

Outline of science

The following outline is provided as a topical overview of science:

Science – systematic effort of acquiring knowledge—through observation and experimentation coupled with logic and reasoning to find out what can be proved or not proved—and the knowledge thus acquired. The word “science” comes from the Latin word “scientia” meaning knowledge. A practitioner of science is called a “scientist”. Modern science respects objective logical reasoning, and follows a set of core procedures or rules in order to determine the nature and underlying natural laws of the universe and everything in it. Some scientists do not know of the rules themselves, but follow them through research policies. These procedures are known as the scientific method.

1 Essence of science

- **Research** – systematic investigation into existing or new knowledge.
- **Scientific discovery** – observation of new phenomena, new actions, or new events and providing new reasoning to explain the knowledge gathered through such observations with previously acquired knowledge from abstract thought and everyday experiences.
- **Laboratory** – facility that provides controlled conditions in which scientific research, experiments, and measurement may be performed.
- **Objectivity** – the idea that scientists, in attempting to uncover truths about the natural world, must aspire to eliminate personal or cognitive biases, a priori commitments, emotional involvement, etc.
- **Inquiry** – any process that has the aim of augmenting knowledge, resolving doubt, or solving a problem.

2 Scientific method

Scientific method – body of techniques for investigating phenomena and acquiring new knowledge, as well as for correcting and integrating previous knowledge. It is based on observable, empirical, measurable evidence, and subject to laws of reasoning, both deductive and inductive.

- **Empirical method** –
- **Experimental method** – The steps involved in order to produce a reliable and logical conclusion include:
 1. Asking a question about a natural **phenomenon**
 2. Making observations of the phenomenon
 3. Forming a **hypothesis** – proposed explanation for a phenomenon. For a hypothesis to be a scientific hypothesis, the scientific method requires that one can test it. Scientists generally base scientific hypotheses on previous observations that cannot satisfactorily be explained with the available scientific theories.
 4. **Predicting** a logical consequence of the hypothesis
 5. **Testing** the hypothesis through an experiment – methodical procedure carried out with the goal of verifying, falsifying, or establishing the validity of a hypothesis. The 3 types of scientific experiments are:
 - **Controlled experiment** – experiment that compares the results obtained from an experimental sample against a control sample, which is practically identical to the experimental sample except for the one aspect the effect of which is being tested (the independent variable).
 - **Natural experiment** – empirical study in which the experimental conditions (i.e., which units receive which treatment) are determined by nature or by other factors out of the control of the experimenters and yet the treatment assignment process is arguably exogenous. Thus, natural experiments are observational studies and are not controlled in the traditional sense of a randomized experiment.
 - **Observational study** – draws inferences about the possible effect of a treatment on subjects, where the assignment of subjects into a treated group versus a control group is outside the control of the investigator.
 - **Field experiment** – applies the scientific method to experimentally examine an intervention in the real world (or as many experimentalists like to say, naturally occurring environments) rather than in the laboratory. See also field research.

6. Gather and analyze data from experiments or observations, including indicators of uncertainty.
7. Draw conclusions by comparing data with predictions. Possible outcomes:
 - Conclusive:
 - The hypothesis is falsified by the data.
 - Data are consistent with the hypothesis.
 - Data are consistent with alternative hypotheses.
 - Inconclusive:
 - Data are not relevant to the hypothesis, or data and predictions are incommensurate.
 - There is too much uncertainty in the data to draw any conclusion.

- Deductive-nomological model
- Scientific modelling –
- Models of scientific method
 - Hypothetico-deductive model – proposed description of scientific method. According to it, scientific inquiry proceeds by formulating a hypothesis in a form that could conceivably be falsified by a test on observable data. A test that could and does run contrary to predictions of the hypothesis is taken as a falsification of the hypothesis. A test that could but does not run contrary to the hypothesis corroborates the theory.

3 Branches of science

See also: Index of branches of science

Branches of science – divisions within science with respect to the entity or system concerned, which typically embodies its own terminology and nomenclature.

3.1 Natural science

Main article: Outline of natural science

See also: Outline of science § Social science

Natural science – major branch of science, that tries to explain and predict nature's phenomena, based on empirical evidence. In natural science, hypotheses must be verified scientifically to be regarded as scientific theory. Validity, accuracy, and social mechanisms ensuring quality control, such as peer review and repeatability of

findings, are amongst the criteria and methods used for this purpose. Natural science can be broken into 2 main branches: biology, and physical science. Each of these branches, and all of their sub-branches, are referred to as natural sciences.

- Branches of natural science (also known as the natural sciences)

3.2 Formal science

Formal science – branches of knowledge that are concerned with formal systems, such as those under the branches of: logic, mathematics, computer science, statistics, and some aspects of linguistics. Unlike other sciences, the formal sciences are not concerned with the validity of theories based on observations in the real world, but instead with the properties of formal systems based on definitions and rules.

- Computer science – study of the theoretical foundations of information and computation and their implementation and application in computer systems. (*See also Branches of Computer Science and ACM Computing Classification System*)
- Theory of computation – branch that deals with whether and how efficiently problems can be solved on a model of computation, using an algorithm
 - Automata theory – study of mathematical objects called abstract machines or automata and the computational problems that can be solved using them.
 - Formal languages – set of strings of symbols.
 - Computability theory – branch of mathematical logic and computer science that originated in the 1930s with the study of computable functions and Turing degrees.
 - Computational complexity theory – branch of the theory of computation in theoretical computer science and mathematics that focuses on classifying computational problems according to their inherent difficulty, and relating those classes to each other
 - Concurrency theory – In computer science, concurrency is a property of systems in which several computations are executing simultaneously, and potentially interacting with each other
- Algorithms – step-by-step procedure for calculations

- **Randomized algorithms** – algorithm which employs a degree of randomness as part of its logic.
- **Distributed algorithms** – algorithm designed to run on computer hardware constructed from interconnected processors
- **Parallel algorithms** – algorithm which can be executed a piece at a time on many different processing devices, and then put back together again at the end to get the correct result.
- **Data structures** – particular way of storing and organizing data in a computer so that it can be used efficiently.
- **Computer architecture** – In computer science and engineering, computer architecture is the practical art of selecting and interconnecting hardware components to create computers that meet functional, performance and cost goals and the formal modeling of those systems.
 - **VLSI design** – process of creating integrated circuits by combining thousands of transistors into a single chip
- **Operating systems** – set of software that manages computer hardware resources and provides common services for computer programs
- **Computer communications (networks)** – collection of hardware components and computers interconnected by communication channels that allow sharing of resources and information
 - **Information theory** – branch of applied mathematics and electrical engineering involving the quantification of information
 - **Internet** – global system of interconnected computer networks that use the standard Internet protocol suite (often called TCP/IP, although not all applications use TCP) to serve billions of users worldwide.
 - **World wide web** – part of the Internet; system of interlinked hypertext documents accessed via the Internet.
 - **Wireless computing** – any type of computer network that is not connected by cables of any kind.
 - **Mobile computing** – form of human-computer interaction by which a computer is expected to be transported during normal usage.
- **Computer security** – branch of computer technology known as information security as applied to computers and networks.
- **reliability** – system design approach and associated service implementation that ensures a prearranged level of operational performance will be met during a contractual measurement period.
- **Cryptography** – practice and study of hiding information.
- **Fault-tolerant computing** – property that enables a system (often computer-based) to continue operating properly in the event of the failure of (or one or more faults within) some of its components
- **Distributed computing** – field of computer science that studies distributed systems
 - **Grid computing** – federation of computer resources from multiple administrative domains to reach a common goal
- **Parallel computing** – form of computation in which many calculations are carried out simultaneously, operating on the principle that large problems can often be divided into smaller ones, which are then solved concurrently (“in parallel”).
 - **High-performance computing** – computer at the frontline of current processing capacity, particularly speed of calculation
- **Quantum computing** – device for computation that makes direct use of quantum mechanical phenomena, such as superposition and entanglement, to perform operations on data
- **Computer graphics** – graphics created using computers and, more generally, the representation and manipulation of image data by a computer with help from specialized software and hardware.
 - **Image processing** – any form of signal processing for which the input is an image, such as a photograph or video frame; the output of image processing may be either an image or a set of characteristics or parameters related to the image
 - **Scientific visualization** – interdisciplinary branch of science according to Friendly (2008) “primarily concerned with the visualization of three-dimensional phenomena (architectural, meteorological, medical, biological, etc.), where the emphasis is on realistic renderings of volumes, surfaces, illumination sources, and so forth, perhaps with a dynamic (time) component”.
 - **Computational geometry** – branch of computer science devoted to the study of algorithms which can be stated in terms of geometry

- **Software engineering** – application of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software; that is the application of engineering to software
 - **Formal methods** – particular kind of mathematically based techniques for the specification, development and verification of software and hardware systems
 - **Formal verification** – act of proving or disproving the correctness of intended algorithms underlying a system with respect to a certain formal specification or property, using formal methods of mathematics
- **Programming languages** – artificial language designed to communicate instructions to a machine, particularly a computer
 - **Programming paradigms** – fundamental style of computer programming
 - **Object-oriented programming** – programming paradigm using “objects” – data structures consisting of data fields and methods together with their interactions – to design applications and computer programs
 - **Functional programming** – programming paradigm that treats computation as the evaluation of mathematical functions and avoids state and mutable data
 - **Program semantics** – field concerned with the rigorous mathematical study of the meaning of programming languages
 - **Type theory** – any of several formal systems that can serve as alternatives to naive set theory, or the study of such formalisms in general
 - **Compilers** – computer program (or set of programs) that transforms source code written in a programming language (the source language) into another computer language (the target language, often having a binary form known as object code)
 - **Concurrent programming languages** – form of computing in which programs are designed as collections of interacting computational processes that may be executed in parallel
- **Information science** – interdisciplinary field primarily concerned with the analysis, collection, classification, manipulation, storage, retrieval and dissemination of information
 - **Database** – organized collection of data, today typically in digital form
 - **Relational database** – collection of data items organized as a set of formally described tables from which data can be accessed easily
 - **Distributed database** – database in which storage devices are not all attached to a common CPU.
 - **Object database** – database management system in which information is represented in the form of objects as used in object-oriented programming
 - **Multimedia** – media and content that uses a combination of different content forms.
 - **hypermedia** – computer-based information retrieval system that enables a user to gain or provide access to texts, audio and video recordings, photographs and computer graphics related to a particular subject.
 - **Data mining** – process that results in the discovery of new patterns in large data sets
 - **Information retrieval** – area of study concerned with searching for documents, for information within documents, and for metadata about documents, as well as that of searching structured storage, relational databases, and the World Wide Web.
- **Artificial intelligence** – branch of computer science that deals with intelligent behavior, learning, and adaptation in machines.
 - **Automated reasoning** – area of computer science and mathematical logic dedicated to understand different aspects of reasoning.
 - **Computer vision** – field that includes methods for acquiring, processing, analysing, and understanding images and, in general, high-dimensional data from the real world in order to produce numerical or symbolic information, e.g., in the forms of decisions.
 - **Machine learning** – scientific discipline concerned with the design and development of algorithms that allow computers to evolve behaviors based on empirical data, such as from sensor data or databases
 - **Artificial neural network** – mathematical model or computational model that is inspired by the structure and/or functional aspects of biological neural networks
 - **Natural language processing** – field of computer science, artificial intelligence (also called machine learning), and linguistics concerned with the interactions

between computers and human (natural) languages.

- **Computational linguistics** – interdisciplinary field dealing with the statistical or rule-based modeling of natural language from a computational perspective.
- **Expert systems** – computer system that emulates the decision-making ability of a human expert
- **Robotics** – branch of technology that deals with the design, construction, operation, structural disposition, manufacture and application of robots
- **Human-computer interaction** – study, planning, and design of the interaction between people (users) and computers.
 - **Numerical analysis** – study of algorithms that use numerical approximation (as opposed to general symbolic manipulations) for the problems of mathematical analysis (as distinguished from discrete mathematics).
 - **Algebraic (symbolic) computation** – relates to algorithms and software for manipulating mathematical expressions and equations in symbolic form, as opposed to manipulating the approximations of specific numerical quantities represented by those symbols. Software applications that perform symbolic calculations are called computer algebra systems.
 - **Computational number theory** – study of algorithms for performing number theoretic computations
 - **Computational mathematics** – involves mathematical research in areas of science where computing plays a central and essential role, emphasizing algorithms, numerical methods, and symbolic methods
 - **Scientific computing (Computational science)** –
 - **Computational biology (bioinformatics)** – involves the development and application of data-analytical and theoretical methods, mathematical modeling and computational simulation techniques to the study of biological, behavioral, and social systems.
 - **Computational science** – subfield of computer science concerned with constructing mathematical models and quantitative analysis techniques and using computers to analyze and solve scientific problems
 - **Computational chemistry** – branch of chemistry that uses principles of computer science to assist in solving chemical problems
- **Computational neuroscience** – study of brain function in terms of the information processing properties of the structures that make up the nervous system.
- **Computer-aided engineering** – broad usage of computer software to aid in engineering tasks.
 - **Finite element analysis** – numerical technique for finding approximate solutions of partial differential equations (PDE) as well as integral equations.
 - **Computational fluid dynamics** – branch of fluid mechanics that uses numerical methods and algorithms to solve and analyze problems that involve fluid flows.
- **Computational economics** – research discipline at the interface between computer science and economic and management science
- **Computational sociology** – branch of sociology that uses computationally intensive methods to analyze and model social phenomena.
- **Computational finance** – cross-disciplinary field which relies on computational intelligence, mathematical finance, numerical methods and computer simulations to make trading, hedging and investment decisions, as well as facilitating the risk management of those decisions
- **Humanities computing (Digital Humanities)** – area of research, teaching, and creation concerned with the intersection of computing and the disciplines of the humanities
- **Information systems** – study of complementary networks of hardware and software that people and organizations use to collect, filter, process, create, and distribute data
 - **Business informatics** – discipline combining information technology (IT), informatics and management concepts.
 - **Information technology** –
 - **Management information systems** – provides information that is needed to manage organizations efficiently and effectively
 - **Health informatics** – discipline at the intersection of information science, computer science, and health care.

- **Mathematics** – search for fundamental truths in pattern, quantity, and change. (*See also Branches of Mathematics and AMS Mathematics Subject Classification*)
 - **Algebra** – one of the main branches of mathematics, it concerns the study of structure, relation and quantity.
 - **Group theory** – studies the algebraic structures known as groups.
 - **Group representation** – describe abstract groups in terms of linear transformations of vector spaces
 - **Ring theory** – study of ring–algebraic structures in which addition and multiplication are defined and have similar properties to those familiar from the integers
 - **Field theory** – branch of mathematics which studies the properties of fields
 - **Linear algebra** – branch of mathematics concerning finite or countably infinite dimensional vector spaces, as well as linear mappings between such spaces.
 - **Vector space** – mathematical structure formed by a collection of vectors: objects that may be added together and multiplied (“scaled”) by numbers, called scalars in this context.
 - **Multilinear algebra** – extends the methods of linear algebra
 - **Lie algebra** – algebraic structure whose main use is in studying geometric objects such as Lie groups and differentiable manifolds
 - **Associative algebra** – associative ring that has a compatible structure of a vector space over a certain field K or, more generally, of a module over a commutative ring R .
 - **Non-associative algebra** – K -vector space (or more generally a module) A equipped with a K -bilinear map
 - **Universal algebra** – field of mathematics that studies algebraic structures themselves, not examples (“models”) of algebraic structures
 - **Homological algebra** – branch of mathematics which studies homology in a general algebraic setting
 - **Category theory** – area of study in mathematics that examines in an abstract way the properties of particular mathematical concepts, by formalising them as collections of objects and arrows (also called morphisms, although this term also has a specific, non-category-theoretical sense), where these collections satisfy some basic conditions
 - **Lattice theory** – partially ordered set in which any two elements have a unique supremum (also called a least upper bound or join) and a unique infimum (also called a greatest lower bound or meet).
 - **Order theory** – branch of mathematics which investigates our intuitive notion of order using binary relations.
 - **Differential algebra** – algebras equipped with a derivation, which is a unary function that is linear and satisfies the Leibniz product rule.
- **Analysis** – branch of pure mathematics that includes the theories of differentiation, integration and measure, limits, infinite series, and analytic functions
 - **Real analysis** – branch of mathematical analysis dealing with the set of real numbers and functions of a real variable.
 - **Calculus** – branch of mathematics focused on limits, functions, derivatives, integrals, and infinite series.
 - **Complex analysis** – branch of mathematical analysis that investigates functions of complex numbers
 - **Functional analysis** – branch of mathematical analysis, the core of which is formed by the study of vector spaces endowed with some kind of limit-related structure (e.g. inner product, norm, topology, etc.) and the linear operators acting upon these spaces and respecting these structures in a suitable sense
 - **Operator theory** – branch of functional analysis that focuses on bounded linear operators, but which includes closed operators and nonlinear operators.
 - **Non-standard analysis** – branch of classical mathematics that formulates analysis using a rigorous notion of an infinitesimal number.
 - **Harmonic analysis** – branch of mathematics concerned with the representation of functions or signals as the superposition of basic waves, and the study of and generalization of the notions of Fourier series and Fourier transforms.
 - **p-adic analysis** – branch of number theory that deals with the mathematical analysis of functions of p-adic numbers.
 - **Ordinary differential equations** – ordinary differential equation (ODE) is an

equation in which there is only one independent variable and one or more derivatives of a dependent variable with respect to the independent variable, so that all the derivatives occurring in the equation are ordinary derivatives.

- **Partial differential equations** – differential equation that contains unknown multivariable functions and their partial derivatives.
- **Probability theory** – branch of mathematics concerned with probability, the analysis of random phenomena.
 - **Measure theory** – systematic way to assign a number to each suitable subset of that set, intuitively interpreted as its size.
 - **Ergodic theory** – branch of mathematics that studies dynamical systems with an invariant measure and related problems.
 - **Stochastic process** – collection of random variables; this is often used to represent the evolution of some random value, or system, over time.
- **Geometry** – branch of mathematics concerned with questions of shape, size, relative position of figures, and the properties of space. Geometry is one of the oldest mathematical sciences.
 - **Topology** – major area of mathematics concerned with properties that are preserved under continuous deformations of objects, such as deformations that involve stretching, but no tearing or gluing.
 - **General topology** – branch of topology which studies properties of topological spaces and structures defined on them.
 - **Algebraic topology** – branch of mathematics which uses tools from abstract algebra to study topological spaces
 - **Geometric topology** – study of manifolds and maps between them, particularly embeddings of one manifold into another.
 - **Differential topology** – field dealing with differentiable functions on differentiable manifolds
 - **Algebraic geometry** – branch of mathematics which combines techniques of abstract algebra, especially commutative algebra, with the language and the problems of geometry
 - **Differential geometry** – mathematical discipline that uses the techniques of differential calculus and integral calculus, as well as linear algebra and multilinear algebra, to study problems in geometry
 - **Projective geometry** – study of geometric properties that are invariant under projective transformations
 - **Affine geometry** – study of geometric properties which remain unchanged by affine transformations
 - **Non-Euclidean geometry** – either of two specific geometries that are, loosely speaking, obtained by negating the Euclidean parallel postulate, namely hyperbolic and elliptic geometry.
 - **Convex geometry** – branch of geometry studying convex sets, mainly in Euclidean space.
 - **Discrete geometry** – branch of geometry that studies combinatorial properties and constructive methods of discrete geometric objects.
 - **Trigonometry** – branch of mathematics that studies relationships involving lengths and angles of triangles
 - **Number theory** – branch of pure mathematics devoted primarily to the study of the integers
 - **Analytic number theory** – branch of number theory that uses methods from mathematical analysis to solve problems about the integers
 - **Algebraic number theory** – major branch of number theory which studies algebraic structures related to algebraic integers
 - **Geometric number theory** – studies convex bodies and integer vectors in n-dimensional space
 - **Logic and Foundations of mathematics** – sub-field of mathematics with close connections to the foundations of mathematics, theoretical computer science and philosophical logic.
 - **Set theory** – branch of mathematics that studies sets, which are collections of objects
 - **Proof theory** – branch of mathematical logic that represents proofs as formal mathematical objects, facilitating their analysis by mathematical techniques
 - **Model theory** – study of (classes of) mathematical structures (e.g. groups, fields, graphs, universes of set theory) using tools from mathematical logic
 - **Recursion theory** – branch of mathematical logic and computer science that originated in the 1930s with the study of computable functions and Turing degrees
 - **Modal logic** – type of formal logic primarily developed in the 1960s that extends classical propositional and predicate logic to include operators expressing modality
 - **Intuitionistic logic** – symbolic logic system differing from classical logic in its

definition of the meaning of a statement being true

- **Applied mathematics** – branch of mathematics that concerns itself with mathematical methods that are typically used in science, engineering, business, and industry.
 - **Mathematical statistics** – study of statistics from a mathematical standpoint, using probability theory as well as other branches of mathematics such as linear algebra and analysis
 - **Probability** – likelihood or chance that something is the case or will happen
 - **Econometrics** – application of mathematics and statistical methods to economic data
 - **Actuarial science** – discipline that applies mathematical and statistical methods to assess risk in the insurance and finance industries.
 - **Demography** – statistical study of human populations and sub-populations.
 - **Approximation theory** – study of how functions can best be approximated with simpler functions, and with quantitatively characterizing the errors introduced thereby.
 - **Numerical analysis** – study of algorithms that use numerical approximation (as opposed to general symbolic manipulations) for the problems of mathematical analysis (as distinguished from discrete mathematics).
 - **Optimization (Mathematical programming)** – selection of a best element from some set of available alternatives.
 - **Operations research** – study of the application of advanced analytical methods to help make better decisions
 - **Linear programming** – mathematical method for determining a way to achieve the best outcome (such as maximum profit or lowest cost) in a given mathematical model for some list of requirements represented as linear relationships
 - **Dynamical systems** – concept in mathematics where a fixed rule describes the time dependence of a point in a geometrical space
 - **Chaos theory** – study of the behavior of dynamical systems that are highly sensitive to initial conditions, an effect which is popularly referred to as the butterfly effect.
- **Fractal geometry** – mathematical set that has a fractal dimension that usually exceeds its topological dimension and may fall between the integers.
- **Mathematical physics** – development of mathematical methods for application to problems in physics
 - **Quantum field theory** – theoretical framework for constructing quantum mechanical models of systems classically parametrized (represented) by an infinite number of degrees of freedom, that is, fields and (in a condensed matter context) many-body systems.
 - **Statistical mechanics** – branch of physics that applies probability theory, which contains mathematical tools for dealing with large populations, to the study of the thermodynamic behavior of systems composed of a large number of particles.
- **Information theory** – branch of applied mathematics and electrical engineering involving the quantification of information.
- **Cryptography** – study of means of obscuring information, such as codes and ciphers
- **Combinatorics** – branch of mathematics concerning the study of finite or countable discrete structures
 - **Coding theory** – study of the properties of codes and their fitness for a specific application
- **Graph theory** – study of graphs, mathematical structures used to model pairwise relations between objects from a certain collection
- **Game theory** – study of strategic decision making. More formally, it is “the study of mathematical models of conflict and cooperation between intelligent rational decision-makers.”
- **Statistics** – collection, analysis, interpretation, and presentation of data.
 - **Computational statistics** – interface between statistics and computer science.
 - **Data mining** – process that results in the discovery of new patterns in large data sets

- **Regression** – estimates the conditional expectation of the dependent variable given the independent variables – that is, the average value of the dependent variable when the independent variables are held fixed.
- **Simulation** – Simulation is the imitation of the operation of a real-world process or system over time. The act of simulating something first requires that a model be developed; this model represents the key characteristics or behaviors of the selected physical or abstract system or process. The model represents the system itself, whereas the simulation represents the operation of the system over time.
 - **Bootstrap (statistics)** – method for assigning measures of accuracy to sample estimates (Efron and Tibshirani 1993).
- **Design of experiments** – design of any information-gathering exercises where variation is present, whether under the full control of the experimenter or not
 - **Block design** – set together with a family of subsets (repeated subsets are allowed at times) whose members are chosen to satisfy some set of properties that are deemed useful for a particular application.
 - **Analysis of variance** – collection of statistical models, and their associated procedures, in which the observed variance in a particular variable is partitioned into components attributable to different sources of variation.
 - **Response surface methodology** – explores the relationships between several explanatory variables and one or more response variables.
- **Engineering statistics** – Engineering statistics combines engineering and statistics
- **Spatial statistics** – any of the formal techniques which study entities using their topological, geometric, or geographic properties.
- **Social statistics** – use of statistical measurement systems to study human behavior in a social environment
- **Statistical modelling** – formalization of relationships between variables in the form of mathematical equations
 - **Biostatistics** – application of statistics to a wide range of topics in biology.
 - **Epidemiology** – study of the distribution and patterns of health-events, health-characteristics and their causes or influences in well-defined populations.
- **Multivariate analysis** – observation and analysis of more than one statistical variable at a time.
 - **Structural equation model** – statistical technique for testing and estimating causal relations using a combination of statistical data and qualitative causal assumptions.
 - **Time series** – sequence of data points, measured typically at successive time instants spaced at uniform time intervals.
- **Reliability theory** – describes the probability of a system completing its expected function during an interval of time.
- **Quality control** – process by which entities review the quality of all factors involved in production.
- **Statistical theory** – provides a basis for the whole range of techniques, in both study design and data analysis, that are used within applications of statistics.
 - **Decision theory** – identifies the values, uncertainties and other issues relevant in a given decision, its rationality, and the resulting optimal decision.
 - **Mathematical statistics** – study of statistics from a mathematical standpoint, using probability theory as well as other branches of mathematics such as linear algebra and analysis.
 - **Probability** – likelihood or chance that something is the case or will happen.
- **Sample Survey** – process of selecting a sample of elements from a target population in order to conduct a survey.
 - **Sampling theory** – study of the collection, organization, analysis, and interpretation of data.
 - **Survey methodology** – field that studies the sampling of individuals from a population with a view towards making statistical inferences about the population using the sample.
- **Systems science** – interdisciplinary field of science that studies the nature of complex systems in nature, society, and science.
 - **Chaos theory** – field of study in mathematics, with applications in several disciplines including physics, engineering, economics, biology,

and philosophy; studies the behavior of dynamical systems that are highly sensitive to initial conditions.

- **Complex systems and Complexity Theory** – studies how relationships between parts give rise to the collective behaviors of a system and how the system interacts and forms relationships with its environment.
- **Cybernetics** – interdisciplinary study of the structure of regulatory systems.
 - **Biocybernetics** – application of cybernetics to biological science, composed of biological disciplines that benefit from the application of cybernetics: neurology, multicellular systems and others.
 - **Engineering cybernetics** – field of cybernetics, which deals with the question of control engineering of mechatronic systems as well as chemical or biological systems.
 - **Management cybernetics** – field of cybernetics concerned with management and organizations.
 - **Medical cybernetics** – branch of cybernetics which has been heavily affected by the development of the computer, which applies the concepts of cybernetics to medical research and practice.
 - **New Cybernetics** – study of self-organizing systems according to Peter Harries-Jones (1988), “looking beyond the issues of the “first”, “old” or “original” cybernetics and their politics and sciences of control, to the autonomy and self-organization capabilities of complex systems”.
 - **Second-order cybernetics** – investigates the construction of models of cybernetic systems.
- **Control theory** – Control theory is an interdisciplinary branch of engineering and mathematics that deals with the behavior of dynamical systems. The external input of a system is called the reference. When one or more output variables of a system need to follow a certain reference over time, a controller manipulates the inputs to a system to obtain the desired effect on the output of the system.
 - **Control engineering** – engineering discipline that applies control theory to design systems with desired behaviors.
 - **Control systems** – device, or set of devices to manage, command, direct or regulate the behavior of other devices or system.
- **Dynamical systems** – concept in mathematics where a fixed rule describes the time dependence of a point in a geometrical space.
- **Operations research** – study of the use of advanced analytical methods to help make better decisions.
- **Systems dynamics** – approach to understanding the behaviour of complex systems over time.
 - **Systems analysis** – study of sets of interacting entities, including computer systems analysis.
- **Systems theory** – interdisciplinary study of systems in general, with the goal of elucidating principles that can be applied to all types of systems at all nesting levels in all fields of research.
 - **Developmental systems theory** – overarching theoretical perspective on biological development, heredity, and evolution
 - **General systems theory** – interdisciplinary study of systems in general, with the goal of elucidating principles that can be applied to all types of systems at all nesting levels in all fields of research.
 - **Linear time-invariant systems** – investigates the response of a linear and time-invariant system to an arbitrary input signal.
 - **Mathematical system theory** – area of mathematics used to describe the behavior of complex dynamical systems, usually by employing differential equations or difference equations.
 - **Systems biology** – several related trends in bioscience research, and a movement that draws on those trends.
 - **Systems ecology** – interdisciplinary field of ecology, taking a holistic approach to the study of ecological systems, especially ecosystems.
 - **Systems engineering** – interdisciplinary field of engineering focusing on how complex engineering projects should be designed and managed over their life cycles.
 - **Systems neuroscience** – subdiscipline of neuroscience and systems biology that studies the function of neural circuits and systems.
 - **Systems psychology** – branch of applied psychology that studies human behaviour and experience in complex systems.

3.3 Social science

Social science – study of the social world constructed between humans. The social sciences usually limit themselves to an anthropomorphically centric view of these interactions with minimal emphasis on the inadvertent impact of social human behavior on the external environment (physical, biological, ecological, etc.). 'Social' is the concept of exchange/influence of ideas, thoughts, and relationship interactions (resulting in harmony, peace, self enrichment, favoritism, maliciousness, justice seeking, etc.) between humans. The scientific method is utilized in many social sciences, albeit adapted to the needs of the social construct being studied.

- **Branches of social science** (also known as the social sciences)

3.4 Applied science

Applied science – branch of science that applies existing scientific knowledge to develop more practical applications, including inventions and other technological advancements.

- **Branches of applied science** (also known as the applied sciences)

4 How scientific fields differ

- **Exact science** – any field of science capable of accurate quantitative expression or precise predictions and rigorous methods of testing hypotheses, especially reproducible experiments involving quantifiable predictions and measurements.
- **Fundamental science** – science that describes the most basic objects, forces, relations between them and laws governing them, such that all other phenomena may be in principle derived from them following the logic of scientific reductionism.
- **Hard and soft science** – colloquial terms often used when comparing scientific fields of academic research or scholarship, with hard meaning perceived as being more scientific, rigorous, or accurate.

5 Politics of science

- **Disruptive technology** – innovation that helps create a new market and value network, and eventually goes on to disrupt an existing market and value network (over a few years or decades), displacing an earlier technology.

- **Kansas evolution hearings** – series of hearings held in Topeka, Kansas, United States 5 to 12 May 2005 by the Kansas State Board of Education and its State Board Science Hearing Committee to change how evolution and the origin of life would be taught in the state's public high school science classes.
- **List of books about the politics of science** – list of books about the politics of science.
- **Politicization of science** – politicization of science is the manipulation of science for political gain.
- **Science by press release** – refers to scientists who put an unusual focus on publicizing results of research in the media.

6 History of science

- **History of science - History of science in general**
 - **History of scientific method** – history of scientific method is a history of the methodology of scientific inquiry, as differentiated from a history of science in general.
 - **Theories/sociology of science** – sociology and philosophy of science, as well as the entire field of science studies, have in the 20th century been occupied with the question of large-scale patterns and trends in the development of science, and asking questions about how science “works” both in a philosophical and practical sense.
 - **Historiography** – study of the history and methodology of the sub-discipline of history, known as the history of science, including its disciplinary aspects and practices (methods, theories, schools) and to the study of its own historical development (“History of History of Science”, i.e., the history of the discipline called History of Science).
 - **History of pseudoscience** – history of pseudoscience is the study of pseudoscientific theories over time. A pseudoscience is a set of ideas that presents itself as science, while it does not meet the criteria to properly be called such.
 - **Timeline of scientific discoveries** – shows the date of publication of major scientific theories and discoveries, along with the discoverer. In many cases, the discoveries spanned several years.
 - **Timeline of scientific thought** – lists the major landmarks across all scientific philosophy and methodological sciences.

6.1 By period

- **History of science in early cultures** – history of science in early cultures refers to the study of proto-science in ancient history, prior to the development of science in the Middle Ages.
- **History of science in Classical Antiquity** – history of science in classical antiquity encompasses both those inquiries into the workings of the universe aimed at such practical goals as establishing a reliable calendar or determining how to cure a variety of illnesses and those abstract investigations known as natural philosophy.
- **History of science in the Middle Ages** – Science in the Middle Ages comprised the study of nature, including practical disciplines, the mathematics and natural philosophy in medieval Europe.
- **History of science in the Renaissance** – During the Renaissance, great advances occurred in geography, astronomy, chemistry, physics, mathematics, manufacturing, and engineering.
 - **Science and inventions of Leonardo da Vinci** – Italian polymath, regarded as the epitome of the “Renaissance Man”, displaying skills in numerous diverse areas of study.
- **Scientific revolution** – scientific revolution is an era associated primarily with the 16th and 17th centuries during which new ideas and knowledge in physics, astronomy, biology, medicine and chemistry transformed medieval and ancient views of nature and laid the foundations for modern science.
- **Governmental impact on science during WWII** – Governmental impact on science during World War II represents the effect of public administration on technological development that provided many advantages to the armed forces, economies and societies in their strategies during the war.

6.1.1 By date

- **List of years in science** – events related to science or technology which occurred in the listed year.
- **Timeline of scientific discoveries** – shows the date of publication of major scientific theories and discoveries, along with the discoverer. In many cases, the discoveries spanned several years.
- **Timeline of scientific experiments** – shows the date of publication of major scientific experiments.
- **Timeline of the history of scientific method** – shows an overview of the cultural inventions that have contributed to the development of the scientific method.

6.2 By field

- **History of natural science** – study of nature and the physical universe that was dominant before the development of modern science.
 - **Natural philosophy** – study of nature and the physical universe that was dominant before the development of modern science.
 - **History of biology** – traces the study of the living world from ancient to modern times.
 - **Natural history** – scientific research of plants or animals, leaning more towards observational rather than experimental methods of study, and encompasses more research published in magazines than in academic journals.
 - **History of ecology** – history of the science of ecology.
 - **History of molecular biology** – begins in the 1930s with the convergence of various, previously distinct biological disciplines: biochemistry, genetics, microbiology, and virology.
 - **History of physical science**
 - **History of nature** – describes the most important events and fundamental stages in the development of the planet Earth from its formation to the present day.
 - **History of astronomy** – Timeline
 - **History of chemistry** – By 1000 BC, ancient civilizations used technologies that would eventually form the basis of the various branches of chemistry.
 - **History of geography**
 - **History of geology** – Timeline
 - **History of meteorology** – Timeline
 - **History of physics** – As forms of science historically developed out of philosophy, physics was originally referred to as natural philosophy, a field of study concerned with “the workings of nature.”
- **History of the social sciences** – has origin in the common stock of Western philosophy and shares various precursors, but began most intentionally in the early 19th century with the positivist philosophy of science.
 - **History of science and technology**
 - **History of scientific method** – history of the methodology of scientific inquiry, as differentiated from a history of science in general.
 - **History of archaeology** – Timeline
 - **History of cognitive science**

- **History of criminal justice** – Throughout the history of criminal justice, evolving forms of punishment, added rights for offenders and victims, and policing reforms have reflected changing customs, political ideals, and economic conditions.
- **History of economics** – study of different thinkers and theories in the subject that became political economy and economics from the ancient world to the present day.
- **History of education** – development of systematic methods of teaching and learning.
- **History of law** – study of how law has evolved and why it changed.
- **History of linguistics** – endeavors to describe and explain the human faculty of language.
- **History of marketing** – recognized discipline, along with concomitant changes in marketing theory and practice.
- **History of parapsychology**
- **History of political science** – social science discipline concerned with the study of the state, government, and politics.
- **History of psychology** – Timeline
- **History of sociology** – Timeline

See also: Outline of technology:: History of technology

6.3 By region

6.3.1 History of science in present states, by continent

See – Category:Science and technology by continent

6.3.2 History of science in historic states

- Science and technology of the Han Dynasty
- Science and technology in the Ottoman Empire
- Science and technology of the Song Dynasty
- Science and technology in the Soviet Union
- Science and technology of the Tang Dynasty

7 Philosophy of science

- **Philosophy of science** – questions the assumptions, foundations, methods and implications of science.

8 Scientific community

- **Scientific community** – group of all interacting scientists.
- **Big Science** – a series of changes in science that occurred in industrial nations during and after World War II.

8.1 Scientific organizations

- **Academy of Sciences** – national academy or another learned society dedicated to sciences.

8.2 Scientists

- **Scientist** – practitioner of science; an individual who uses **scientific method** to objectively inquire into the nature of reality—be it the fundamental laws of physics or how people behave. There are many names for scientists, often named in relation to the job that they do. One example of this is a **biologist**, a scientist who studies biology (the study of living organisms and their environments).

8.2.1 Types of scientist

By field The scientific fields mentioned below are generally described by the science they study.

- **Agricultural scientist** – broad multidisciplinary field that encompasses the parts of exact, natural, economic and social sciences that are used in the practice and understanding of agriculture.
- **Archaeologist** – study of human activity, primarily through the recovery and analysis of the material culture and environmental data that they have left behind, which includes artifacts, architecture, biofacts and cultural landscapes (the archaeological record).
- **Astronomer** – astronomer is a scientist who studies celestial bodies such as planets, stars and galaxies.
 - **Astrophysicist** – branch of astronomy that deals with the physics of the universe, including the physical properties of celestial objects, as well as their interactions and behavior.
- **Biologist** – scientist devoted to the study of living organisms and their relationship to their environment.
 - **Astrobiologist** – study of the origin, evolution, distribution, and future of extraterrestrial life.
 - **Biophysicist** – interdisciplinary science that uses the methods of physical science to study biological systems.

- **Biotechnologist** – field of applied biology that involves the use of living organisms and bioprocesses in engineering, technology, medicine and other fields requiring bioproducts.
- **Botanist** – discipline of biology, is the science of plant life.
- **Cognitive scientists** – scientific study of the mind and its processes.
- **Ecologist** – scientific study of the relations that living organisms have with respect to each other and their natural environment.
- **Entomologist** – scientific study of insects, a branch of arthropodology.
- **Evolutionary biologist** – sub-field of biology concerned with the study of the evolutionary processes that have given rise to the diversity of life on Earth.
- **Geneticist** – biologist who studies genetics, the science of genes, heredity, and variation of organisms.
- **Herpetologist** – branch of zoology concerned with the study of amphibians (including frogs, toads, salamanders, newts, and gymnophiona) and reptiles (including snakes, lizards, amphisbaenids, turtles, terrapins, tortoises, crocodilians, and the tuataras).
- **Immunologist** – branch of biomedical science that covers the study of all aspects of the immune system in all organisms.
- **Ichthyologist** – study of fish.
- **Lepidopterist** – person who specialises in the study of Lepidoptera, members of an order encompassing moths and the three superfamilies of butterflies, skipper butterflies, and moth-butterflies.
- **Marine biologist** – scientific study of organisms in the ocean or other marine or brackish bodies of water.
- **Medical scientist** – basic research, applied research, or translational research conducted to aid and support the body of knowledge in the field of medicine.
- **Microbiologist** – study of microscopic organisms.
- **Mycologist** – branch of biology concerned with the study of fungi, including their genetic and biochemical properties, their taxonomy and their use to humans as a source for tinder, medicinals (e.g., penicillin), food (e.g., beer, wine, cheese, edible mushrooms) and entheogens, as well as their dangers, such as poisoning or infection.
- **Neuroscientist** – individual who studies the scientific field of neuroscience or any of its related sub-fields.
- **Ornithologist** – branch of zoology that concerns the study of birds.
- **Paleontologist** – study of prehistoric life.
- **Pathologist** – precise study and diagnosis of disease.
- **Pharmacologist** – branch of medicine and biology concerned with the study of drug action.
- **Physiologist** – science of the function of living systems.
- **Zoologist** – branch of biology that relates to the animal kingdom, including the structure, embryology, evolution, classification, habits, and distribution of all animals, both living and extinct.
- **Chemist** – scientist trained in the study of chemistry.
 - **Analytical chemist** – study of the separation, identification, and quantification of the chemical components of natural and artificial materials.
 - **Biochemist** – study of chemical processes in living organisms, including, but not limited to, living matter.
 - **Inorganic chemist** – branch of chemistry concerned with the properties and behavior of inorganic compounds.
 - **Organic chemist** – subdiscipline within chemistry involving the scientific study of the structure, properties, composition, reactions, and preparation (by synthesis or by other means) of carbon-based compounds, hydrocarbons, and their derivatives.
 - **Physical chemist** – study of macroscopic, atomic, subatomic, and particulate phenomena in chemical systems in terms of physical laws and concepts.
- **Earth scientist** – all-embracing term for the sciences related to the planet Earth.
 - **Geologist** – scientist who studies the solid and liquid matter that constitutes the Earth as well as the processes and history that has shaped it.
 - **Glaciologist** – study of glaciers, or more generally ice and natural phenomena that involve ice.
 - **Hydrologist** – study of the movement, distribution, and quality of water on Earth and other planets, including the hydrologic cycle, water resources and environmental watershed sustainability.
 - **Limnologist** – study of inland waters

- **Meteorologist** – study of weather
- **Mineralogist** – study of chemistry, crystal structure, and physical (including optical) properties of minerals.
- **Oceanographer** – branch of Earth science that studies the ocean
- **Paleontologist** – study of prehistoric life
- **Seismologist** – scientific study of earthquakes and the propagation of elastic waves through the Earth or through other planet-like bodies.
- **Volcanologist** – study of volcanoes, lava, magma, and related geological, geophysical and geochemical phenomena.
- **Informatician** – science of information, the practice of information processing, and the engineering of information systems.
 - **Computer scientist** – scientist who has acquired knowledge of computer science, the study of the theoretical foundations of information and computation
- **Library scientist** – interdisciplinary or multidisciplinary field that applies the practices, perspectives, and tools of management, information technology, education, and other areas to libraries; the collection, organization, preservation, and dissemination of information resources; and the political economy of information.
- **Management scientist** – study of advanced analytical methods to help make better decisions.
- **Mathematician** – person with an extensive knowledge of mathematics, a field that has been informally defined as being concerned with numbers, data, collection, quantity, structure, space, and change.
 - **Statistician** – someone who works with theoretical or applied statistics.
- **Military scientist** – process of translating national defence policy to produce military capability by employing military scientists, including theorists, researchers, experimental scientists, applied scientists, designers, engineers, test technicians, and military personnel responsible for prototyping.
- **Physicist** – scientist who does research in physics
- **Psychologist** – professional or academic title used by individuals who practice psychology
 - **Abnormal psychologist** – branch of psychology that studies unusual patterns of behavior, emotion and thought, which may or may not be understood as precipitating a mental disorder.
 - **Educational psychologist** – psychologist whose differentiating functions may include diagnostic and psycho-educational assessment, psychological counseling in educational communities (students, teachers, parents and academic authorities), community-type psycho-educational intervention, and mediation, coordination, and referral to other professionals, at all levels of the educational system.
 - **Biopsychologist** – application of the principles of biology (in particular neurobiology), to the study of physiological, genetic, and developmental mechanisms of behavior in human and non-human animals.
 - **Clinical psychologist** – integration of science, theory and clinical knowledge for the purpose of understanding, preventing, and relieving psychologically based distress or dysfunction and to promote subjective well-being and personal development.
 - **Comparative psychologist** – scientific study of the behavior and mental processes of non-human animals, especially as these relate to the phylogenetic history, adaptive significance, and development of behavior.
 - **Cognitive psychologist** – subdiscipline of psychology exploring internal mental processes. It is the study of how people perceive, remember, think, speak, and solve problems.
 - **Developmental psychologist** – scientific study of systematic psychological changes, emotional changes, and perception changes that occur in human beings over the course of their life span.
 - **Evolutionary psychologist** – approach in the social and natural sciences that examines psychological traits such as memory, perception, and language from a modern evolutionary perspective.
 - **Experimental psychologist** – study of behavior and the processes that underlie it, by means of experiment
 - **Neuropsychologist** – studies the structure and function of the brain as they relate to specific psychological processes and behaviors.
 - **Social psychologist** – scientific study of how people's thoughts, feelings, and behaviors are influenced by the actual, imagined, or implied presence of others.
- **Social scientist** – field of study concerned with society and human behaviours.
 - **Anthropologist** – study of humanity.
 - **Ethnologist** – branch of anthropology that compares and analyzes the origins, distribution, technology, religion, language,

and social structure of the ethnic, racial, and/or national divisions of humanity.

- **Communication scientist** – academic field that deals with processes of human communication, commonly defined as the sharing of symbols to create meaning.
- **Criminologist** – study of criminal behavior
- **Demographer** – statistical study of populations
- **Economist** – professional in the social science discipline of economics.
- **Geographer** – geographer is a scholar whose area of study is geography, the study of Earth's natural environment and human society.
- **Political economist** – study of production, buying, and selling, and their relations with law, custom, and government, as well as with the distribution of national income and wealth, including through the budget process.
- **Political scientist** – social science discipline concerned with the study of the state, government, and politics.
- **Sociologist** –
- **Technologist**
 - **Architectural technologist** – specialist in the technology of building design and construction
 - **Educational technologist** – specialist in tools to enhance learning
 - **Engineering technologist** – specialist who implements technology within a field of engineering
 - **Industrial technologist** – specialist in the management, operation, and maintenance of complex operation systems
 - **Medical Technologist** – healthcare professional who performs diagnostic analysis on a variety of body fluids
 - **Radiologic technologist** – medical professional who applies doses of radiation for imaging and treatment
 - **Surgical technologist** – health specialist who facilitates the conduct of invasive surgical procedures

By employment status

- **Academic** – community of students and scholars engaged in higher education and research.
- **Corporate Scientist** – someone who is employed by a business to do research and development for the benefit of that business

- **Layperson** – someone who is not an expert or someone who has not had professional training
- **Gentleman scientist** – financially independent scientist who pursues scientific study as a hobby.
- **Government scientist** – scientist employed by a country's government

8.2.2 Famous scientists

Main list: Lists of scientists

- **Aristotle** – Greek philosopher and polymath, a student of Plato and teacher of Alexander the Great.
- **Archimedes** – Greek mathematician, physicist, engineer, inventor, and astronomer.
- **Andreas Vesalius** – Flemish anatomist, physician, and author of one of the most influential books on human anatomy, *De humani corporis fabrica* (On the Structure of the Human Body).
- **Nicolaus Copernicus** – Renaissance astronomer and the first person to formulate a comprehensive heliocentric cosmology which displaced the Earth from the center of the universe.
- **Galileo Galilei** – Italian physicist, mathematician, astronomer, and philosopher who played a major role in the Scientific Revolution.
- **Johannes Kepler** – German mathematician, astronomer and astrologer. A key figure in the 17th century scientific revolution, he is best known for his eponymous laws of planetary motion, codified by later astronomers, based on his works *Astronomia nova*, *Harmonices Mundi*, and *Epitome of Copernican Astronomy*.
- **René Descartes** – French philosopher, mathematician, and writer who spent most of his adult life in the Dutch Republic.
- **Isaac Newton** – English physicist, mathematician, astronomer, natural philosopher, alchemist, and theologian, who has been “considered by many to be the greatest and most influential scientist who ever lived.”
- **Leonhard Euler** – pioneering Swiss mathematician and physicist.
- **Pierre-Simon Laplace** – French mathematician and astronomer whose work was pivotal to the development of mathematical astronomy and statistics.
- **Alexander von Humboldt** – German geographer, naturalist and explorer, and the younger brother of the Prussian minister, philosopher and linguist Wilhelm von Humboldt.

- **Charles Darwin** – Charles Robert Darwin FRS (12 February 1809 – 19 April 1882) was an English naturalist.[1] He established that all species of life have descended over time from common ancestors, and proposed the scientific theory that this branching pattern of evolution resulted from a process that he called natural selection.
- **James Clerk Maxwell** – Scottish physicist and mathematician.
- **Marie Curie** – Polish physicist and chemist famous for her pioneering research on radioactivity.
- **Albert Einstein** – German-born theoretical physicist who developed the theory of general relativity, effecting a revolution in physics
- **Linus Pauling** – American chemist, biochemist, peace activist, author, and educator. He was one of the most influential chemists in history and ranks among the most important scientists of the 20th century.
- **John Bardeen** – American physicist and electrical engineer, the only person to have won the Nobel Prize in Physics twice
- **Frederick Sanger** – English biochemist and a two-time Nobel laureate in chemistry, the only person to have been so.
- **Stephen Hawking** – British theoretical physicist, cosmologist, and author.

9 Science education

Science education

- **Scientific literacy** – encompasses written, numerical, and digital literacy as they pertain to understanding science, its methodology, observations, and theories.

10 See also

- **Sci-Mate** – open collaboration of scientists using Web 2.0 software to address well known challenges in academic publishing and technology transfer
- **Science Daily** – news website for topical science articles
- **Science.tv** – virtual community for people interested in science

11 References

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