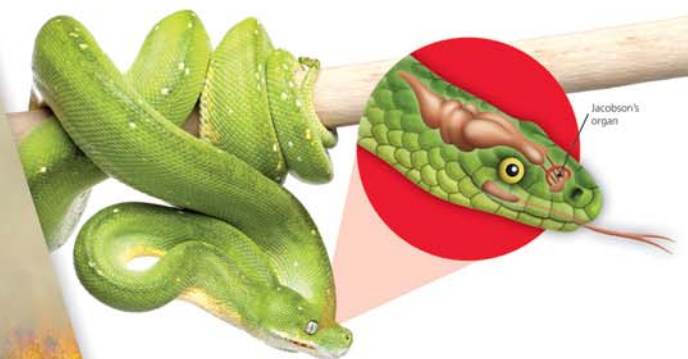


EXPERIMENT WITH THE SENSE OF TOUCH

If you want to know more about your own senses, we invite you to conduct a simple experiment.

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This chapter details some of the senses you already know, and others you may not



Jacobson's organ

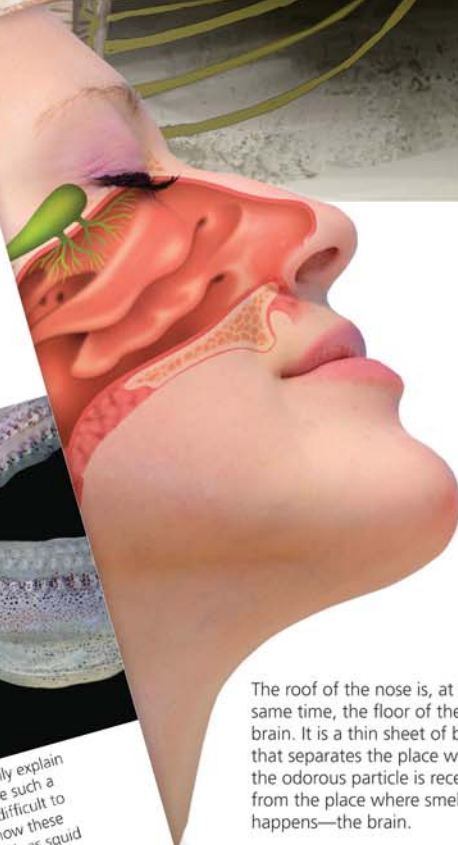


The eagle's eye is a real telescope and can see a rabbit at over one mile away (two kilometres).

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) diameter! It
plate!



The theory of evolution cannot easily explain how vertebrate animals might have such a complex eye. But it is even more difficult to explain, by means of evolution, how these eyes appear again in molluscs, such as squid



The roof of the nose is, at the same time, the floor of the brain. It is a thin sheet of bone that separates the place where the odorous particle is received from the place where smell really happens—the brain.



In this chapter you will find
real wonders created
by very small architects



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5 Homes in Nature

Human beings have managed to erect buildings over 1,600 feet tall (over 500 metres); and the Great Wall of China is long enough to be seen from space. However, the Great Barrier Reef of Australia, an unplanned construction made up of clusters of miniature homes, can be better seen from space than the Great Wall. It is the result of the efforts of millions of small builders.

In the world of mammals, the most complex animals, there are not many great architects, except beavers. However, the majority of birds build nests, some of them authentic engineering wonders. And in the world of insects there are extraordinarily-amazing architects. The brain of these little animals is insignificant next to a human brain; yet in this chapter, you will be able to find **authentic wonders** created by these little architects.

Among birds there are amazing builders, as you will see. They build nests taking advantage of suitable places that they find, and we suggest that you build such a place that can be used as home by a wide variety of small birds.

Simple Homes

Some animals do not have a home and they simply find refuge in the vegetation or in natural formations. Other animals use empty homes abandoned by others. Others may take care in where they search for a home.



Some animals, such as crabs, which are found in the ocean. However, some animals, such as octopuses, will hide in a dead shell.

Some animals, such as octopuses, will hide in a dead shell. They may use a house to protect themselves from predators. Some fishermen take advantage of this to catch them in earthen jars.

Some animals, such as octopuses, will hide in a dead shell. They may use a house to protect themselves from predators. Some fishermen take advantage of this to catch them in earthen jars.



Just like other insects, the *Limnephilus* turns into a winged insect living outside the water and stops building his house at that point.

BUILDING NEST-BOX



1 Make it with good quality wood.



2 You can waterproof it with linseed oil.



3 Place it out of the reach of possible predators such as cats



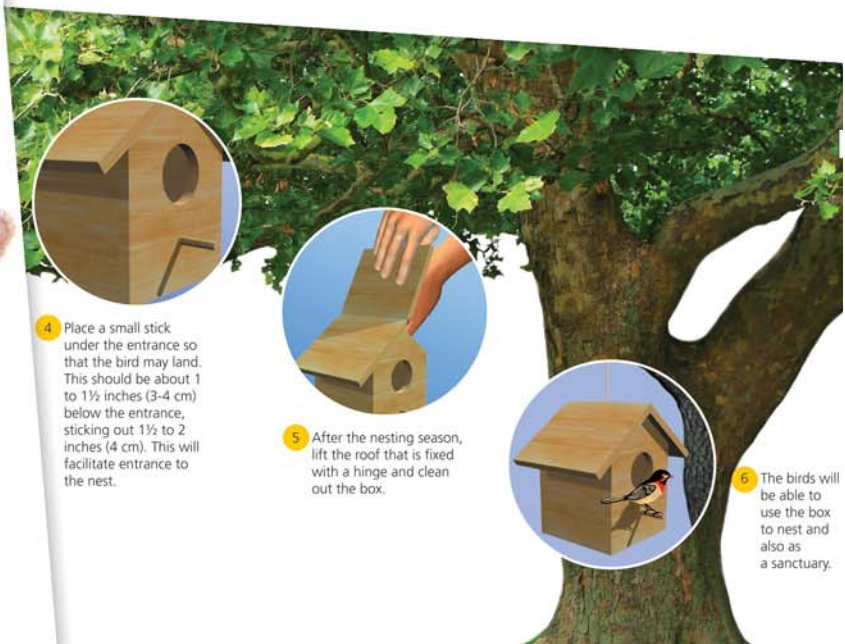
4 Place a small stick under the entrance so that the bird may land. This should be about 1 to 1½ inches (3-4 cm) below the entrance, sticking out 1½ to 2 inches (4 cm). This will facilitate entrance to the nest.



5 After the nesting season, lift the roof that is fixed with a hinge and clean out the box.



6 The birds will be able to use the box to nest and also as a sanctuary.



Vegetables have hidden wonders that are no less marvelous than those of the animal kingdom

6

Secrets of the Green Giants

Plants, stationary as they are in the ground, seem less exciting to us than the fast and beautiful cheetah, and less amazing than the incredible tyrannosaurus. However, hidden in their apparent stillness are mysteries no less wonderful than those in the animal kingdom. The plant world maintains a

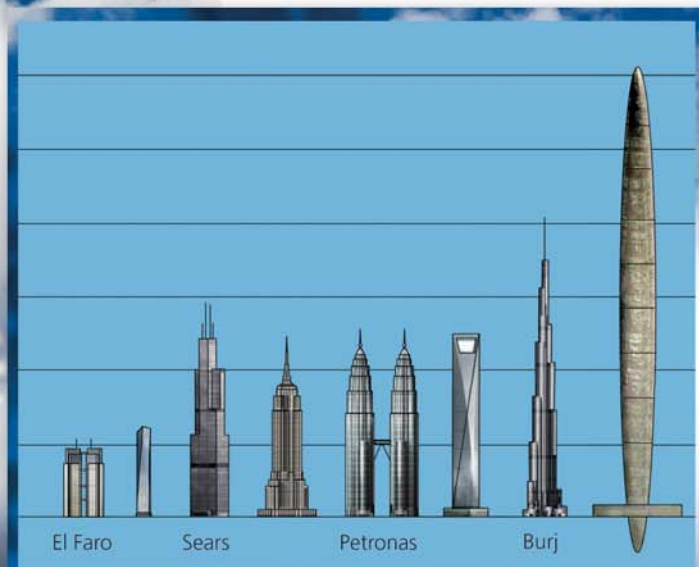
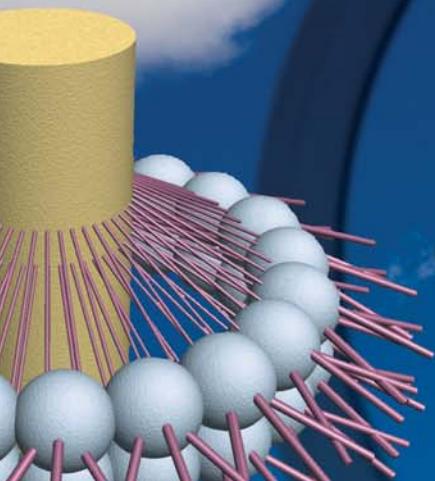
know it. Without plants, nor would the within size.

We, a micro as cypress height became pass through

ges of this book. Now it plants and its application construction problems.

ar examples of biological the way trees grow, have building structures.

the erection of a tower) tall. It has been called n become a reality thanks es naturally grow.



Cooperating

What we informally call the law of the jungle governs the interaction between living beings inhabiting our planet. As they say, eat or get eaten.

The **law of survival** is cruel, violent, and bloody; but it cannot be avoided in the current order of how life progresses on our planet. An ecosystem or ecological system is made up of species that are intimately interrelated and are dependent one upon another. They need each other, and even though their relationship may be one of life or death, when man interferes this balance is altered. In many occasions, this imbalance may cause the collapse of the ecosystem.

Eagles, hawks, or mammals such as the wolf, the fox, the lynx, or the weasel have been considered as dangerous, even odious. As a result, they have been poisoned, trapped, shot and, in many cases, exterminated. But the consequence follows

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Ecosystems are made up of closely related species that depend on each other

There Is Nothing Like the Family

Caring between members of the same family is frequent in the animal kingdom. When this happens we cannot but compare it with the protecting behaviours of human beings. And we do this because of the amazing fact that animals take care of ill or disadvantaged members or even give their lives for those of their same blood. In this way, they become an authentic example to us as human beings.

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They travel over 50 miles (90 kilometres) into the sea to catch and bring food. Males cluster together to make the journey to search



Living things adapt
to truly extreme situations

8

The Limits of Life

Cold and Hunger

Bacteria, tardigrades, and a lot of other relatively simple organisms resist extreme cold; however, it is amazing that vertebrates such as frogs and mammals can survive extremely low temperatures and even dwell in those conditions.

Now, on this topic of endurance under extreme conditions, life manages to resist not only heat or cold. Reptiles, for example, are masters in the art of dodging hunger. They can spend years without eating.

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Polar bears have to live at below freezing temperatures, and in many occasions minus 76°F (-60°C).

Their fur is thick, the hair follicles are hollow, and there is a camera of air between the hairs providing excellent protection and insulation.

Hairs are transparent allowing the light to pass through. And the skin is dark, thus retaining heat.

They can store several hundred pounds of fat. Fat works to insulate and to store energy.

An insect called *Belgica antarctica* lives in Antarctica, on the opposite pole from the polar bear's habitat, but with the same level of cold. Its larvae resist freezing thanks to some cryoprotective dehydrators or anti-freezers made up of sugars. Adults, like that in the drawing, do not resist freezing.

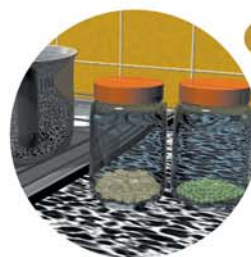
The dromedary is capable of a physiological feat, being able to drink 53 gallons (200 litres) in three minutes. With such an excess of water in the bloodstream, the red blood cells could burst with water, causing death as would happen to human beings. But those cells in this animal have characteristics that allow him to survive being dehydrated with water.

inferior, they help us understand life in all its dimensions. They are not really primitive like

are not exceptions found only rigorous research by scientists. Any our daily living, by stopping and a little, can find daily evidences of ts of life. This can be revealed by a experiment with some incorrectly 'primitive beings.'



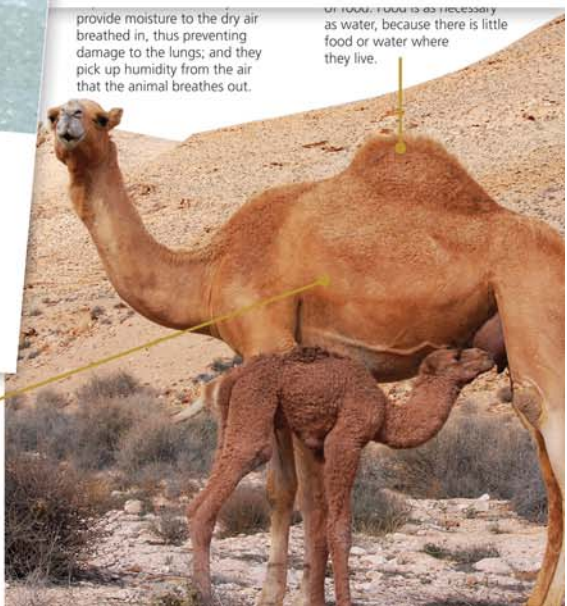
Then, put them into a glass jar. Fill it with water and put the lid on. You may do the same with raw peas: wash them and place them in a glass jar full of water covering them with the lid.



4. Turn off the flame and let them cool down.

provide moisture to the dry air breathed in, thus preventing damage to the lungs; and they pick up humidity from the air that the animal breathes out.

of food, food is as necessary as water, because there is little food or water where they live.



Nature Mathematics

Surely you have already been told that mathematics is very necessary for education, and that it is very useful in many facets of life. It is true. Furthermore, more maths we learn, and the more we study nature, the more use we find. There are **numbers** that are repeated over and over again within living things even within the inanimate world. The same thing happens with certain shapes. Besides, life, for the most part, is formed with a special touch which makes it particularly beautiful. It is as if a mathematician had left his mark and signature upon the developmental stages of animals, plants, and minerals. Indeed, it is a mathematical signature.

There are certain numbers that are repeated over and over again both in living things and the inanimate world

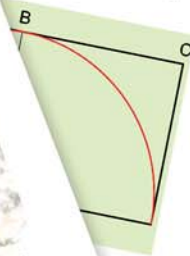


A Number and a Proportion

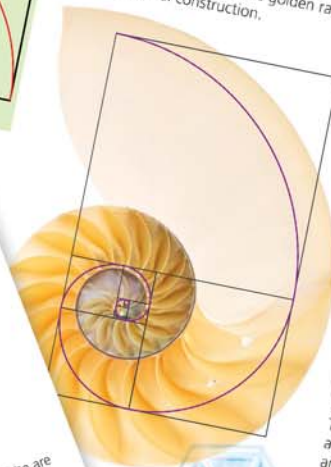
There are special numbers. *Pi*, represented by the Greek letter π , is possibly the best known. Another of those special numbers is *phi*, represented by the Greek letter ϕ . Well, this number *phi* is amazing because it repeatedly appears in some spiral horns of plants, and even in the arrangement of some types of galaxies. This is such an astonishing number that it is called the

golden number. This number appears as a result of a proportion that has been given names such as 'golden section' or 'golden ratio.' Some have dared to define it as 'Divine proportion.' It is no wonder that many scientists, architects, or artists, from Kepler to Dali, have found this number or proportion so fascinating.

If we divide up a line in such a way that the proportion of the AB segment in relation to AB, then the B point divides the line into the 'golden section.' $AB/BC = AC/AB = 1.618...$ This is the golden number with an infinite number of decimals.



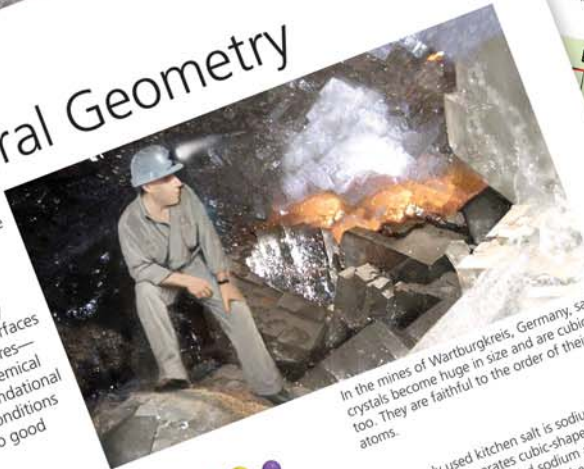
The beauty of many mollusc shells, such as this Nautilus, is connected with the golden ratio. It is a mathematical construction.



The spirals built based on the golden ratio are also found in the cloudy arms of hurricanes and in the spiral of galaxies such as this M51.

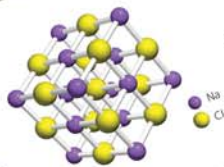
Mineral Geometry

Rocks do not have a fixed shape because they are aggregates of one or several minerals. But minerals generally have fixed shapes. The atoms of which they are made are arranged in such an orderly manner that they form flat surfaces and generate geometric figures—**crystals**. Only when the chemical elements that serve as foundational material are in the best conditions to arrange themselves do good crystals emerge.



In the mines of Wartburgkreis, Germany, salt crystals become huge in size and are cubic too. They are faithful to the order of their atoms.

Commonly used kitchen salt is sodium chloride and generates cubic-shaped crystals. The chloride and sodium atoms arrange themselves always in the same way.



Pyrite is a cubic mineral, generated by iron and sulphur. Some have mistaken it with gold, as both share the colour and shine. This is why it is also called 'Fools Gold.'



Under desert conditions, gypsum may crystallize, shaping into the well-known Desert Roses.



Calcite and aragonite are two different shapes originating from the crystallization of the same chemical compound—calcium carbonate. The carbonate in the aragonite in the picture shows the geometric form of a hexagonal prism.

Wikimedia Commons



This final chapter shows us everything from the invisible atom to the galaxy having dimensions measured in light years

10

A Made-to-Measure Universe

As we journey through nature's mysteries, we realise that there is an infinite path of discovery that science has not yet explored. Each door opened by the scientist's work reveals a new world with many more entryways opening into other worlds. From the invisible atom to the galaxy measured in light-years, nature continues to amaze us with its marvellous complexity and the precision with which it is made.

Isaac Newton, who discovered the law by which all planets and celestial bodies abide, and who is considered by many as the first to ever live, showed his astonishment at the complexity of the universe created by the

A Home in Detail

Earth, the planet we inhabit, is the only home we have, at least for the time being. Trips to other planets are yet to come, and even if they become possible, it will happen as with the Moon: we will need enormous technological complexity to inhabit them because the ideal **living conditions** that we have on our planet are not easy to find elsewhere.

The Earth contains the appropriate conditions for life to develop. Many variables must happen simultaneously if a planet is to be inhabitable. Earth fulfils all of them.

The Earth's atmosphere is thin, but it contains the necessary gases in the right proportion for us to breathe without any problem. In addition, the atmosphere contributes to the regulation of the planet's temperature.

90

The Earth emits a magnetic field that acts as a shield against solar winds and cosmic rays, which are capable of eliminating living beings. Some rays reach the atmosphere, especially the poles, and cause the aurora borealis and the aurora australis to happen.

The Sun is at the right distance from the Earth for it to receive the needed light and heat.

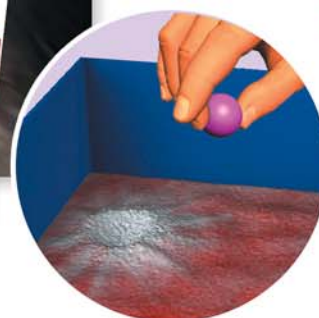
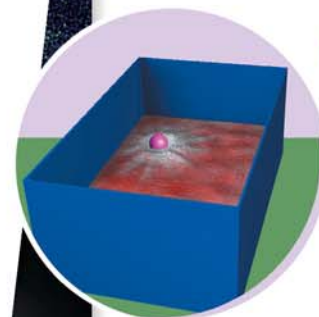
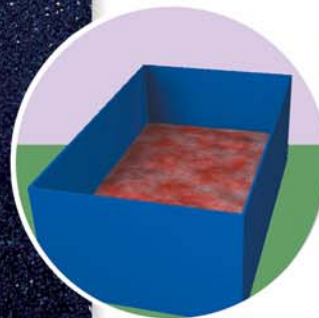
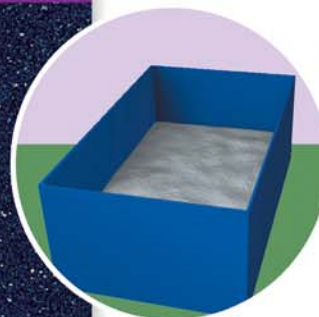
LUNAR EXPERIMENT

1 Get a shoe box, pour flour into it and press it lightly to make it compact.

2 Sprinkle paprika or coal dust over the flour to form a different-coloured layer.

3 Once you have prepared the 'lunar' surface, get a few marbles, or the ball that is inside the computer mouse, or simply little rocks of different weights. These objects will represent meteorites or asteroids.

4 Let them now fall with different amounts of force over your 'lunar' surface, causing different impacts upon the under-layer of flour, which represents the subsoil of the moon. In this way you can test different impact conditions. You will see how the resulting craters are similar to the shapes found in nature.



Nature continues to amaze us with its marvelous complexities and meticulous construction

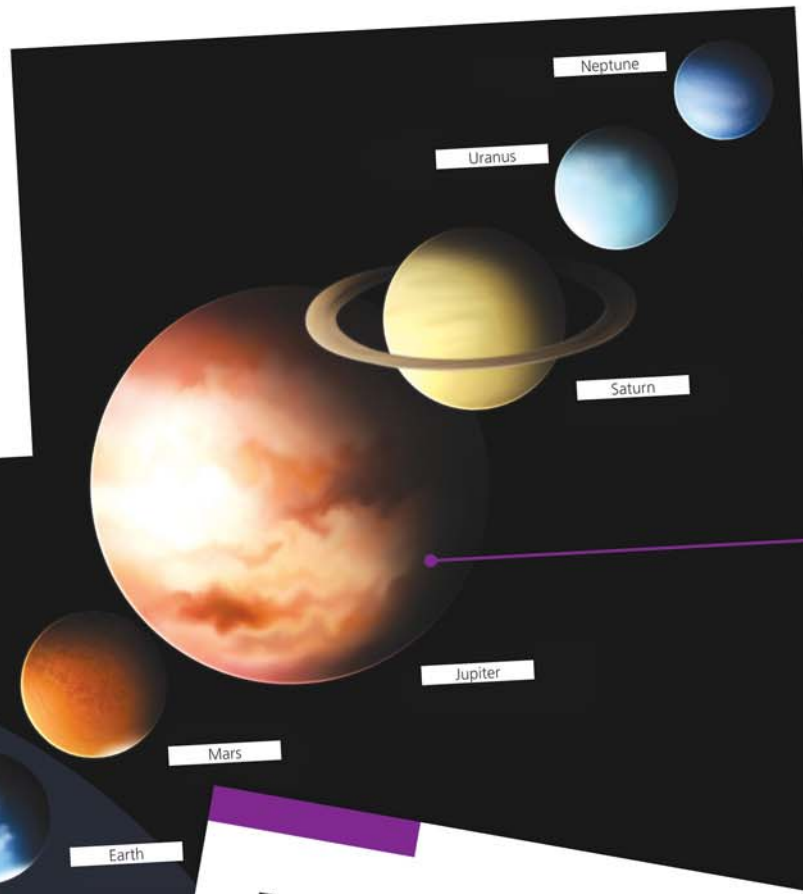
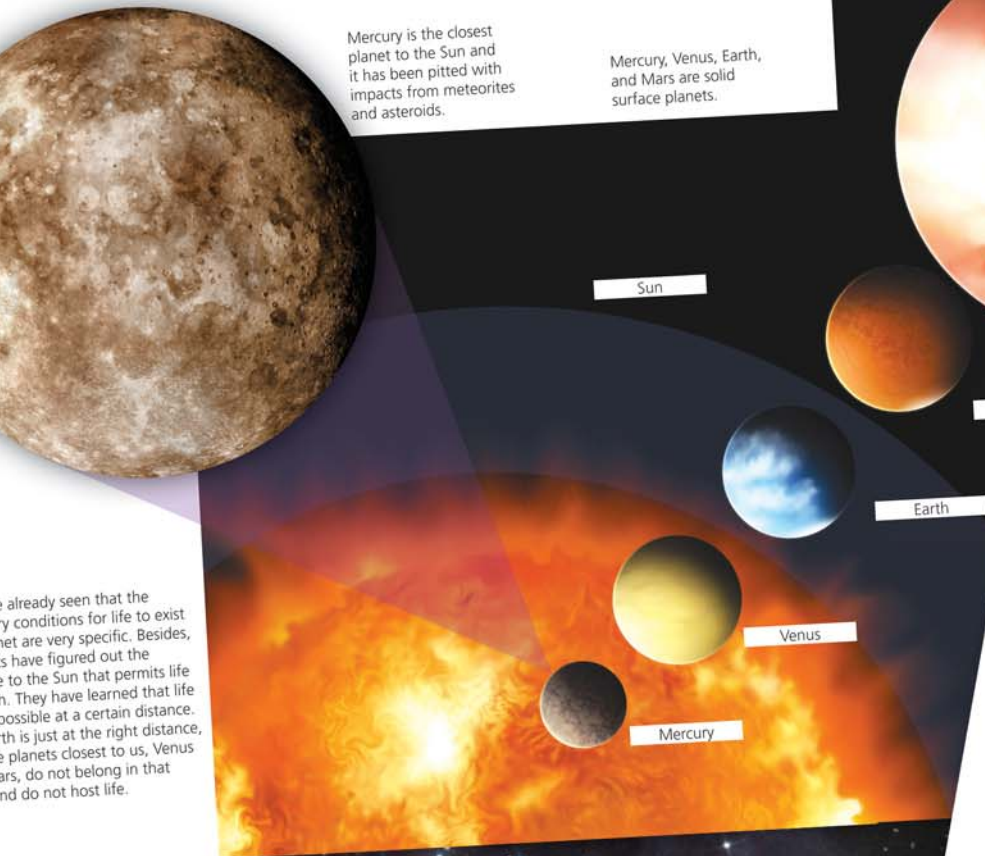
The Solar System

system we belong to is a system of planets that revolve around the Sun. It is situated in the constellation, Orion, which belongs to the galaxy called the **Milky Way**. Today, the solar system is deemed to have eight planets, leaving out Pluto, which was considered the ninth until 2006. The reason for not including it among the planets today is because of its lack of certain characteristics, such as not having the necessary mass to be spherical and not having cleaned its orbit of minor objects by means of attraction to it.

Mercury is the closest planet to the Sun and it has been pitted with impacts from meteorites and asteroids.

Mercury, Venus, Earth, and Mars are solid surface planets.

We have already seen that the conditions for life to exist are very specific. Besides, scientists have figured out the distance to the Sun that permits life. They have learned that life is possible at a certain distance. Earth is just at the right distance. The planets closest to us, Venus and Mars, do not belong in that category and do not host life.



Jupiter, Saturn and Neptune are gaseous planets.

The great gas giants are almost two and a half times greater in size than the remaining planets put together. Its atmosphere is permanent; it has a greater mass than that of the solar system prepared for it to be a speck. It is within a strip of half a degree of reference time and it has 100 times the mass of Jupiter as it has 100 times the atmosphere. Many meteorites and asteroids fall on it or hitting Jupiter appear as a large point of attraction. Many of the things that normally come to it are lost. It is a kind of vacuum.

In 1994, it was how 20 fragments of the comet Shoemaker-Levi hit Jupiter. The effect of the impacts was visible from Earth.

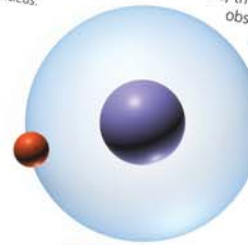
From the Atom to the Universe

"The heavens declare the glory of God." This Bible verse from Psalm 19:1 found engraved in a memorial plaque that commemorates the foundation of the Armagh Astronomical Observatory in Northern Ireland. It clearly expresses the fascination of human beings before the great, unfathomable and breathtaking universe. Yet, our possibility of observation with the naked eye is limited and we can barely manage to see ten thousand stars. That is a large number, but there are millions of galaxies, each containing millions of stars.

Yes, the universe shown to us by telescopes and other astronomical observation instruments is still more imposing than what our naked senses allow us to perceive. The greatest thing, the universe, is awe-inspiring. Yet it is in the smallest bits, in the invisible atom, in the elementary forces of nature where we find answers to the questions we have about the immensity of the heavens. If those forces were just slightly different from what they are, life as we know it would be impossible.

Each ball in this chart represents one atom from the DNA molecule, and each colour, a different atom: carbon, hydrogen, oxygen, nitrogen, or phosphorus.

The simplest atom of all is the hydrogen atom. It contains one electron with negative charge at its surface, and one proton with positive charge in its nucleus.

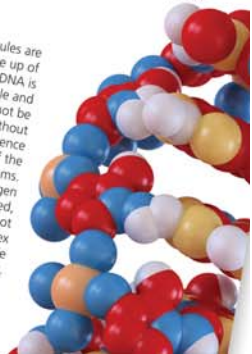


The helium atom is the next step in complexity after hydrogen. It has two electrons at its surface, and two protons and two neutrons in its nucleus. It is the first atom with neutrons, because the positively charged protons tend to repel each other, so the neutrons stabilise the nucleus.



One of the basic forces in nature is the strong nuclear force. If this force were slightly less than it actually is, nuclei with more than one proton could not stabilise and only the hydrogen atom would exist.

Molecules are made up of atoms. DNA is life's molecule and it could not be formed without the existence of each of the complex atoms. If only hydrogen atoms existed, there would not be any complex molecule, and life would not exist.



A useful tool to understand nature

By means of examples, this book attempts to convey two main ideas:

- that nature can still help us in the educational task because it provides exemplary cases;
- and that nature possesses all the indicators pointing to a designing will, that has not left threads hanging or too much space for chance.

It is not always easy to teach, using the lessons of nature. Safeliz publishers and the author trust that this book may serve you as a useful tool.

