

PLANTS IN OUR LIFE

The celebration of the *Fascination of Plants Day* on the 18th May 2012 is an initiative run under the umbrella of the EPSO (European Plant Science Organization) and has the support of organisations from over 36 countries.

We want to draw attention to the important place plants have in our lives. Plants release the oxygen we breathe and grow thanks to their capacity to turn light into chemical energy contained in the sugars they produce when they fix carbon-dioxide from the atmosphere. They also constitute our own basic food-stuff as well as that of animals. We also get fibre, pigments and active ingredients with medicinal properties from plants. Plant investigation prompted the birth of two scientific disciplines: Genetics and Virology, as can be seen in this game. All these facts emphasize the need to keep on investigating the fascinating world of plants.

How to play the game

1. Look at the pictures and choose a plant or a famous scientist.
2. From this square, move **horizontally** or **vertically** to the nearest square depicting a scientist.
3. From here, move to the **left** or **right** to the nearest plant square.
4. From that square, move **up** or **down** to the nearest square depicting a famous scientist.
5. Now, move **diagonally** to the nearest square depicting a plant.
6. From this square move **downwards** or **to the left** to the nearest square depicting a scientist.
7. And ... you will have arrived at the *Fascination of Plants Day* square.

Scientists

MENDEL, Gregor Johann (1822-1884)
Born in Heinzendorf, a town in the Austro-Hungarian Empire, now in the Czech Republic. He performed experiments to make hybrids of the pea (*Pisum sativum* L.) and discovered the basic laws of biological inheritance and the concept of the informative units transmitted by parents to their offspring: genes. Mendel is thought of as the father of Genetics.

McCLINTOCK, Barbara (1902-1992)
American. Nobel Prize in Physiology or Medicine in 1983. Discovered the existence of fragments of mobile DNA in the corn genome which were later called transposons or *jumping genes*, capable of causing flower variegated phenotypes (which change colour due to the expression of regulator genes of the biosynthesis of anthocyanins). This discovery opened up the possibility of generating genetic variability by using transposons to produce mutations.

BORLAUG, Norman (1914-2009)
American. Nobel Peace Prize winner in 1970. Plant breeder and considered the father of the *Green Revolution*. He obtained very productive varieties of wheat and rice with short growth cycles and semi-dwarf phenotypes (it has recently been found that those varieties are insensitive to gibberellins which are phytohormones responsible for stem lengthening) thus diminishing losses due to the spikes drooping. The increase in the grain productivity spread globally. The new varieties along with agriculture becoming more mechanised and the use of fertilizers and pesticides allow feeding today more than 7 billion people.

DARWIN, Charles Robert (1809-1882)
British. Father of the *Theory of Evolution* by *Natural Selection*. He described in a systematic way the ability of plants to perform movements that allow them to climb to improve their exposure to light (using stems, peduncles, stalks, tendrils, nerves in the leaves and adventitious roots), the capture of insects for food (carnivorous plants) or the bending in response to environmental factors such as the light.

GOETHE, Johann Wolfgang von (1749-1832)
German writer and scientist. He observed the phenomenon of phyllody in roses and suggested that leaves are the basic structure of plants and that the other organs are actually modified leaves. Two hundred years later, genetic engineering techniques have shown that Goethe's hypothesis was correct: when the activities of the genes named, A, B, and C are suppressed, all the organs of a flower become leaves.

Plants

PEA *Pisum sativum*
The species originated in the Near East and belongs to the legume family, the second most agronomically important plant group after the *gramineae*. Legumes are very important to the environment, given that they are capable of fixing atmospheric nitrogen and thus keeping the soil fertile. Peas are an excellent source of proteins, carbohydrates and minerals.

WHEAT *Triticum* sp.
A group of cereals of the genus *Triticum*, belonging to the *Gramineae* family originating in Mesopotamia. Along with corn and rice this group are the most important staple foods. The most cultivated species are *Triticum aestivum* used for bread-making and *Triticum durum* for pasta. Today it is grown world-wide and over 600 million tons are harvested annually.

RICE *Oryza sativa*
A species originating in China or India which is the basic foodstuff in Asia. At present, rice contributes one fifth of all the calories consumed by humanity. After corn, rice is the most widely cultivated *Gramineae* in the world, the production being over 600 million tons. It has less proteins than wheat or corn. Exclusively rice-based diets provide sufficient calories but cause serious eye disorders as conventional varieties lack pro-vitamin-A.

IVY *Hedera helix*
A plant of ancient origins, from the humid forests of the Middle East and Southern Europe, a survivor of the laurisilva (sub-tropical forest) flora of the Tertiary era. It is capable of climbing to the top of a cliff or making its way to the top of the tallest trees using its adventitious roots. *Hedera helix* possesses vasodilating substances such as hederin. Dioscorides states that ivy has been used in natural medicine applied both orally and locally.

ROSE *Rosa* sp.
The genus *Rose* is made up of over a hundred species belonging to the rose family. Most of them originated in Asia. The original varieties and hybrids are commonly grown in gardens and much appreciated for their beauty and fragrance. Essential oils are extracted from the flowers for use in cosmetics and perfumes. Many roses display numerous petal whorls due to the homeotic transformation of the flower stamen into petals. Blue roses are impossible to create by hybridization but two varieties called *Moonshadow* and *Moon dust* have been produced by the introduction, using genetic engineering, of a petunia gene which produces a shade of delphinium blue.

SHELL, Jeff (1935-2003) y Van MONTAGU, Marc (1933-)
Belgians. They discovered the genetic transfer between *Agrobacterium* and plants, now used as a fundamental tool in reverse genetics techniques which allow us to understand the functions of genes, as well as for the generation of transgenic crops, some of the advantages of which are that they are resistant to attack by insects and/or tolerant to herbicides.

CALVIN, Melvin (1911-1997)
American. Nobel Chemistry Prize winner in 1961. He discovered the process of photosynthetic assimilation of carbon-dioxide by the green cells of plants, the process known as the Calvin Cycle, using cultures of the unicellular algae *Chlorella pyrenoidosa*.

SCHLEIDEN, Matthias Jakob (1804-1881)
German. Basing his ideas on observations with a microscope, he proposed the cellular theory, in which the cell is the structural unit common to all plants, which grow thanks to the generation of new cells. The studies into the processes going on in plant cells led to the birth of Embryology. Later, his colleague and fellow-countryman Theodor Schwann extended the cellular theory to the animal world, thus unifying Botany and Zoology under a common theory. In the XX Century the Frenchman Roger Gautheret and the American Philip White developed the technique of *in vitro* plant cultivation using growth regulators (phytohormones). Meanwhile, the Dutch scientist Frits Went discovered that auxins are the growth regulators responsible for giving plants the capacity to bend towards stimuli such as light, the phenomenon which Darwin had observed in his experiments. At the same time (1926), the Japanese research scientist Eiichi Kurosawa, was studying the "bakanae" plant disease (mad rice plants), when he discovered another type of plant growth regulator, the gibberellin, responsible for stalk length. The ability of a plant cell to differentiate into any kind of cell type and lead to a complete plant, called "totipotency", was proposed by Gottlieb Haberlandt and demonstrated experimentally by Frederick C. Steward. This feature forms the basis of *in vitro* culture systems and production of plant clones that are used, among other purposes, for genetic transformation.

BEIJERINCK, Martinus Willem (1851-1931)
Dutch. Founder of Virology. Using very fine filters and other techniques, he demonstrated that causal agent of the Tobacco Mosaic Virus (TMV) belonged to a new class of pathogens that he called virus. He also discovered, using broad-beans (*Vicia faba*) in his experiments, the symbiotic fixing of nitrogen by legumes which is a fundamental process for keeping soils fertile.

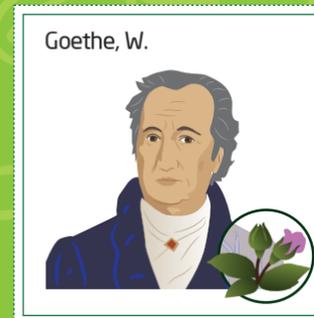
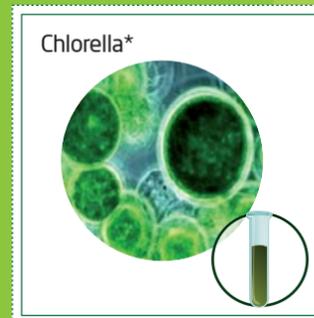
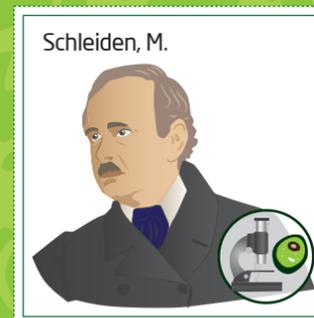
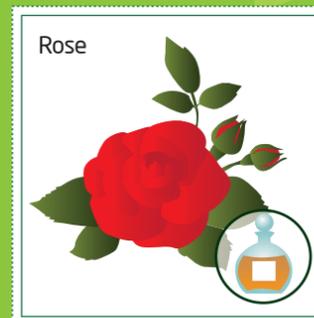
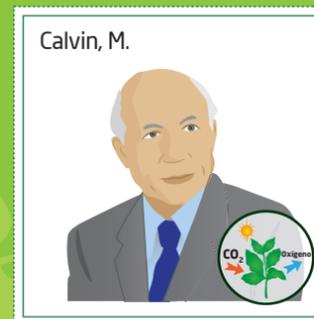
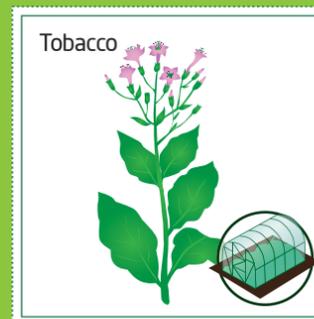
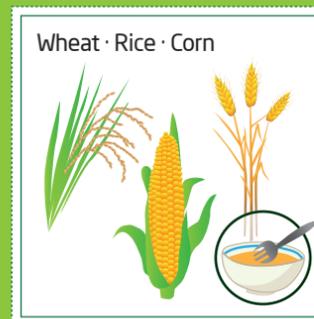
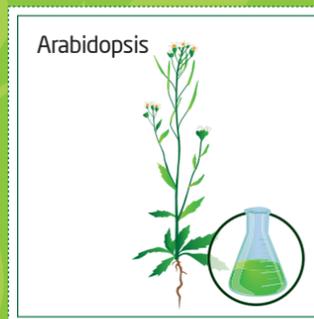
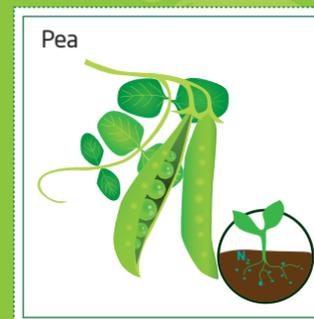
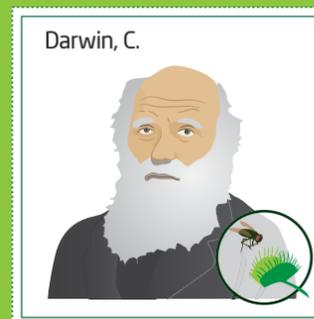
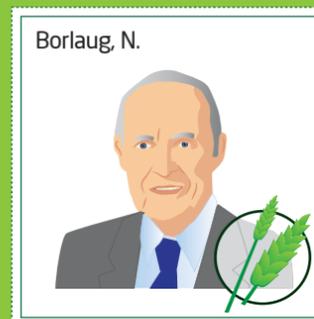
CORN *Zea mays*
Belongs to the *Gramineae* family. The species originated in America, and was introduced into Europe in the XVI Century. It is the staple food cereal produced in the greatest quantity (820 million tons in 2010-11), ahead of both wheat and rice. The seeds contain high amounts of starch, polyunsaturated fatty acids and carotenes.

TOBACCO *Nicotiana tabacum*
Tobacco originates in South America, in the Andean regions of Peru and Ecuador. Tobacco consumption in the Maya civilization was associated with ritual and religious practices. Following the discovery of the Americas, tobacco cultivation and consumption spread to Europe. It is now known from numerous research studies that tobacco consumption causes serious health problems. Both *Nicotiana tabacum* and *Nicotiana glauca* are used for laboratory experiments, especially for *in vitro* cultures, genetic modification and agroinfiltration.

ARABIDOPSIS *Arabidopsis thaliana*
Herbal species belonging to the *Brassicaceae* family which is considered the model plant for biological studies. Since the year 2000 we have had its complete genome sequence. Its most useful characteristics are: diploid, rapid generation, many seeds produced per plant, natural variation with many ecotypes, availability of numerous collections of mutants, easy to modify genetically and accessibility to the use of reverse genetic techniques.

CHLORELLA *Chlorella pyrenoidosa*
Chlorella is a genus of unicellular green algae containing the photosynthetic machinery in their chloroplasts. Photosynthesis is the basic process used by plants, algae and cyanobacteria in order to fix carbon-dioxide from the atmosphere and release oxygen to the atmosphere. Without this process life as we know it would not be possible. Studies on photosynthesis carried out in *Chlorella pyrenoidosa* led Melvin Calvin to the Nobel Prize in Chemistry in 1961 for the discovery of the metabolic pathways of carbon-dioxide assimilation.

ORANGE *Citrus sinensis*
A fruit tree, native to China, belonging to the genus *Citrus* of the family *Rutaceae*. Of all fruit trees, citrus cultivation is one of the most important worldwide. Oranges contain high levels of vitamin C, flavonoids and essential oils. Vitamin C deficiency can lead to scurvy which can cause death by generalised haemorrhages. Sailors often suffered from scurvy until the British doctor, James Lind, discovered that just eating citrus fruit was enough to cure it and convinced the famous Captain Cook that the treatment was effective.



The algae **Chlorella* is included as a model photosynthetic organism.

You can choose any square to start your game. Due to a mathematical property that governs the instructions of the game you will always end up on the **Gregor Mendel** square which commemorates the *Fascination of Plants Day*.

Note: The plants and discoveries chosen for the game are representative of the fascination we hold for them but are only examples of many others which could have been selected. We invite you to create a new game with your own choices.

For more information on activities for the *Fascination of Plants Day* please contact: José Pío Beltrán, National Coordinator for Spain. jpbeltran.fascinationofplants@dicv.csic.es