DONATO PICCOLO

L'ARTE DEL PENSIERO MECCANICO

Texts for brochure by
PopMED snc: Daniela Longo, Erika Nerini
and Mattia Di Bartolomeo

popmed

EFFETTO FARFALLA (BUTTERFLY EFFECT)

As science progresses, it is increasingly evident how various events on our planet are determined by a multitude of interconnected factors. That is to say, we live in a **complex system** where many elements interact with each other and it is not always possible to trace a linear relationship between **cause and effect**. More elaborate theories have been developed for this.
A fascinating example of this complexity is the **butterfly effect**, a metaphor that originated in the field of chaos theory. The butterfly effect explains how **small initial changes** in a complex system can trigger a chain reaction, eventually leading to totally unexpected, potentially immense results: in 1972 scientist Edward Lorenz made this theory famous in a presentation called “Does the Flap of a Butterfly's Wings in Brazil Set Off a Tornado in Texas?” Since then, the butterfly effect metaphor at the basis of chaos theory has become more popular, also giving the title to a successful early 2000s film.
This vision reminds us of the hand that even the smallest action can have in making **significant transformations**. If everything is interconnected, which day-to-day choices can help us generate a positive impact on our planet?

*Image generated with artificial intelligence: created with **Gemini (Google AI)** and then edited and optimized with **ChatGPT (OpenAI)** and **Canva**.*

FLUIDODINAMICA (FLUID DYNAMICS)

Liquids and gases have no shape of their own: they adapt to fit the container that hosts them. Unlike in solids, each of their particles can move freely. This is why they are called **fluids**: because they can move, deform and flow.
When a force is applied to a fluid, it can set itself in motion or change shape. The science that studies these behaviours is called **fluid dynamics**. It deals not only with the motion of fluids, but also with the factors that influence them, the effects they produce and their possible uses.
Since ancient times, scholars such as **Archimedes** have wondered about the behaviour of fluids: his discovery of the principle of buoyancy and his exclamation "Eureka!" are famous. Centuries later, the **Wright brothers** exploited the principles of fluid dynamics to build the first working aeroplane.
We find fascinating examples of fluid dynamics among animals too: in the **hummingbird**, which can remain suspended thanks to its incredibly rapid wing beat; or in **sea turtles**, whose tapered form allows them to glide through the water following the ocean currents.
The laws of fluid dynamics also explain fundamental natural phenomena: from **ocean currents** to the **movement of magma** in volcanoes to the way **blood flows in our blood vessels**.
Understanding how fluids move helps us read the world around us – and the world within us too.

*Image generated with artificial intelligence: created with **Gemini (Google AI)** and then edited and optimized with **ChatGPT (OpenAI)** and **Canva**.*

ELECTROMAGNETISMO (ELECTROMAGNETISM)

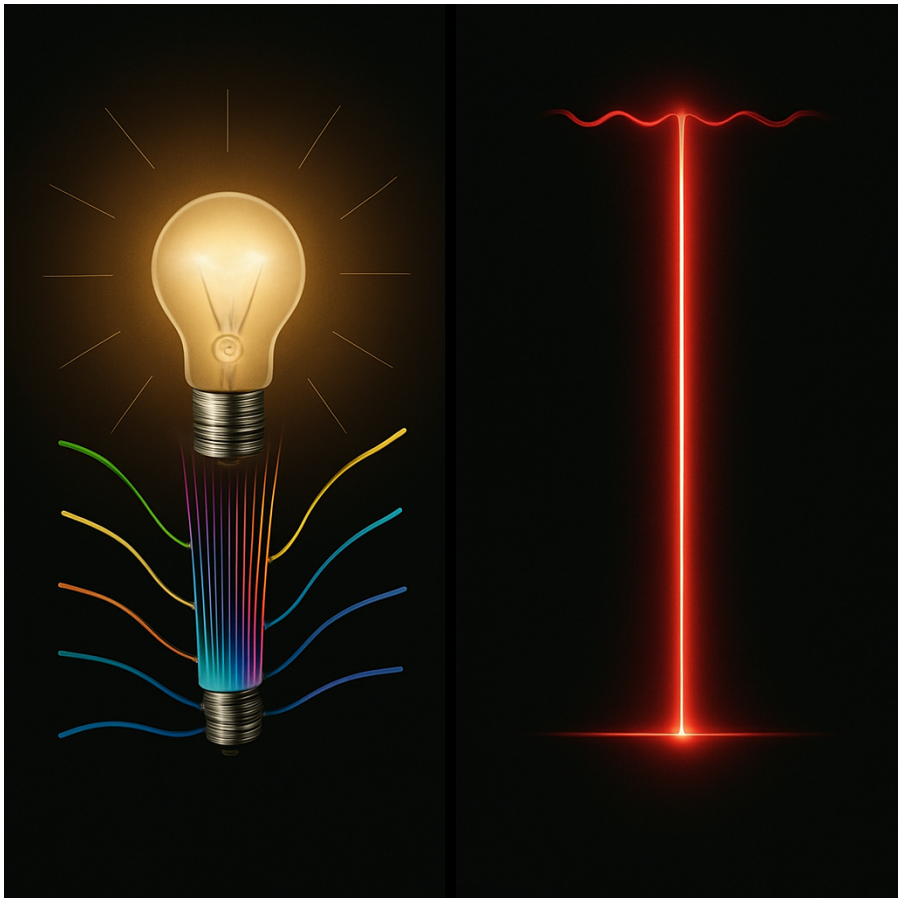
Magnets attract or repel each other thanks to a physical phenomenon called a **magnetic field**, a region of space in which forces act on magnetic materials or moving charges.
Electric current, on the other hand, is the flow of electrons moving within a conducting material, such as a copper wire.
These two phenomena meet in **electromagnetism**, a branch of physics that studies the close links between electricity and magnetism: an electric current can generate a magnetic field, and a changing magnetic field can in turn generate an electric current.
Electromagnetism is behind a great many of the technologies we use every day, such as mobile phones, electric motors, the electric grid or Wi-Fi. But it can also be seen in nature, in spectacular phenomena such as **lightning** or **polar auroras**.
Even simple instruments such as a **compass** exploit electromagnetism: it is thanks to the earth's magnetic field that they help us get our bearings. Similarly, many **migratory animals**, such as birds and sea turtles, are able to sense our planet's magnetic field – an ability called **magnetoreception** – to find their way on their long journeys.

*Image generated with artificial intelligence: created with **Gemini (Google AI)** and then edited and optimized with **ChatGPT (OpenAI)** and **Canva**.*

TEORIA DEI LASER (LASER THEORY)

The white light we see every day is not a single wave, but a collection of **many colours**, each with a different **wavelength**. This is demonstrated when a ray of light passes through a prism: the light separates into its component colours, revealing this composition which is otherwise invisible to the naked eye.
But light can also be **manipulated and controlled with extreme precision**. This is what happens in **laser technology**, which produces beams of light with very special characteristics. The term **LASER** is actually an acronym of *Light Amplification by Stimulated Emission of Radiation.* The theory behind this phenomenon was proposed by **Albert Einstein** in the early twentieth century, leading to the creation of the first laser decades later.
Laser light has three basic characteristics: it is **monochromatic** (it is a single colour, hence with a single wavelength), **collimated** (the beams travel nearly parallel to each other) and **coherent** (the waves are in phase with each other). All this makes it possible to **direct the beam of light with great precision** and **concentrate its energy** in one minute spot.
This is why lasers are applied in so many areas: from **distance sensors** to **metal cutting**, from **precious material engraving** to **fibre-optic telecommunications**, and even **eye surgery** and **physiotherapy** to treat muscle and joint inflammation.

*Image generated with artificial intelligence: created with **Gemini (Google AI)** and then edited and optimized with **ChatGPT (OpenAI)** and **Canva**.*



INTELLIGENZA ARTIFICIALE (ARTIFICIAL INTELLIGENCE)

The term **artificial intelligence** (AI) refers to the ability of machines to mimic certain human cognitive functions, such as **reasoning**, **learning** or **problem solving**.
AI is based on **complex mathematical models and algorithms** capable of learning from data. This process is called **machine learning** and can be *supervised* (guided by humans) or *unsupervised* (the machine finds patterns and rules in the data on its own).
Although it has only become a topic of great interest in recent years, artificial intelligence has a long history: as early as the 1950s, mathematician **Alan Turing** pondered whether machines could think. And in the 1960s, the first chatbot, **ELIZA**, was born: a distant cousin of modern virtual assistants such as ChatGPT.
The recent development of AI has been made possible by innovations such as **artificial neural networks**, models that are inspired by the structure of the neurons in the human brain.
Today, AI is used in many areas: from medicine to art, science to industry. And such is its impact that **two of the six 2024 Nobel Prizes** were awarded for research related specifically to artificial intelligence!
Like any major innovation, however, AI calls for oversight: **clear rules** and **ethical choices** are needed to ensure that it is used responsibly and safely, to serve people.

*Image generated with artificial intelligence: created with **Gemini (Google AI)** and then edited and optimized with **ChatGPT (OpenAI)** and **Canva**.*

AUTOPOIESI ROBOTICA (ROBOTIC AUTOPOIESIS)

Autopoiesis (from the Greek for "self-creation") is a concept in biology that describes living systems capable of **self-organizing** and **maintaining themselves** in time.
This ability to **maintain one's own internal organization** is considered one of the fundamental characteristics of life, and we find it in every living thing, from animals to plants to microorganisms.
In recent years, the concept of autopoiesis has also been extended to the field of **robotics**. Robots, by definition, are not living things: they depend on external instructions and on the energy or materials that we provide. But with **robotic autopoiesis**, scientists are trying to design robots that are capable of **self-diagnosing**, **self-repairing** and even **autonomously managing the resources and materials** to continue functioning. The nearest example, despite their limited scope, are vacuum cleaner robots that go to recharge and empty themselves...we are still some way from true autopoiesis!
If these developments become reality, we will be able to have more and more independent machines capable of adapting to the environment by themselves. A new frontier bringing us closer and closer to the fine line between what is **mechanical** and what is **living**.

*Image generated with artificial intelligence: created with **Gemini (Google AI)** and then edited and optimized with **ChatGPT (OpenAI)** and **Canva**.*