

## Plants

### Plants knowledge

#### What is it?

Like the word "fauna", the word flora also comes from Greek mythology and is used to indicate the world of the vegetal species that inhabit the Earth. This world is no less complex than the animal world, and to begin to learn more about it, it is useful therefore to divide it into four large groups: algae, bryophyta (i.e. moss), ferns and seed plants (or spermatophytes).

#### Bryophyta

Short after the emerged lands were conquered, plants were classed into: bryophyta, that include hepatics, anthocerotae and mosses and vascular plants, i.e. all higher plants.

The structure of bryophyta is very simple and it is made up of individuals that are generally shorter than 20 cm.

Bryophyta do not have roots, but they have **rhizoids**, i.e. long cells or cell filaments, that stick to the substrate. Many bryophyta have a leaf-like structure, made up of few cell layers through which they carry out the photosynthesis. As they have no roots to absorb the water, they have to take the water from aerial structures, therefore they grow mainly in wet and dark areas, or in marshes.

#### Ferns

These plants have big leaves, called fronds, they do not produce seeds and they generally need water to fertilize. For this reason they are generally found in humid and shady forests and in marshes. Some ferns can reach 20 metres of height and behave like trees.

#### Spermatophytes

Spermatophytes are divided into gymnosperms and angiosperms. The name **Angiosperms** comes from the Greek words: angeion, "vase", and sperm, "seeds". This name means that the seeds of these plants are not "naked", but encased in a specific structure, the ovary, that protects them from the external environment. The differences between Angiosperms and Gymnosperms are generally very clear.

The most important ones are:

- the Angiosperms include many wood or shrub species as well as many herbaceous species (unlike Gymnosperms);
- the cotyledons (i.e. the apparatuses that store food to feed the plant embryo) in Gymnosperms and few in Angiosperms (normally, one in monocotyledons and two in dicotyledons);
- finally, in Gymnosperms the leaves are generally small and thin (needle- or scale-shaped leaves), while in Angiosperm they are more or less large and generally have an expanded lamina and reticulated or parallel ribs.

#### Angiosperms

Angiosperms include approximately 220,000 species (over one half of the known higher plants) and their classification is very complex and detailed and not perfectly defined yet. Angiosperms can be divided into two large groups: dicotyledons and monocotyledons. The features that distinguish Dicotyledons from Monocotyledons are generally quite clear and peculiar. The most important discriminating parameter is the number of cotyledons contained in the embryo: Dicotyledons own two cotyledons only (rarely 1, 3 or 4), while Monocotyledons own only one (or sometimes none at all). Other features shared by Angiosperms are the presence of a trunk, leaves and roots and the production of flowers, fruits and seeds. They may have either a herbaceous or wooden "habitus". Herbaceous plants can be annual, biennial and

perennial. In annual plants, the vegetative and reproductive cycle is completed in one year, while biennial plants stock up food in the first year, then bloom and make fruits in the second year, then the plant dies. Perennial herbaceous plants bloom every year.

Wooden plants are all perennial, and can be divided into shrub or tree plants. The former have a limited height and their branches depart from the basal portion of the plant; trees can reach remarkable heights and have a branched trunk. In fact, the distinction between trees and shrubs is not always easy, since many plants can look differently according to where they live.

## Gymnosperms

Gymnosperms include around 750 species. Among gymnosperms we find the tallest trees on Earth, like for example sequoia that can reach up to 100 metre height. Among gymnosperms we also find coniferae (this word means “cone-carrier”). Among them, we find pines, fir trees, larches, cedars of Lebanon, cypress and juniper. Most of conifers are ever-green plants, with needle-shaped or squama-shaped leaves..

## Photosynthesis

All living beings are largely composed of organic molecules (sugars, fats, proteins, etc.), that are produced from other molecules (synthesis). Plants are however different from animals, since they use different molecules in the process. Actually, green plants produce the organic substances their body is made of by using a limited number of inorganic substances that can be found in the environment, such as **carbon dioxide** (contained in air) and water and some **inorganic ions** (nitrates, sulphates, and other substances contained in soil). In particular, green plants can use solar energy to trap and turn into organic molecules the carbon contained in the atmosphere in the form of carbon dioxide. This process is called photosynthesis and is typical of autotrophic organisms. All the other organisms that cannot accomplish the photosynthesis process, such as man or animals, are called heterotrophic organisms. Heterotrophic organisms can synthesise the molecules their body is made of only by using the organic molecules contained in food (vegetal or animal food). Vegetal species are therefore an essential element for natural balance and for the life of other living species.

## Still but vital

If we look at the way plants feed themselves, we can understand the reason of the specific distinguishing features of this kingdom. Plants are actually motionless, often cover large areas, both in the air (with their branches and leaves) and underground (with their roots), sometimes have no specific growth limit and are very adaptable to external stimuli. Plants are motionless because their food is rather evenly contained in the atmosphere (carbon dioxide), soil and water (inorganic ions), so they do not need to move. It is just for this reason, that they cannot move, that plants have become extremely adaptable to external living conditions; in addition, since plants take in nutrients through their leaves and roots, the larger the surface of contact between the plant and the environment (and therefore the area covered), the more the nutrients it can take in to grow. And this is the reason why plants, unlike man or animals, tend to grow bigger and bigger without a specific time limit (a property called “indefinite growth”).

## Adjustment of the Earth's climate

Vegetation strongly affects the Earth's climate and the composition of the atmosphere through the photosynthesis activity. Through this process, plants absorb carbon dioxide (CO<sub>2</sub>) from the atmosphere, trap carbon (C) to build organic molecules and release oxygen (O). Due to the extension of vegetation on Earth, the amounts of oxygen and carbon dioxide that get into this process are huge: every year, the plants' photosynthesis releases approximately 70 billion tons of oxygen and consumes an equally huge amount of carbon dioxide.

Through the photosynthesis, plants counteract the many oxidation processes (for instance, combustion for the production of energy, as is in all the bodies of the living beings, or combustion in industrial processes and car engines), that, using the oxygen contained in the air and giving back carbon dioxide, cause the concentration of the former in the atmosphere

to decrease and that of the latter to increase.

In this way, plants play an essential role for life on Earth: stabilising the gas composition of the atmosphere.

In addition, the stabilisation of the composition remarkably affects the atmospheric temperature and humidity; this subject will be dealt in more detail in the Section on "AIR".

## Plants as energy source

At present, a large part of man's energy requirements is covered by products of vegetal origin. Fossil fuels (coal, oil, natural gas) have formed from the partial decomposition of organisms – mainly vegetal – that lived over one hundred millions years ago (see the Section on ENERGY). When petrol burns in a car engine or methane burns in the kitchen stove, some of the solar energy trapped by the plants in distant times through photosynthesis is released. Talking of fuels, let's not forget firewood, which now is no longer used in industrialised countries, but which in developing countries is still one of the main energy sources for the home (cooking and heating).

## World plants

The main factors that affect the spreading of a vegetal species are climatic conditions (especially sun exposure, temperature and availability of water) and the characteristics of the soil.

The impact of the other living organisms that inhabit the same ecosystem (herbivores, insects, other vegetal species, etc.) should not be underestimated either.

But an analysis of the factors above is not sufficient to account for all the reasons why a species inhabits a given place and not another, similar one. A species can actually spread in a given place just because of an occasional event: for instance, many Arctic species that grow in the Alps arrived there during the glaciations, when all Europe offered them favourable climatic conditions. As the glaciers withdrew, they disappeared everywhere but on the mountain tops, where they still found favourable living conditions. In other cases, the chance factor is man, who, through migrations and trade, has promoted the spreading of numerous species away from their places of origin.

## Life pioneers

Palaeontology is the science that studies the ancient living beings, their origin and evolution. This study requires the examination of the animal and vegetal remains that lived in the past and that we find today as fossils inside sedimentary rocks. Primordial organisms had very simple and small shapes, so they could not turn into fossil remains. The most ancient fossils to have been found so far date back to approximately 3 billion years ago. How have the first living organisms originated? Before the appearance of life, the Earth's landscape was dominated by active volcanoes, a grey, lifeless ocean and a very turbulent atmosphere. The ocean received organic substances from the mainland, the atmosphere and the fall of meteorites and comets. And the ocean is the place in which such substances as water, carbon dioxide, methane and ammonia chemically reacted, producing sugars, amino-acids and fats. These molecules are the raw material required for the formation of proteins and nucleic acids that are the basic compounds of any living organism.

## A history lasting millions of years

The history of the Earth is divided into five ages: Archaeozoic or Precambrian, Palaeozoic or Primary, Mesozoic or Secondary, Cainozoic or Tertiary, Neozoic or Quaternary.

### **Archaeozoic age**

The Archeozoic age is the longest one: it began 4.6 billion years ago and ended 530 million years ago. 3 billion-year-old fossils prove that the oldest organisms known so far are very simple, heterotrophic unicellular algae. Some green-blue autotrophic algae appeared, however, approximately two billion years; they could produce the nutrients they needed by themselves, through the photosynthesis. This process caused oxygen to spread from the sea to the atmosphere, thus leading to the appearance of more complex organisms that would conquer the Earth's surface.

### **The Palaeozoic age**

The Palaeozoic age is called the age of "manifest life" and spans across 285 million years, from 530 million years ago to

245 million years ago. A high number of events occurred over this period. Many animal and vegetal groups made their first appearance, many of which disappeared during the same age. At the dawn of the Palaeozoic age, life existed only inside or near oceans. The most common living beings were trilobites, crustaceans, corals and some primitive types of fish. Plants were the first forms of life to spread on the mainland. Huge marshy forests developed, that over the years originated the large deposits of fossil coals that are currently exploited as an energy source. The Palaeozoic age is also known as the age of the great extinctions: at some point, approximately 95% of all the living beings of the Earth disappeared. This event was probably caused by deep climatic changes and powerful volcanic eruptions.

### ***The Mesozoic age***

Mesozoic age lasts 180 million years, from 245 million years ago to 65 million years ago. Mesozoic means "mid-life". The living organisms were actually not as primitive as in the Palaeozoic age, but were not too developed either. It is the so-called "reptilian age" because of the appearance (and disappearance) of dinosaurs. The most common vegetal organisms were trees and plants with seeds and flowers. The warm climate boosted a huge spreading of the flora, that supplied dinosaurs with large amounts of food.

### ***The Cainozoic age***

The Cainozoic age ranges from 65 million years ago to 2 million years ago and corresponds to the age of Mammals. Actually, as the big reptilians disappeared, forests and plains were invaded by these animals. The flora and fauna began to look as they do today.

### ***The Neozoic age***

The Neozoic age (which means "new life"), the age in which we live. It is in this age, which is still young compared to the earlier ones, that man made his appearance. Man has soon learnt to grow and exploit plants for his needs, to obtain more and more productive species through cross-breeding, and recently also to manipulate them genetically to artificially create plants with specific characteristics.