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Leonardo da Vinci, "El hombre vitruviano", 1485.

En sus 67 años de vida, Leonardo da Vinci hizo por lo menos siete códices o cuadernos que, sumados, comprenden más de 7.000 páginas de apuntes y dibujos, hoy en manos de museos y bibliotecas en Windsor, París, Londres, Madrid, Turín, y en la colección privada de Bill Gates, quien en 1994 compró uno, el Códice de Leicester. La Mona Lisa y La última cena son sus obras más conocidas, pero no cabe duda de que la verdadera riqueza del trabajo de Leonardo reside en los hoy más de cinco mil apuntes que en ellas plasmó sus observaciones en temas tan variados como botánica, anatomía, óptica e ingeniería. “Era 100 hombres en uno”, dice Walter Isaacson para resaltar esa capacidad de su mente de brincar de un tema a otro y profundizar en todos como un especialista. Esa también, sea también, la pelea para que Leonardo DiCaprio sea Leonardo da Vinci hoy, 500 años después, este legado no solo prueba el nivel de su mente creativa y peregrina, de su monumental capacidad de observación y del extraordinario don para dibujar, sino de cómo, con su trabajo, desarrolló un método experimental que involucra la observación de la naturaleza, el conocimiento lógico y algunas fórmulas matemáticas. Pero eso, un método de trabajo que demuestra el uso de instrumentos musicales de viento y percusión. Uno de ellos, la viola organista, que lo polaco Szymon Zubrzycki construyó en 2012 con base en los dibujos en las que se interesó este hombre que bien podría ser el padre de la ciencia moderna. Los talentos de Leonardo se apoyan en el dibujo. Pero, al mismo tiempo, su entendimiento de la física, la botánica y la geología nutrieron su disposición para dibujar. El papel doble de los dibujos del artista, dice Capra, “muestra por qué su ciencia no se entiende sin su arte, ni su arte sin su ciencia”. El creador usó ese don para plasmar el mundo a su alrededor, y lo hizo con esa mezcla brillante de obsesión por el detalle y una monumental destreza artística. Con esto, como se dice Francesca Fiorani, decana de artes y humanidades de la Universidad de Virginia, “hizo visible el conocimiento”. Esa capacidad de observación produjo retratos de personas con una mirada más humana y permitió técnicas revolucionarias como el sfumato, que consiste en dar al contorno de sus objetos y personajes una sensación indefinida y, por lo tanto, natural. De su estudio de la óptica desarrolló un sentido de perspectiva sutil que se expresa con maestría en La última cena. Da Vinci se interesó en el estudio del cuerpo humano durante su estadía en Milán en 1480. Para esto diseccionó cadáveres y estudió a fondo órganos como el corazón, así como músculos y huesos, lo que le permitió conocer a profundidad su fisiología. Muchos de sus contemporáneos también lo hacían para perfeccionar sus esculturas, pero Da Vinci fue más allá al estudiarlos con la mirada de un anatomista. En contexto: Julio Verne, Da Vinci y Nantes en un solo proyecto De hecho, quería hacer un tratado que, de haber publicado, lo habría convertido en padre de la anatomía moderna, título que reclamaría más tarde Andreas Vesalius. En 1490 hizo un estudio detallado de las proporciones humanas para crear una forma real del cuerpo. El cuadro de El Hombre Vitruviano, una figura desdoblada sobrehecha y marcada en una circunferencia y un cuadrado, hoy considerado el símbolo de la simetría y del humanismo del Renacimiento. Da Vinci clasificó su habilidad musical en el segundo lugar después de la pintura y fue por encima de la escultura. Desde entonces la música como la capacidad de “representar a cosas invisibles”. Además de tocar, también inventó un instrumento musical de viento y percusión. Uno de ellos, la viola organista, que lo polaco Szymon Zubrzycki construyó en 2012 con base en los dibujos y las anotaciones del artista. Presentó el instrumento en un concierto en un castillo al sur de Suecia, y tal como explicó Da Vinci en sus apuntes, generó sonidos perfectos. Diseñó puentes, edificios, armas pesadas como tanques y catapulas, máquinas, submarinos, y hasta un aparato para respirar bajo el agua. La fascinación de Da Vinci por la ingeniería no tenía límites, como refleja el Códice Atlanticus, el más extenso de todos. También se enfocó en la mecánica de las palancas, las grúas, los engranajes, la hidráulica, las bicicletas y los rodamientos. La mayoría nunca fueron construidos, pero su talento artístico permitió que esas ideas quedaran plasmadas en dibujos con tal detalle que sirven de planos para realizarlos. Da Vinci estudió durante dos décadas el vuelo de los pájaros y sus últimos cuadernos contienen numerosos análisis de alas basadas en la estructura de las de los murciélagos. También dibujó máquinas voladoras para humanos, como el famoso ornitóptero, que muestra los poderes de observación e imaginación del artista, así como su sueño por volar. Algunos expertos consideran que una de sus creaciones, el tornillo volador, presagia el helicóptero moderno, que, según las indicaciones del artista, debía construirse con cable, caña y lino. Además de eso, dibujó alas mecánicas, alas delta y paracaídas. En una época en que los mapas tenían poca precisión, duques y reyes le encargaron a Da Vinci la tarea de diseñar planos para fines militares. De esas misiones provienen los mapas de la ciudad de Imola en 1502, que produjeron mucha admiración, así como el del valle de Chiama, en la Toscana, en que Da Vinci hizo al medir las distancias con pasos. También elaboró el mapa de la costa del sur de Roma, inmediatamente después de la batalla de la Vozza. En 1511, en la Toscana y en el valle del río Arno y de las zonas de necheros, realizó una técnica conocida como perspectiva cartográfica, que logró plasmar en un mapa de la cartografía aérea. Muchos bocetos y diseños se convirtieron en un gran folio de trabajo. Resulta interesante ver cómo la lógica para resolver problemas se refleja en muchos de estos dibujos que realizó de catedrales, edificios, castillos y fuertes. Un ejemplo es cómo concebía la naturaleza en sus disciplinas en su escalera espiral basada en la concha de un caracol. Para el diseño de la cúpula de la catedral de Milán, el artista hizo un boceto detallado, desde diferentes ángulos que incluyó una vista aérea. Ese trabajo nunca se hizo realidad. El estudio de plantas y animales es evidente en sus dibujos. 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Microbiology, Jurassic, Cretaceous, Tertiary, and Quaternary.[95] The similarities among all known present-day species indicate that they have diverged through the process of evolution from their common ancestor.[97] Biologists regard the ubiquity of the genetic code as evidence of universal common descent for all bacteria, archaea, and eukaryotes.[98][99][100] Microbial mats consisting of bacteria and archaea are the dominant form of life in the early Archean eon, and many of the major steps in early evolution are thought to have taken place in such mats. The earliest life on Earth is thought to have been present earlier, their diversification accelerated when they started using oxygen in their metabolism. Later, around 1.7 billion years ago, multicellular organisms began to appear, with differentiated cells performing specialised functions.[104] Algae-like multicellular plants are dated back to about 1 billion years ago.[105] Although evidence suggests that microorganisms formed the earliest terrestrial ecosystems, at least 2.7 billion years ago.[106] Microorganisms are thought to have paved the way for the early evolution of land plants in the Ordovician period. Land plants were so successful that they are thought to have contributed to the Late Devonian extinction event.[107] Ediacara biota appear during the Ediacaran period,[108] while vertebrates, along with most other modern phyla originated about 525 million years ago during the Cambrian explosion.[109] During the Permian period, synapsids, including the ancestors of mammals, dominated the land, [110] but most of this group became extinct in the Permian-Triassic extinction event 252 million years ago.[111] During the recovery from this catastrophe, archosaurs became the most abundant land vertebrates.[112] One archosaur group, the dinosaurs, dominated the Jurassic and Cretaceous periods.[113] After the Cretaceous–Paleogene extinction event 66 million years ago killed off the non-avian dinosaurs,[114] mammals increased rapidly in size and diversity.[115] Such mass extinctions may have accelerated evolution by providing opportunities for new groups of organisms to diversify.[116] Further information: Microbiology Bacteria – Gemmatimonas aurantiaca (=1 Micrometer)Archaea – Haloarchaea Bacteria are a type of cell that constitute a large domain of prokaryotic microorganisms. Typically a few micrometers in length, bacteria have a number of shapes, ranging from spheres to rods and spirals. Bacteria were among the first life forms to appear on Earth, and are present in most of its habitats. Bacteria inhabit soil, water, acidic hot springs, radioactive waste,[117] and the deep biosphere of the Earth's crust. Bacteria also live in symbiotic and parasitic relationships with plants and animals. Most bacteria have not been characterised, and only about 2% of the bacterial phyla have species that can be grown in the laboratory.[118] Archaea consist of the other domain of prokaryotic cells and were initially classified as bacteria, receiving the name archaeobacteria (in the Archaeobacteria kingdom), a term that has fallen out of use.[119] Archaeal cells have unique properties separating them from the other two domains, Bacteria and Eukaryota. Archaea are further divided into multiple recognized phyla. Archaea and bacteria are generally similar in size and shape, although a few archaea have very different shapes, such as the flat and square cells of Haloquadratum walsbyi.[120] Despite this morphological similarity to bacteria, archaea possess genes and several metabolic pathways that are more closely related to those of eukaryotes, notably for the enzymes involved in transcription and translation. Other aspects of archaeal biochemistry are unique, such as their reliance on ether lipids in their cell membranes.[121] Including archaeoels. Archaea use more energy sources than eukaryotes: these range from organic compounds, such as sugars, to ammonia, metal ions or even hydrogen gas. Salt-tolerant archaea (the Haloarchaea) use sunlight as an energy source, and other species of archaea fix carbon, but unlike plants and cyanobacteria, no known species of archaea does both. Archaea reproduce asexually by binary fission, fragmentation, or budding; unlike bacteria, no known species of Archaea form endospores. The first observed archaea were extremophiles, living in extreme environments, such as hot springs and salt lakes with no other organisms. Improved molecular detection tools led to the discovery of archaea in almost every habitat, including soil, oceans, and marshlands. Archaea are particularly numerous in the oceans, and the archaea in plankton may be one of the most abundant groups of organisms on the planet. Archaea are a major part of Earth's life. They are part of the microbiota of all organisms. In the human microbiome, they are important in the gut, mouth, and on the skin.[122] Their morphological, metabolic, and geographical diversity permits them to play multiple ecological roles: carbon fixation; nitrogen cycling; organic compound turnover; and maintaining microbial symbiotic and syntrophic communities, for example.[123] Main article: Eukaryotes Eukaryotes are single-celled or multicellular organisms with a nucleus. Eukaryotes are hypothesised to have split from archaea, which was followed by their endosymbiosis with bacteria (or symbiogenesis) that gave rise to the eukaryotic cell. The blastula, during embryonic development. Over 1.5 million living animal species have been described—of which around 1 million are insects—but it has been estimated there are over 7 million animal species in total. They have complex interactions with each other and their environments, forming intricate food webs.[129] Main article: Virus Bacteriophages attached to a bacterial cell wall Viruses are submicroscopic infectious agents that replicate inside the cells of organisms.[130] Viruses infect all types of life forms, from animals and plants to microorganisms, including bacteria and archaea.[131][132] More than 6,000 virus species have been described in detail.[133] Viruses are found in almost every ecosystem on Earth and are the most numerous type of biological entity.[134][135] The origins of viruses in the evolutionary history of life are unclear: some may have evolved from plasmids—pieces of DNA that can move between cells—while others may have evolved from bacteria. In evolution, viruses are an important means of horizontal gene transfer, which increases genetic diversity in a way analogous to sexual reproduction.[136] Because viruses possess some but not all characteristics of life, they have been described as “organisms at the edge of life”.[137] and as self-replicators.[138] Main article: Ecology Ecology is the study of the distribution and abundance of life, the interaction between organisms and their environment.[139] Main article: Ecosystem The community of living (biotic) organisms in conjunction with the nonliving (abiotic) components (e.g., water, light, radiation, temperature, humidity, atmosphere, acidity, and soil) of their environment is called an ecosystem.[140][141][142] These biotic and abiotic components are linked together through nutrient cycles and energy flows.[143] Energy from the sun enters the system through photosynthesis and is incorporated into plant tissue. By feeding on plants and on one another, animals move matter and energy through the system. They also influence the quantity of plant and microbial biomass present. By breaking down dead organic matter, decomposers release carbon back to the atmosphere and facilitate nutrient recycling by converting nutrients stored in dead biomass back to a form that can be readily used by plants and other microbes.[144] Main article: Population ecology Reaching carrying capacity through a logistic growth curve A population is the group of organisms of the same species that occupies an area and reproduce from generation to generation.[145][146][147][148][149] Population size can be estimated by multiplying population density by the area or volume. The carrying capacity of an environment is the maximum population size of a species that can be sustained by that specific environment, given the food, habitat, water, and other resources that are available.[150] The carrying capacity of a population can be affected by changing environmental conditions such as changes in the availability of resources and the cost of maintaining them. In human populations, new technologies such as the Green revolution have helped increase the Earth's carrying capacity for humans over time, which has stymied the attempted predictions of impending population decline, the most famous of which was by Thomas Malthus in the 18th century.[145] Main article: Community (ecology) A (a) trophic pyramid and a (b) simplified food web. The trophic pyramid represents the biomass at each level.[151] A community is a group of populations of species occupying the same geographical area at the same time.[152] A biological interaction is the effect that a pair of organisms living together in a community have on each other. They can be either of the same species (intraspecific interactions), or of different species (interspecific interactions). These effects may be short-term, like pollination and predation, or long-term; but often strongly influence the evolution of the species involved. A long-term interaction is called a symbiosis. Symbioses range from mutualism, beneficial to both partners, to competition, harmful to both partners.[153] Every species participates as a consumer, resource, or both in consumer–resource interactions, which form the core of food chains or food webs.[154] There are different trophic levels within any food web, with the lowest level being the primary producers (or autotrophs) such as plants and algae that convert energy and inorganic material into organic compounds, which can then be used by the rest of the community.[146][155][156] At the next level are the heterotrophs, which are the species that obtain energy by breaking apart organic compounds from other organisms.[154] Heterotrophs can be primary consumers (or herbivores) whereas heterotrophs that consume herbivores are secondary consumers (or carnivores). And those that eat secondary consumers are tertiary consumers and so on. Omnivorous heterotrophs are able to consume at multiple levels. Finally, there are decomposers that feed on the waste products or dead bodies of organisms.[154] On average, the total amount of energy incorporated into the biomass of a trophic level per unit of time is about one-tenth of the energy of the trophic level that it consumes. Waste and dead material used by decomposers as well as heat lost from metabolism make up the other ninety percent of energy that is not consumed by the next trophic level.[157] Main article: Biosphere Fast carbon cycle showing the movement of carbon between land, atmosphere, and oceans in billions of tons per year. Yellow numbers are natural fluxes, red are human contributions, white are stored carbon. Effects of the slow carbon cycle, such as volcanic and tectonic activity, are not included.[158] In the global ecosystem or biosphere, matter exists as different interacting compartments, which can be biotic or abiotic as well as accessible or inaccessible, depending on their forms and locations.[159] For example, matter from terrestrial autotrophs are both biotic and accessible to other organisms whereas the matter in rocks and minerals are abiotic and inaccessible. A biogeochemical cycle is a pathway by which specific elements of matter are turned over or moved through the biotic (biosphere) and the abiotic (lithosphere, atmosphere, and hydrosphere) compartments of Earth. There are biogeochemical cycles for nitrogen, carbon, and water. Main article: Conservation biology Conservation biology is the study of the conservation of Earth's biodiversity with the aim of protecting species, their habitats, and ecosystems from excessive rates of extinction and the erosion of biotic interactions.[160][161][162] It is concerned with factors that influence the maintenance, loss, and restoration of biodiversity and the scientific of sustaining evolutionary processes that engender genetic, population, species, and ecosystem diversity.[163][164][165][166] The concern stems from estimates suggesting that up to 50% of all species on the planet will disappear within the next 50 years.[167] which has contributed to poverty, starvation, and will reset the course of evolution on this planet.[168][169] Biodiversity affects the functioning of ecosystems, which provide a variety of services upon which people depend. Conservation biologists research and educate on the trends of biodiversity loss, species extinctions, and the negative effect these are having on our capabilities to sustain the well-being of human society. Organizations and citizens are responding to the current biodiversity crisis through conservation action plans that direct research, monitoring, and education programs that engage concerns at local through global scales.[170][163][164][165] Biology in fiction Glossary of biology Idiobiology List of biological websites List of biologists List of biology journals List of biology topics List of life sciences List of omics topics in biology National Association of Biology Teachers Outline of biology Periodic table of life sciences in Tiberghien's four questions Science tourism Terminology of biology * Modell, Harold; Cliff, William; Michael, Joel; McFarland, Jenny; Wenderoth, Mary Pat; Wright, Ann (December 2015). 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