PERCORSI PER STUDENTI NON ITALOFONI

tratti da *Intorno a te - Capire e vedere la Scienza* di Stefano Zanoli

MONDADORI EDUCATION

PERCORSI PER STUDENTI
NON ITALOFONI

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CLASSE PRIMA

The atmosphere, the weather and the climate

L'atmosfera, il tempo e il clima

1 What is air made of?

Air is a mixture of gases consisting almost entirely of nitrogen and oxygen, together with smaller amounts of other gases, including argon and carbon dioxide.

2 What are the different layers of the atmosphere?

Starting from the surface of the Earth's crust and moving upwards, the atmosphere's layers are: troposphere, stratosphere, mesosphere and thermosphere.

3 What do the troposphere and stratosphere contain?

In the troposphere, most meteorological phenomena occur. The stratosphere holds a layer of ozone which absorbs most ultraviolet rays.

4 Why is the air much colder at high altitudes than on the ground?

The air at ground level is heated principally by the heat rising from the ground.

5 What is the greenhouse effect?

Some atmospheric gases, such as carbon dioxide, withhold part of this heat, preventing it from being dispersed into space: this phenomenon is known as the greenhouse effect.

6 What is atmospheric humidity?

The quantity of vaporous water found in the air is known as atmospheric humidity. The higher the temperature, the higher the quantity of vaporous water contained.

7 How are clouds and fog formed?

When the temperature in a humid air mass drops, the vaporous water condenses to create miniscule water droplets which make up a cloud at high altitude or fog and haze closer to the ground.

8 What is atmospheric pressure?

Atmospheric pressure is due to the weight of the air on the Earth's surface; it lowers as you move up to higher altitudes.

9 Where do winds come from?

If there is a difference in atmospheric pressure between two regions, the air moves from the higher pressure area to the lower pressure area.

10 What is atmospheric weather?

Atmospheric weather is the set of atmospheric conditions recorded in a certain place and at a certain time.

11 What is climate?

Climate is the sum of the average values of the atmospheric conditions over a long period of time (years or decades). It depends on geographical and astronomical factors.

The classification: prokaryotes, protists and fungi

I procarioti, i protisti e i funghi

1 **What is the basic unit to classify life forms and how is it defined?**

The species. Organisms which belong to the same species can mate and produce offspring, who in turn perpetuate reproduction.

2 **What are a genus, a family, an order, a class, a phylum and a kingdom?**

A genus groups together a collection of similar species. By regrouping diverse genera one obtains a family. An order consists of many families. Many orders form a class. A phylum consists of a collection of classes. A group of phyla is a kingdom..

3 **What are the three domains of living beings?**

Today, scientists divide living beings into three domains: eukarya, bacteria and archaea.

4 **What are the kingdoms of eukaryotic organisms?**

The domain of eukaryotes consists of protista, fungi, animalia, and plantae.

5 **What are the characteristics of prokaryotes?**

Prokaryotes have two domains: archaea and bacteria. They are formed by prokaryotic cell types, which have a plasma membrane surrounded by a thick cellular wall.

6 **In what conditions can archaebacteria live?**

Many archaebacteria can live in extreme environmental conditions, such as hydrothermal vents with temperatures exceeding 100 °C.

7 **Are bacteria autotrophic or heterotrophic?**

Bacteria are largely heterotrophic. Cyanobacteria are autotrophic.

8 **What is the difference between parasitic, symbiotic and biodegrading bacteria?**

Parasite bacteria obtain nutrition by attaching themselves to the cells of living organisms. Symbiotic bacteria live in a mutually beneficial environment with other organisms. The biodegrading bacteria absorb organic material from dead organisms.

9 **What are protists?**

Protists are unicellular eukaryotic organisms, such as amoebas and diatoms.

10 **What are fungi made of and how do they feed?**

Fungi are formed by cells (hyphae) which form an underground network called mycelium. All types of fungi are heterotrophic: their nutrition derives from the absorption of organic materials through their cell walls.

11 **What are lichens?**

Lichens are symbiotic associations of two organisms: a fungus and an algae.

12 **What are viruses?**

Viruses are particles formed by DNA or RNA, surrounded by a protein coat.
They are parasites that must enter a living cell to reproduce themselves.

Scientific investigation
L'indagine scientifica

1 What is science?

Science is the knowledge of the natural world obtained through observation, experimentation and rational thinking.

2 What is a phenomenon?

Anything that occurs and can be observed.

3 What is the difference between physical and chemical phenomena?

The transformation of matter whereby the material composition doesn't change is known as physical phenomena. The transformation of matter whereby the composition changes is known as chemical phenomena or reactions.

4 What scientific disciplines are there?

Science is divided into many disciplines: e.g., physics (the study of matter, bodies and their behaviour), biology (the study of life forms) and astronomy (the study of the Universe).

5 What is the experimental method?

The scientific method of modern science, developed by Galileo, is called the experimental method. This method consists in observing a phenomenon, making a hypothesis to explain the cause, and verifying its validity through experimentation.

6 What is a hypothesis?

A hypothesis is a provisional explanation of an observed phenomenon; it is based on the observer's knowledge and insights; it must be plausible and verifiable.

7 What are quantities?

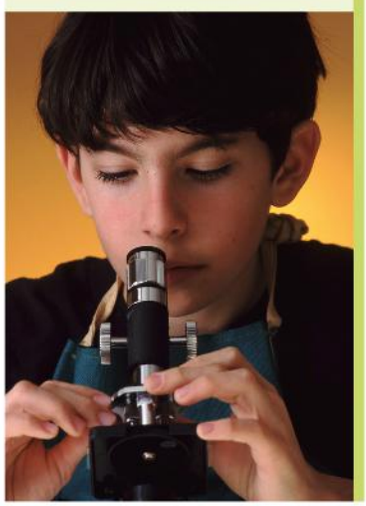
In science, physical quantities, or simply quantities, are all the measurable characteristics of an object or phenomenon.

8 What does it mean to measure something?

It means choosing a unit of measure appropriate to the quantity we wish to measure; using a suitable measuring tool to compare the unit of measurement with the quantity to be measured; and indicating how many times the unit of measurement fits in the quantity to be measured through a number, accompanied by the unit of measurement used.

9 What are the units of measurement of the International System (SI)?

The International System (SI) is the standard unit of measurement and it is used all over the world. In the SI, the unit for the measurement of length is the meter, the unit of time is the second and the unit of mass is the kilogram.



Matter
La materia

1 **What is the difference between matter, volume and material?**

Matter is anything that occupies space.
The space occupied by a body is called volume and is measured in cubic metres (m^3).
Different types of matter are called materials.

2 **What are atoms and molecules?**

Matter is formed by microscopic invisible particles called atoms. There are about 92 different types, called chemical elements. Molecules are the smallest parts of (composite) matter which carry the specific characteristics of a material.

3 **What is a mixture?**

In a mixture two materials are mixed together without any chemical reaction. A mixture is heterogeneous when both components are distinguishable and separable. It is homogeneous when the two components are no longer distinguishable and the composition is equal everywhere.

4 **What is the difference between solute and solvent?**

In a homogeneous mixture or solution the material present in larger quantity is called the solvent and the one present in smaller quantity is called the solute.
Solubility is the capacity of a material to be dissolved in water. Its value increases as the temperature rises.

5 **What is the mass of a body?**

The mass of a body represents the quantity of matter in it. To measure it, a balance (weight scale) with two plates is used and the unit of measurement is the kilogram (kg).

6 **What is the weight of a body?**

The weight of a body is the force with which it is attracted towards Earth. It is measured by a dynamometer and the unit of measurement is the newton (N).

7 **What is the difference between density and specific weight?**

The density of a body is equal to the mass of the body divided by its volume.
Its unit of measurement is the gram per cubic centimetre (written as g/cm^3).
The specific weight of a body is equal to its weight divided by its volume.

8 **What are the possible states of aggregation of a material?**

A given material can be in three different states of aggregation: solid, liquid and gaseous form. A solid always has the same shape and the same volume.
A liquid has the shape of its container, but always has the same volume. A gas takes the shape and volume of its container.

Life forms and cells

I viventi e la cellula

1 What do you call the branch science that studies life forms?

The science that studies life forms is called biology.

2 What is the life cycle of living beings?

Living beings are born, they grow and then they die: this is their life cycle.

3 What is the difference between autotrophic and heterotrophic organisms?

Organisms which are capable of synthesising their own food are called autotrophic. Organisms which are not able to synthesise their food but must take it from other organisms are called heterotrophic.

4 What do herbivores, carnivores and omnivores eat?

Among heterotrophic organisms, herbivores eat vegetables, carnivores eat other animals, and omnivores (like humans) eat both vegetables and animals.

5 What is the difference between sexual and asexual reproduction?

Reproduction that requires two parents is called sexual; if only one parent takes part, then it is called asexual reproduction.

6 What are living organisms made up of?

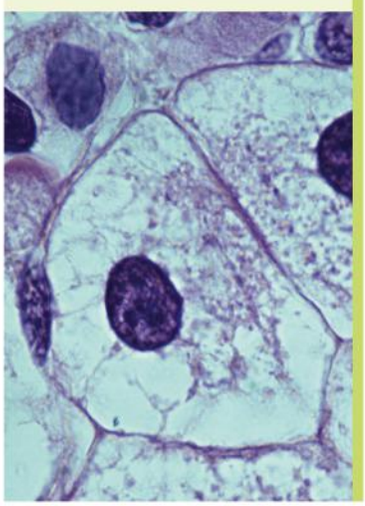
All living beings are formed of cells.

7 What are the most important parts of the cell?

Cells have an external shell, called plasma membrane, a cytoplasm and a control centre, called nucleus.

8 What other structures are present in the cell?

At high magnification, one can see that a cell contains a system of membranes and small bodies called organelles. Among these, one finds a 'power station' of sorts, namely the mitochondrion. Vegetable cells also contain chloroplasts for photosynthesis and a cellular wall.



9 What is the difference between eukaryotic and prokaryotic cells?

Cells with a properly visible nucleus are called eukaryotes. Cells which do not have a proper nucleus are called prokaryotes.

10 What do you call organisms formed by one or more cells?

A life form made of a single cell is called unicellular. An organism formed by many cells is called multicellular.

11 How do cells reproduce?

Every cell is born out of the preceding cell through a simple process of cell division called mitosis.

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CLASSE SECONDA

Fundamentals of chemistry
Le basi della chimica

1 What are the constituents of matter?

All matter is made of microscopic particles called atoms.

2 What is an atom made of?

Every atom is made of three types of particles: protons, neutrons and electrons.

3 What is the atomic number?

All atoms of a given element have the same number of protons, which is the same as the number of electrons; this is the element's atomic number, symbolised by the letter Z.

4 What is the mass number?

The overall number of protons and neutrons of an atom is the mass number, symbolised by the letter A.

5 What are isotopes? Can you give an example?

The isotopes of an element are atoms that have the same atomic number but a different mass number, because they have a different number of neutrons. Deuterium and tritium are isotopes of hydrogen.

6 How many types of atoms are there in nature?

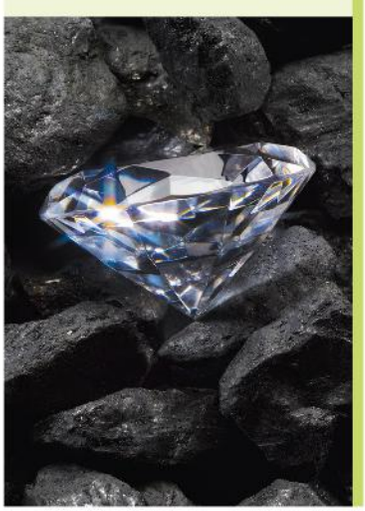
There are 92 types of atoms, called chemical elements.

7 What are the chemical symbols of carbon, hydrogen and methane?

The symbol for the carbon atom is C, for the hydrogen atom H, for methane CH_4.

8 How are elements arranged in the periodic table?

They are arranged by atomic number in seven rows (periods) and eighteen columns (groups). The ten groups at the centre are transition elements, metals that are quite similar in terms of their chemical properties.



9 What is the carbon atom composed of?

The carbon atom has 6 protons in the nucleus and the same number of electrons orbiting in the external shells.

10 When are chemical bonds created and what forms can they take?

Almost all isolated atoms are unstable: in order to reach stability, they must bond together by losing or gaining electrons. The chemical bonds formed can be ionic, covalent or metallic.

11 What are ions?

An atom which has lost an electron is called a positive ion; an atom which has gained an electron is known as a negative ion.

The human body: structure and skin

Il corpo umano: organizzazione e rivestimento

1 What are the main parts of the human body?

The main parts of the human body are the head, the trunk and the limbs.
The head includes the skull and the face. The trunk is subdivided in: the thorax, which contains and protects the heart and the lungs, and the abdomen with several internal organs. Each of the upper limbs consists of an arm, forearm and hand. Each lower limb has a thigh, a leg and a foot.

2 What is the symmetry of the human body?

The human body has bilateral symmetry and it is symmetrical about a plane running from head to toe: both left and right section are identical to each other.

3 How are the cells in the human body organized?

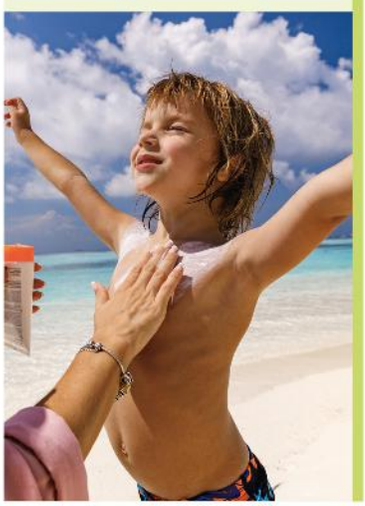
The cells in the human body are organized in systems with increasing complexity, depending on precise cellular levels. When many similar cells group together to carry out a specific function, they form a tissue. An organ is a part of the body consisting of two or more tissues which carry out a specific function.
When different organs are connected with each other and work to carry out a function, they make up a system. An organism comprises many systems to carry out its bodily functions.

4 What are the characteristics of the main tissues of the human body?

Epithelial tissue covers the body and protects different internal organs.
Muscular tissue makes it possible to move all parts of the body.
The nerve cells form a networking system to allow the communication among the different parts of the body and the brain.
Connective tissue helps keep all other tissues and organs together.

5 What is the integumentary system and what is its function?

The integumentary system covers the outermost part of the body and protects internal organs. It consists of skin and appendages such as hairs, sebaceous glands, sweat glands and nails.



6 What are some characteristics of the skin?

The skin has three main layers: epidermis, dermis and hypodermis.
The epidermis has a protective function. The dermis makes the body surface very flexible; it is rich in blood vessels, nerve ending and sensory receptors.
The hypodermis serves as a thermal isolation system.

7 What is melanin and what is its purpose?

Melanin is a dark pigment found in the epidermis, and protects the body from the Sun's UV rays.

Ecological balance
L'equilibrio ecologico

1 What is an environment?

An environment is defined as the sum of all abiotic and biotic factors affecting organisms in a certain area.

2 What are abiotic factors?

All physical-chemical factors, such as light, temperature and the availability of water.

3 What is the difference between ecosystem and habitat?

The ecosystem comprises living organisms, the physical space in which they live, and the mutual relations they establish. The habitat is the kind of environment in which a given species tends to live.

4 What are the main kinds of relations that different species establish within an ecosystem?

Competition, when organisms fight with one another, for example over food.
Predation, when one organism (the predator) feeds on another (the prey).
Symbiosis, when two organisms belonging to different species establish a relationship that is crucial for the survival of one or both of them.

5 What is the difference between a food chain and a food web?

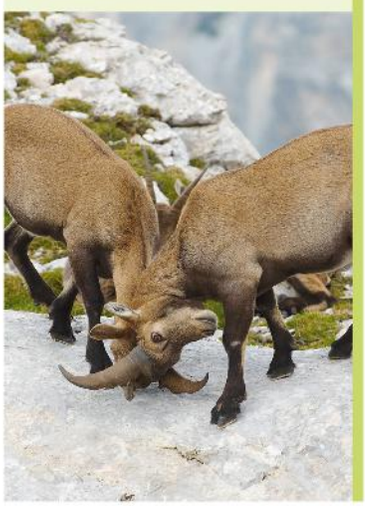
A food chain graphically illustrates the food relations between the various species within an ecosystem. It includes producers (photosynthetic species), primary consumers (herbivores), secondary consumers (carnivores) and so on, down to the decomposers. A food web is made up of several interconnected food chains.

6 What are the cycles of matter or biogeochemical cycles?

They are the transformations which matter undergoes in an ecosystem, according to a constant cycle that ensures its conservation.

7 Where does energy come from in ecosystems?

From the Sun: energy flows into ecosystems through the food chain, but at each step part of this energy is dispersed into the environment in the form of heat.



8 What does population dynamics study?

It studies the growth of populations in natural environments or ones altered by human beings.

9 Do ecosystems also evolve?

Yes, they evolve through a process known as ecological succession, whereby new species appear and others disappear.

10 When is an ecosystem balanced?

An ecosystem is ecologically balanced when, despite constant transformations, it preserves its main biotic and abiotic features over time.

11 What are biomes?

Biomes are parts of the biosphere that include ecosystems with similar features.

The Earth's interior, volcanoes and earthquakes

I vulcani e i terremoti

1 **What are the different layers that make up the Earth?**

The Earth is made up of the crust, the mantle, the outer core and the inner core. The crust has an irregular thickness: thinner below oceans, thicker under continents.

2 **What is volcanism?**

Volcanism is the process through which magma, composed of molten rocks and gases at extremely high temperatures, rises to the surface of the crust.

3 **What happens during a volcanic eruption?**

A volcano is a crack in the Earth's crust through which the magma reaches the surface, known as lava. In an effusive eruption, the magma is fluid and creates a lava stream; in an explosive eruption, the magma is thick and is released in the air along with gas and solid rock fragments.

4 **Where are the main active volcanoes?**

Most active volcanoes can be found along the edges of the Pacific Ocean, known as the Ring of Fire. The main active volcanoes in Italy are: Mount Vesuvius, Mount Etna, Mount Stromboli and Mount Vulcano.

5 **Why can volcanoes be dangerous?**

The characteristics that make a volcano dangerous are: explosions, ash fall, pyroclastic flows, gas emissions and lava streams.

6 **What generates an earthquake?**

An earthquake or seismic event is a shaking movement of the ground due to rapid vibrations. It is generated by the sudden release of accumulated energy in the fractured rocks: the fracture is called a fault.

7 **What are the hypocentre and the epicentre of an earthquake?**

The point at which the Earth's layer fractures and from which the earthquake originates is known as the hypocentre. The point at which the seismic waves reach the surface, directly above the hypocentre, is known as the epicentre.

8 **How is the intensity of an earthquake measured?**

The Mercalli scale measures the intensity of an earthquake based on the effects of a seismic wave on property and people; the Richter scale measures the magnitude of the earthquake, that is the energy released by the seismic wave. The instrument that takes these measurements is a seismograph.

9 **How is a seismic risk calculated?**

To calculate a seismic risk we need to take into account: the intensity level of the earthquake, human exposure and the vulnerability of buildings.

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CLASSE TERZA

Energy and work
Energia e lavoro

1 **What is work and what is its unit of measurement?**
Work is the product of force applied to a body and the displacement of the body in the same direction as that of the force. The formula is: $L = F \times s$. The unit of measurement of work is the joule.

2 **What is power and what is its unit of measurement?**
Power is the ratio between the work done and the time taken. The unit of measurement is the watt.

3 **What is energy and how is it measured?**
Energy is a physical entity that measures the capacity of a body to perform work. Its unit of measurement is the joule.

4 **What type of energy does a body at a certain height have?**
A body placed at a certain height above the ground has gravitational potential energy. When the body falls, this energy is transformed into kinetic energy.

5 **What is mechanical energy?**
The sum of kinetic energy and potential energy is called mechanical energy, which is constant in the absence of friction.

6 **What is first principle of thermodynamics?**
The first principle of thermodynamics states that energy cannot be created or destroyed; it can only be transformed from one form into another.

7 **What is heat?**
Heat is a form of energy, called thermal energy.

8 **What are the consequences of frictional force?**
Due to frictional forces, a part of kinetic energy is transformed into thermal energy or heat.

9 **What is the difference between primary and secondary energy sources?**
Primary energy sources can be used in the form in which they are found in nature (e.g. fossil fuels).
Secondary energy sources are obtained through the chemical or physical transformation of primary sources (e.g. petrol).

10 **What is the difference between renewable and non-renewable sources?**
Renewable sources can be used indefinitely, either because they are considered inexhaustible or because their regeneration occurs within a short time compared to the human life span (sustainable sources).
Non-renewable energy sources take a long time to regenerate, amounting to whole geological eras; in certain cases, once they have been used up, they can no longer be regenerated.

Evolution
L'evoluzione

1 What are fossils and under what conditions are they formed?

Fossils are a testimony of past life conserved in various layers of rocks, deposited during geological time. In order for a fossil to form and leave a trace in the rocks, the body of the organism must be promptly protected from the process of decomposition and covered with a layer of material.

2 What is fixism?

The doctrine that species do not change over time.

3 What were Cuvier's observations on fossils?

Cuvier explained the existence of ancient life forms, now extinct, by hypothesising that the Earth had a series of natural catastrophes in the past which extinguished animals and plants.

4 What does the theory of evolution assert?

According to the theory of evolution, species change over time. Today's organisms are different from those in the past.

5 What is Lamarck's theory of evolution?

The change that appears in life forms is the result of their need to adapt to their environment. Useful organs remain active and further develop through their use, whereas those never used diminish and disappear. Changes that an organism acquires during its life are transmitted to offspring.

6 Who formulated the modern theory of evolution?

The modern theory of evolution was formulated by Charles Darwin.

7 In what way did artificial selection inspire Darwin?

Darwin was inspired by animal breeders, who reproduce only animals with specific characteristics in each generation.

8 Why was Malthus' work an inspiration for Darwin?

According to Malthus, an economist, the human population was increasing faster than the available food resources and part of the population would not be able to survive: Darwin thought this should be the case for other species as well.

9 What does the theory of evolution through natural selection assert?

In every existing species there is a change in traits. Individuals who have more advantageous traits in their environment have better chances of survival than others, and are therefore able to transmit those traits to their offspring.

10 What is speciation?

It is the long evolutionary process whereby a species gives rise to a new one over time. It often occurs through the geographical isolation of a population.

The response and control systems
I sistemi di controllo e risposta

1 What kind of cells form the nervous system?

The nervous system is formed by cells called neurons and glial cells.

2 What is the structure of a neuron?

A neuron is composed of a cellular body, from which a large number of branches called dendrites and an extension called axon emerge. The axon is often enclosed by a myelin sheath.

3 How are neurons connected to each other?

The synapse is a connection area between two neurons. In the synaptic space, the (electrical) nerve impulse is transmitted through chemical substances called neurotransmitters.

4 What is the structure of the encephalon?

The encephalon consists of three parts: the brain, the cerebellum and the medulla oblongata. It is wrapped in three protective membranes called meninges. The two hemispheres of the brain are connected by a bridge called the corpus callosum.

5 What are nerves?

Nerves are formed by neural axonic fibers. Nerves can be of sensory, motor or of a mixed type.

6 What makes up the voluntary nervous system?

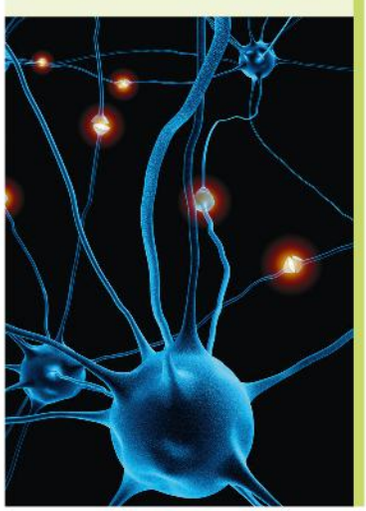
The voluntary nervous system is formed by 43 pairs of nerves which transmit electrical impulses from the central nervous system to all parts of the body and vice versa.

7 How is the autonomous nervous system organised?

The autonomous nervous system monitors and controls all the involuntary functions of internal organs. It consists of two sections: the sympathetic and the parasympathetic system.

8 What is the function of the endocrine system?

The endocrine system controls the activity of some organs through special substances called hormones, which are produced in the endocrine glands and act by attaching themselves to special receptors on the cells of the target organ.



9 What are the main endocrine glands?

The main endocrine glands are: the pituitary gland and epiphysis in the head; the thyroid and parathyroid in the neck; the thymus in the chest and abdomen; the adrenal glands; the pancreas; the ovaries in females and the testicles in males.

10 How is the activity of glands monitored and adjusted?

Gland activity is largely monitored by a brain area called the hypothalamus, which acts directly on the pituitary gland. The auto-regulatory hormonal mechanism is called the negative feedback mechanism.

Environmental sustainability
La sostenibilità ambientale

1 What are resources?

Resources include everything that enables and nourishes life: matter, energy and biodiversity.

2 What is the difference between renewable and non-renewable resources?

Renewable resources are replenished within a short time. Non-renewable resources are replenished over the course of geological eras.

3 What is biodiversity?

Biodiversity means the variety of all living beings on Earth. It is possible to distinguish between different levels of biodiversity: genetic diversity, species diversity and ecosystem diversity.

4 What is the carrying capacity of an environment?

It is the highest possible number of individuals belonging to a given population that the environment can support through its resources.

5 What are limiting factors and which are the most common?

A limiting factor is any condition which prevents a population from growing too much. Examples include food scarcity, the presence of predators, the lack of water, the type of soil and extreme temperatures.

6 Why is the human population growing exponentially?

Because through technological and scientific progress it has learned to increase the environment's carrying capacity, by eliminating many limiting factors.

7 What consequences can the excessive growth of the human population have?

The main consequences are increased resource consumption, waste production and pollution.

8 What is the ecological footprint and what does it depend on?

The ecological footprint measures the amount of natural surface area that an individual (or a family or a country or the whole human species) requires in order to produce what (s)he consumes and to absorb the waste (s)he produces. It depends on the natural area's biocapacity.

9 What is a natural area's biocapacity?

It is the area's capacity to provide resources. To meet the human species' current demand for resources, 1.7 planet Earths would be required.

10 What is sustainable development?

Development is sustainable when it meets everyone's needs without compromising future generations' possibilities to satisfy their needs.