DICTIONARY OF SCIENTIFIC PRINCIPLES
To E. E. Barnes,
with long overdue thanks
for
sharing ideas, concepts, and challenges
in the way we seek and organize information
CONTENTS

Preface ix
Acknowledgments xi
Notes to the Reader xiii

Principles—Definitions 1
Principles—Applications 481
The Dictionary of Scientific Principles is an attempt to compile the language of art used for various known rules or laws applied to a broad category of topics, including mathematics, medicine, sciences, psychology, management, and even philosophy and art. This project has taken over 6 years to develop to this point. I have consulted with scientists and colleagues on the development of this dictionary and had some help in organizing the files from an MS Excel spreadsheet. There are approximately 2000 + principles that form the language of art. Some are rewording of the same principle; For instance, the principle of maximum entropy is also listed as the maximum entropy principle. I exerted a great deal of effort to have this work prepared in time for the new millennium and to call it Millennial Principles. However, the myriad new discoveries in scientific and other disciplines necessitated the continual addition of new entries and cross-references to similar-context or related entries already listed in this volume. In creating this dictionary, I consulted many encyclopedias, dictionaries, books, indexes, and journal articles. There is no single source containing the breadth of coverage of all principles listed in this work. The references listed in footnotes are some of the many resources that I consulted. I hope that this will be an ongoing project, in order that new principles may be added in future editions or enhancements can be made in the applications listed. Many of the entries in this dictionary are excerpts from journal articles, summaries from other literature sources, or information obtained from unique Internet sources or available content definitions from patent files.

The Dictionary of Scientific Principles was prepared to provide information about basic fundamental properties, systems, activities, or phenomena that have become terms in common use, including eponyms, among various fields of study. It provides a brief description of the individual principle, a variety of definitions applied to the principle, and alternate names used to describe the principle in “see also” attachments to the name, with definitions of over 2000 terms, both current and historical. About 85% of these terms cannot be found in any other source such as dictionaries, encyclopedias, or other collected printed (hardcopy) or electronic works. The footnoted references are included to help the reader find further in-depth information as needed. The Dictionary of Scientific Principles neither attempts nor intends to exhaust the entire spectrum of meaning and potential intention with historical connections for each principle.

The principles included may be factual, historical, fictitious, or comical. Abbreviations are included [e.g., TNSTAAFL principle]. Some surname-based eponyms containing the term law, (e.g., Newton's law), are also described as Newton's principle and thus are included.

Principles have been included regardless of their frequency of use or the manner in which they were created. The polyuronid principle, for example, was found in only one single reference. Occasionally, names are in formative or transitional stages of
development, which legitimately justifies the compiler's reasons for assigning different names to the same or very similar principles. The inclusion of a name as part of a term in no way depends on how well the person is or was known at the time, nor does it mean that this person will become well known in the future because of the principle with which she or he may be affiliated or associated. Many of the principles include names of famous persons, while a very large number include the names of people who were modest practitioners of their trades and who lived and died in anonymity. Such people could not be included in professional and membership directories, biographical listings, or national newspaper obituaries. Biographical information, as explained earlier, for many of the principles, is incomplete. Selection was made to include and focus on the principle, not the individual for whom it was named. Literary, historical, and mythological names are included. Many of the biographical resources on these names can be found in commonly available biographical sources.

A surname-based eponym contains both a proper noun (the name of the person after whom something is named) and a generic term. The eponym need not contain the person's real name (e.g., the Dilbert principle); a pseudonym can become an eponym, such as the Tinkerbell principle. Names may appear in multiple forms and they are included with cross-reference's to alternate forms including spelling variations. Associating names with specific individuals is often difficult since the names are coined not by the persons who first described the concept but by someone else, often many years later.

The entries in this Dictionary of Scientific Principles are arranged in alphabetic order with cross-references to alternate terms applied. The listing depends on the manner in which the principle was described. For a hypothetical example, the term principle of XYZ and its variation, XYZ principle, are both listed. Only usage dictates whether the name includes a possessive "s" (e.g., Einstein's theory of relativity). Principles containing more than one personal (e.g., Borwein–Price principle) name are followed by brief biographic notes regarding the people in the order to in which their names appear in the term.
I want to thank my wife for being so support-ive in encouraging me to continue. I want to thank my children for their interest and of apparent understanding my need to sac-ifice some of our time together while this work was being completed. I wish to also thank Samantha Richardson for many pa-tient days of editing and correcting spelling errors. Tracie Meloy helped with with organ-izing many text records into a single stan-dard format. I must thank many members of the Philadelphia Chapter of the Special Library Association for their encouragement. I have to thank Barbara and Bruce, who thought I was crazy but persistent. I must thank the various companies who provided additional support, including the Dialog Cor-poration, NewsNet, MNIS and Telebase. I would like to express special appreciation for support and encouragement from friends at Penn State University Great Valley campus and West Chester University.

A very special note of thanks to those who contributed their subject expertise as collabor-ators to this work. With deep thanks for her dedication and effort despite her terminal ill-ness, Jennifer Papin-Ramcharan, Librarian III, Engineering & Physical Sciences Divi-sion, The University of the West Indies, St. Augustine Campus, St. Augustine, Trinidad and Tobago, West Indies provided a very comprehensive review of mathematics and developed mathematical formulas to be in-cluded. She passed away September 9, 2009 and was a delightful tenacious supporter. She leaves to mourn, apart from her library fam-ily, her husband Oliver and four children, her mother and two sisters. A qualified engineer, University of Hong Kong and holder of B.Sc Math/Physics from the University of the West Indies, and Fulbright—LASPAU scholar, she served as the subject specialist for the Engi-neering and Physical Sciences Division. She received her M.L.S. from the University at Buffalo, State University of New York and continued to serve the UWI and the Library with distinction. Her memorial service was held at the St. Stephen’s Anglican Church, High Street Princes with burial at the St. Nicholas Churchyard Cemetery.

I envy Gregory D. Mahlon, Science and Technology librarian, Penn State Mont Alto, Mont Alto, PA 17237-9799 and his steady, consistent, and well organized deliberations, comments, and humor regarding this project. There were many others who sent additions to be included and provided editing or con-tent advise. Finally, I would like to personally thank the contributions from Eleanor Brown, Ph.D., Clinical Psychology, Assistant Profes-sor, West Chester University of Pennsylvania and her student research assistant, Andrea Knorr. Ellie collaborated with colleagues and contributed several new entries from the field of psychology and medical related practice.

Very special thanks to E. E. Barnes for offering definitions and suggestions to the list.
NOTES TO THE READER

The Dictionary of Scientific Principles is an exercise in acquiring all known rules or laws commonly called principles and describing the language of art corresponding to usage. These principles cover all subjects ranging from science, to business, literature, philosophy, medicine, and society. Cross-references to other principles are listed with the definition. In addition to principle definitions, [denoted (D)], you will find applications [denoted (A)], which cover an equally broad field of multiple subject disciplines aiding in a search for principles as they relate to a certain subject.
PRINCIPLES—DEFINITIONS
AARON ANTONOVSKY’S COMFORT-THROUGH-DISCOMFORT PRINCIPLE [psychology] (Aaron Antonovsky, 1923–1994, Israeli American Sociologist) Comfort, or well-being, arises through a process of making meaning out of discomfort, or distress, thereby arriving at a sense of coherence. When one’s sense of coherence is strong, the stimuli that impinge on one are perceived as comprehensible, as being manageable, and as being meaningful, or challenges worth engaging in.* See also PRINCIPLE OF SOMATOMENTAL BALANCE; PRINCIPLE OF THE SALUTOGENETIC TRIAD; SALUTOGENESIS PRINCIPLE.

ABEL’S PRINCIPLE [mathematics] (Neils Henrik Abel, 1802–1829, Norwegian mathematician) (1) Also known as Abel’s theorems, stating: (1) if \( \sum_{n=0}^{\infty} a_n x^n \) converges for \( |x| < R \) and for \( x = R \), then the series converges uniformly on \( 0 \leq x \leq R \). (2) Abel’s theorem of algebraic equations: For \( n > 5 \), the general equation of nth order cannot be solved by radicals.f (3) Abel’s theorem for power series: If a power series in \( z \) converges for \( z = a \), it converges absolutely for \( |z| < |a| \). If the power series, \( S(z) = \sum_{k=0}^{\infty} a_k(z - b)^k \), where \( a_k, b, z \) are complex numbers, converges at \( z = z_0 \), then it converges absolutely and uniformly within any disk \( |z - b| < R \) of radius \( R < |z_0 - b| \) and with center at \( b \). It follows from the theorem that there exists a number \( R \in [0, \infty) \) such that if \( |z - b| < R \), the series is convergent, while if \( |z - b| > R \), the series is divergent. The number \( R \) is called the radius of convergence of the series \( S(z) \), while the disk \( |z - b| < R \) is known as the disk of convergence of the series. (4) If the three series with nth term \( a_n, b_n, \) and \( c_n = a_0 b_n + a_1 b_{n-1} + \cdots + a_n b_0 \), respectively, converge, then the third series equals the product of the first two series. (5) If a power series in \( z \) converges to \( f(z) \) for \( |z| < 1 \) and to \( a \) for \( z = 1 \), then the limit of \( f(z) \) as \( z \) approaches 1 equals \( a \). Abel’s continuity theorem: If the power series converges at point \( z_0 \) on the boundary of the disk of convergence, then it is a continuous function in any closed triangle \( T \) with vertices \( z_0, z_1, z_2 \), where \( z_1 \) and \( z_2 \) are located inside the disk of convergence. In particular, \( \lim_{z \to z_0} S(z) = S(z_0), z \in T \). This limit always exists along the radius: The series converges uniformly along any radius of the disk of convergence joining points \( b \) and \( z_0 \). (6) Abel’s theorem on Dirichlet series: If the Dirichlet series \( \phi(s) = \sum_{n=1}^{\infty} a_n e^{-\lambda_n s}, s = \sigma + it, \lambda_n > 0 \) converges at point \( s_0 = \sigma_0 + it_0 \), then it converges in the half-plane \( \sigma > \sigma_0 \) and converges uniformly inside any angle \( |\arg(s - s_0)| < \theta < \pi/2 \). It is a generalization of Abel’s theorem on power series (take \( \lambda_n = n \) and put \( e^{-s} = z \)).

ABSORPTION PRINCIPLE [physics, energy] (1) Light decreases exponentially with distance; fractional loss is the same for equal distances of penetration. Energy loss from the light appears as energy added to the medium.§ (2) Penetration of a substance into the body of another.¶ (3) Eigenfunction expansions for the self-adjoint operator governing the propagation of elastic waves in an unperturbed


stratified media radiation.* See also LIMITING ABSORPTION PRINCIPLE, LIMITING AMPLITUDE PRINCIPLE.

ACCOUNTING PRINCIPLE [mathematics] A collection of rules and procedures and conventions that define accepted accounting practice; includes broad guidelines as well as detailed procedures. Governs current accounting practice and that is used as a reference to determine the appropriate treatment of complex transactions.† See also GENERALLY ACCEPTED ACCOUNTING PRINCIPLE (GAAP).

ACETYLENE CYCLOADDITION AROMATIC HETEROCYCLE INERTIA PRINCIPLE [chemistry] See INERTIA PRINCIPLE.

ACKERMAN PRINCIPLE [engineering] (Rudolph Ackermann, 1764–1834, anglo-german inventor) For any given corner, the outside wheel should have less turn angle than the inside one, because it is following a larger radius than the inside wheel. In order to minimize lateral skid while turning, the extensions of the center lines of the wheel axles must intersect at the center of the arc on which the vehicle turns.‡ (2) When a vehicle is steered, it follows a path that is part of the circumference of its turning circle, which will have a centerpoint somewhere along a line extending from the axis of the fixed axle. The steered wheels must be angled so that they are both at a 90° angle to a line drawn from the circle center through the center of the wheel. Since the wheel on the outside of the turn will trace a larger circle than will the wheel on the inside, the wheels need to be set at different angles.§

ACKNOWLEDGMENT CHAINING PRINCIPLE [engineering] The principle of acknowledgment chaining works by processes sending messages to the group of processes. Allows each message to be directly acknowledged only a few times, and through chains of acknowledgements, to be indirectly acknowledged by other processes. This leads to an efficient utilization of resources.¶

ACROPHONIC PRINCIPLE [linguistics] (from Greek aKpo-"tip" + φωνι&, "voice," "the initial sound"; Dr. Richard Venezky, linguistics, USA) Illuminating the nature of English writing by relating current spellings to the sounds, morphemic structure, and history of our language. As in telephone directory spelling, “A for apple,” “B for . . .,” and so on.‖

ACTION PRINCIPLE [mathematics, physics] (1) An action principle is a method for reformulating differential equations of motion for a physical system as an equivalent integral equation. Although several variants have been defined, the most commonly used action principle is Hamilton's principle. An earlier, less informative action principle is Maupertuis' principle, which is sometimes called by its (less correct) historical name, the principle of least action. (Newton's second law is sometimes called an action principle.) Any force \( \mathbf{F} \) acting on a body of mass \( m \) induces an acceleration \( \mathbf{a} \) of that body, which is proportional to the force and in the same direction \( \mathbf{F} = m\mathbf{a} \).** (2) Originally used to derive the equation of motion for a particle in classical mechanics, the action was defined by Hamilton to be the difference \( L = T - U \), where \( T \) is the kinetic energy and \( U \) the potential energy of a mechanical system. Hamilton's principle (or the action principle) states that the

motion of a mechanical system is such that the action integral $S[X(t)] = \int_{t_1}^{t_2} L(X, X') dt$ is stationary with respect to variations in path $X(t)$. The Euler–Lagrange equations for this system are known as Lagrange's equations $(d/dt)(\partial L/\partial X) = (\partial L/\partial X')$, which are equivalent to Newton's equations of motion. In other words, a classical dynamical system evolves from $t_1$ to $t_2$ along a path $X(t)$ for which its action $S[X(t)]$ is an extremum. The extremum is often a minimum. In such a case, nature is efficient; it spends the least amount of action. In these cases we speak of “the principle of least action.” Most commonly, the term is used for a functional $S$ that takes a function of time and (or fields) space, as input, and returns a scalar. Specifically, in classical mechanics, the input function is the evolution $q(t)$ of the system between two timepoints $t_1$ and $t_2$, where $q$ represents the generalized coordinates. The action $S[q(t)]$ is defined as the integral of the Lagrangian $L$ (in classical mechanics, the Lagrangian is defined as the kinetic energy $T$ of the system minus its potential energy $V$) for an input evolution between the two timepoints $S[q(t)] = \int_{t_1}^{t_2} L[q(t), \dot{q}(t), t] dt$, where the endpoints of the evolution are fixed and defined as $q_1 = q(t_1)$ and $q_2 = q(t_2)$. According to Hamilton's principle, the true evolution $q_{\text{true}}(t)$ is an evolution for which the action $S[q(t)]$ is stationary (a minimum, a maximum, or a saddle point). This principle results in the equations of motion in what is known as Lagrangian mechanics. See also HAMILTON PRINCIPLE; LEAST-ACTION PRINCIPLE; MAUPERTUIS' PRINCIPLE; PRINCIPLE OF LEAST ACTION.

ACTIVE PRINCIPLE [pharmaceuticals] (1) An ingredient giving a complex drug its chief therapeutic value. The portion of a pharmaceutical preparation producing the therapeutic action. By analogy, any substance providing the more significant value and thus producing the primary action. The substance in a preparation exerting an effect; as distinct from the substances, is also included. (2) A constituent of a drug, usually an alkaloid or glycoside, on which the characteristic therapeutic action of the substance largely depends.

ACYCLIC DEPENDENCES PRINCIPLE (ADP) [computers] (Robert Cecil Martin) A package is a binary deliverable like a .jar file, or a .dll as opposed to a namespace like a java package or a C++ namespace. Package metrics evaluate the structure of a system. The dependence graph of packages must have no cycles.

ADAPTIVE PRINCIPLE [mathematics] (1) Means for overall design of a precision measurement system by the correlation of the disturbance effect. (2) Analyzing a system and determining the compensation factors as Encyclopedia.com: (http://www.encyclopedia.com/doc/1062-activeprinciple.html).

ADAPTATION-LEVEL PRINCIPLE [social psychology] Our expectations of success and failure, satisfaction and dissatisfaction, even justice and injustice, are relative to our prior experience and to what we observe people like ourselves receiving. If our achievements rise above those expectations, we experience success and satisfaction; if they fall below, we feel dissatisfied and frustrated.

ADAPTIVE DIFFERENTIAL PULSE-CODE MODULATION (ADPCM) PRINCIPLE [computer science] (Developed by Alec H. Reeves, 1926) See PRINCIPLE OF PULSE-CODE MODULATION.

ADAPTIVE PRINCIPLE [mathematics] (1) Means for overall design of a precision measurement system by the correlation of the disturbance effect. (2) Analyzing a system and determining the compensation factors as Encyclopedia.com: (http://www.encyclopedia.com/doc/1062-activeprinciple.html).


well as giving the possibility of correction.* Also referred to as common-path principle.

**ADDITION PRINCIPLE** [mathematics] (1) If two actions are mutually exclusive, and the first can be done in \(N_1\) ways and the second in \(N_2\) ways, then one action or the other can be done in \(N_1 + N_2\) ways.† (2) If set \(A\) is a union of two mutually exclusive sets \(B\) and \(C\), then \(n(A) = n(B) + n(C)\), where \(n(A)\) is the number of elements (objects) in set \(A, B\) and \(C\) are said to be mutually exclusive if \(B\) and \(C\) have no elements in common, i.e., \(B \cap C = \emptyset\). In other words, if a set can be partitioned into disjoint subsets, then the number of objects in the set = the sum of the number of objects in each of its parts. The addition principle can be generalized to counting a set that is a union of several mutually exclusive sets.‡ (3) Adding the same number to both sides of an equation does not change its solution set. (4) In probability, if \(E_1, E_2, \ldots, E_s\) are all mutually exclusive events, then the probability some \(E_i\) occurs is the sum of the probabilities the individual \(E_i\) occur, i.e., \(P(E_1 \cup E_2 \cup \cdots \cup E_s) = P(E_1) + P(E_2) + \cdots + P(E_s)\).§ See also *MULTIPLICATION PRINCIPLE, FUNDAMENTAL PRINCIPLE OF COUNTING.*

**ADDITIVITY PRINCIPLE** [mathematics] (1) The value of a magnitude or property corresponding to a whole is equal to the sum of the values of the magnitudes or properties corresponding to its parts for any division of the whole into its parts. (2) The judged probabilities for complementary events should sum to unity.† See also *ADDITION PRINCIPLE.*

**ADIABATIC PRINCIPLE** [physics, computer science] Correlates the capacity of a system to interact with the frequency of attempted interaction by another.** Also referred to as *ehrenfest adiabatic principle.*

**ADJACENCY PRINCIPLE** [geometry] Size cues between adjacent objects is more effective than the size cue between displaced objects in determining the perceived relative depth portion of objects.††

**ADLER PRINCIPLE** [psychology] (Alfred Adler, 1870–1937, Austrian physician) Theory placing emphasis on the individual’s need to belong and to contribute, based on social equality and mutual respect. These sociopsychological concepts are integrated in Adlerian writings with concepts that bear on an individual’s dynamics, such as the individual’s goals and private logic.‡‡

**ADLERIAN PRINCIPLES** [psychology] (Alfred Adler, 1870–1937, Austrian physician) Emphasis on making the children aware of their goals in speech deficiency and misbehavior; leaving to them the decision to improve, encouraging their learning through mutual help within the group; and providing logical consequences for their behavior.§§ (2) Applies four principles of conflict resolution: practicing mutual respect, pinpointing the real issue, changing the conflict agreement, and involving all concerned in decisionmaking.¶

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ADVANTAGE OF RARITY PRINCIPLE See CHAOTIC PRINCIPLE.

AFFINITY PRINCIPLE [chemistry] (Julius Thomson and Marcellin Berthelot) Every simple or complex action of a purely chemical nature is accompanied by an evolution of heat. Energy difference between ionization of elements, combination of power, attraction, or magnetism impacts the lowest state of the corresponding reaction.* See also THOMSON–BERHELOT PRINCIPLE.

AGGREGATION PRINCIPLE [biology] A grouping or clustering of individuals within a population.† (2) The sum of a set of multiple measurements is a more stable and representative estimator than any single measurement.§

AIR DISTRIBUTION PRINCIPLE [engineering] Arrangement by which gases may be patterned, ordered, confined, or dispersed in order to control the allotment, mixture, partitioning, circulation, or saturation for possible reaction.§

AIR FLOAT PRINCIPLE [engineering] Drying by means of directing streams of a drying gas while at the same time floating or flowing air and carrying the surface according to the Coandă effect.¶

AIRFLOW PRINCIPLE [engineering] Measurement of the resistance to airflow through a plug of fibers. This resistance can be directly related to fiber fineness.¶

ALPHA PRINCIPLE [management] (James Morgan, Allied Materials CEO) Once a company gains critical mass, it can accelerate like an alpha particle emitted from a radioactive atom and the company can experience exponential growth.**

ALARA PRINCIPLE [mathematics] Also referred to as ALARP or as low as reasonably achievable.

ALARP PRINCIPLE [mathematics] See AS LOW AS REASONABLY PRACTICAL PRINCIPLE. Also referred to as ALARA (as low as reasonably achievable).

ALEXANDER PRINCIPLE [psychology] (Frederick Matthias Alexander, 1869–1955, Australian Actor) Biofeedback and relaxation with methods employed in sport, physical education, and acting. The work of the athlete and the performances of the actor and the dancer are magnifications of skills demonstrated with all people at some level. Although the next-door neighbor may not dance, the upstairs resident may not act, the person across the road may never get out of the armchair, it is suggested that all ordinary people may benefit from the biofeedback principle and the Alexander principle as part of an education toward their full consummation of being.***

ALLEE’S PRINCIPLE [ecology] (Warder Clyde Allee, 1885–1955, American Zoologist) The tendency of individuals in some populations to flourish best at intermediate optimal population density.††

ALPHA PRINCIPLE [management] (James Morgan, Allied Materials CEO) Once a company gains critical mass, it can accelerate like an alpha particle emitted from a radioactive atom and the company can experience exponential growth.‡‡

ALPHABETIC PRINCIPLE [language] Two components of phonemic awareness involves recognition of phoneme identity across words and recognition of phonemic segmentation within words. Word identity can be equally easily taught using word-initial and word-final phonemes.*

ALTMAN PRINCIPLE [biology] (Sidney Altman, 1939-, Yale Univ., Nobel prize, Canadian molecular biologist) (1) Molecular biology studies made in the area of RNA processing. Ribonucleoprotein is a key enzyme in the biosynthesis of tRNA. RNase precursor is involved in processing all species of tRNA and is present in all cells and organelles that carry out tRNA synthesis. (2) Used to prove a vector-valued equilibrium variant.*

AMBERTSUMYAN'S INVARIANCE PRINCIPLE [physics, mathematics, chemistry] (Viktor Ambartsumyan, 1908–1996, Armenian physi-cist) (1) Density limit theorems for delays from limit theorems for queue lengths when studying queue-dependent arrival and or molecular orbits service completion rates. (2) Applied in demonstrating the existence of adaptive stabilizers and servomechanisms for a variety of nonlinear system classes. (3) Prevention of nonlinear suppression of signal in receiving and amplifying circuits. See INVARIANCE PRINCIPLE.

AMINE CAPTURE PRINCIPLE [chemistry] Amino acid esters react with 4-methoxy-3-acyloxy-2-hydroxybenzaldehydes to form imines, which on reduction undergo intramolecular acyl transfer to form N-4-methoxy-2,3-dihydroxybenzaldehydes, useful in peptide synthesis. The feasibility of peptide bond formation through a new principle of intramolecular acylation which is preceded by amine capture. Imine formation from salicylaldehydes occurs with unusually large rate and equilibrium constants.**

ANALYTICAL PRINCIPLE [chemistry] Elements used to make a determination toward a result such as the use of calorimetric analyzer limiting interference from chloride, temperature, or hydrogen ions. t+

ANATOMOCLINICAL PRINCIPLES [medicine] Correlated with lesions of specific anatomic foci. Based on identified relations between structural brain lesions and behavioral disturbances.†

ANCILLARITY PRINCIPLE [mathematics] A statistical experiment or a model M is defined as a triplet \((\chi, \Omega, P)\), where \(\chi = \{x\}\) is an abstract sample space, \(\Omega = \{\theta\}\) is an abstract parameter space, and \(P = \{P_\theta : \theta \in \Omega\}\) is a class of distributions on \(\chi\) indexed by the parameter \(\theta\). It is assumed that \(\chi\) and \(\Omega\) are finite. The inference one can make on the basis of an observation \(x\) (in \(\chi\)) given the experiment \(M\) can be denoted by \(\text{inF}(x, M)\).


The ancillarity principle states, that if \( P_{\theta} \) is the same for all \( \theta \in \Omega \), then \( \text{Inf}(\cdot |x, M) \) is the same for all \( x \) in \( \chi \). In other words, no inference about \( \theta \) is possible on the basis of an observation \( x \), under the experiment \( M \).*

**ANTENNA PRINCIPLE** [physics] Focused reflected electromagnetic energy used to identify size, speed, and location of an object.\(^\text{II}\)

**ANTHROPIC COSMOLOGICAL PRINCIPLE** [physics] (John Barrow and Frank Tipler) We ought not be surprised at measuring a universe so finely tuned for life, for if it were different, we would not observe it.\(^*\) See COSMOLOGICAL PRINCIPLE.

**ANTHROPIC PRINCIPLE** [astronomy, genetics] (Brandon Carter, b. 1942; Australian theoretical physicist, British mathematician) (1) The nature of the universe is constrained because of our presence as observers.\(^\ddagger\) (2) Life, even if abundant on many worlds, is only an infinitesimal portion of the cosmos. The presence of intelligent life on Earth places limits on the many ways the universe could have developed and could have caused the prevailing conditions.\(^\ddagger\) See also BLACK HOLE PRINCIPLE; COPERNICAN PRINCIPLE; PRINCIPLE OF BLACK HOLE COMPLEMENTARITY; STELLAR PRINCIPLE; ANTHROPIC COSMOLOGICAL PRINCIPLE; COSMOLOGICAL PRINCIPLE; FINAL ANTHROPIC PRINCIPLE; STRONG ANTHROPIC PRINCIPLE; WEAK ANTHROPIC PRINCIPLE.

**ANTHROPOMURPHIC PRINCIPLE** [mathematics] Any universe built along conventional lines that contains intelligent polymorphs will conform to Murphy's law.\(^\S\S\)


ANTIAGING PRINCIPLE [nutrition] A 60% reduction in the typical normal daily caloric allotment will have an antiaging effect.*

ANTIARRHYTHMIC PRINCIPLE [chemistry] (1) Channel modification is the response to the interaction with organic or inorganic molecules and causes repetitive activity by removal of inactivation. † (2) Sodium channel blocks controlling cardiac arrhythmias by the selective or isolated prolongation of repolarisation. ‡ (3) Pharmacologically induced removal of inactivator is kinetically indistinguishable from spontaneous failure on inactivation.§

ANTIBIOTIC PRINCIPLE [medicine] (1) Characteristics show traits of heat resistance, time resistance, and a relationship between the pH of the medium generally with greater production around 7–8 days on media containing starch or carbohydrates. † (2) Function, mode, and effect on the physiological ecology of animal habitats can be investigated to determine natural occurrences of antibiotic means to adjust to certain diet or plant growth interactions. ‡

ANTICOERCION PRINCIPLE [psychology] (Aristotle) Everything (within the sphere of social conduct) forced is unjust (e.g., aggression is defined as the initiation of physical force, the threat of such, or fraud committed on persons or their property). Aristotle subscribed to two principles relating justice and nature: a positive principle linking the just and the natural.** Also termed zero-aggression principle; see NONAGGRESSION PRINCIPLE.

ANTIDEPRESSANT PRINCIPLE [medicine] Increasing control over depression sympathetic activity by increasing use of exercise as an effective antidepressant or decreasing stress relieving the susceptibility toward depression. Exercise and stress have many opposing effects in the brain and are consistent with this hypothesis.††

ANTIDIURETIC PRINCIPLE [psychology] A peptide hormone limiting the amount of water excreted by the kidneys. Deficiencies of this hormone result in central diabetes insipidus. Excesses cause water retention and hyponatremia.‡‡

ANTIHISTAMINIC PRINCIPLE [pharmacy] Tending to neutralize or antagonize the action of histamine or inhibit its production in the body. §§

ANTINFLAMMATION PRINCIPLE [medicine] Medical procedure or pharmaceuticals designed to prevent or inhibit coagulation, activation, thrombosis, tissue factor complex, heart disease, or biosynthesis.†† See also ANTIHYPHLOGISTIC PRINCIPLE; ANTITHROMBOTIC PRINCIPLE.

**ANTIMAXIMUM PRINCIPLE** [mathematics] A fundamental result in the theory of partial differential equations is the following maximum principle. According to it a function $u$ on an interval $[a, b]$ that satisfies $-u'' \geq 0$ on $[a, b]$ achieves its maximum at $a$ or $b$. If, additionally, $u(a) = u(b) = 0$, then $u \geq 0$ on $[a, b]$, and either $u \equiv 0$ on $[a, b]$ or $u > 0$ on $[a, b]$ with $u'(a) > 0$ and $u'(b) < 0$. In 1979 P. Clement and L. Peletier studied the classical Dirichlet problem $-Au = \lambda u + f(x)$ in $\Omega$, $u = 0$ on $\partial \Omega$, when the real parameter $\lambda$ satisfies $\lambda > \lambda_1$ with suitable $\lambda_1 > 0$. They derived, for a certain value of $\lambda$, a conclusion that is opposite to the preceding one; namely, if $f \neq 0$ but not identically zero, then it implies $u < 0$.*

**ANTIPERNICIOUS ANEMIA PRINCIPLE** [medicine] (1) Therapeutic effect of liver in controlling the disease of pernicious anemia.† (2) Regeneration of red cells by the liver requiring the combination of an intrinsic factor, present in normal human gastric juice, with an extrinsic factor of vitamin B_{12}. Intrinsic factor is a specific B_{12} binding protein secreted by the stomach to enhance absorption of the vitamin.‡

**ANTIPHLOGISTIC PRINCIPLE** [pharmaceuticals] Medical procedure or pharmaceuticals designed to prevent or inhibit coagulation, activation, thrombosis, tissue factor complex, heart disease, or biosynthesis.§ See also ANTIINFLAMMATION PRINCIPLE; ANTITHROMBOTIC PRINCIPLE.

**ANTIVIRAL ACTIVE PRINCIPLE** [pharmaceuticals] Method for quantization of the antiviral effect comprising the following steps: (1) transducing cells with a viral vector, containing all the genetic data required for infecting a cell with a type of target virus; (2) introducing a prospective antiviral into the cells; and (3) quantitatively analyzing the activity.** See also ACTIVE PRINCIPLE.

**APPROXIMATION INDUCTION PRINCIPLE** [mathematics, physics] See INDUCTION PRINCIPLE.

**ARC-EXTINGUISHING PRINCIPLE** [engineering] The high-temperature fluid near the arc striking part attributed to the thermal energy emission of the arc is caused by flowback into the gas storage chamber.

**ANTISYMMETRY PRINCIPLE** [electronics, anatomy] In regard to electrode placement there is a fundamental neurological difference between antisymmetric and symmetric excitation, in which the skin polarization is respectively antisymmetric and symmetric with respect to the sagittal plane. In antisymmetric excitation, the weak frequency-modulated signals from the modulated afferents act antisymmetrically on the brain.† See INVARINCE PRINCIPLE; LINDELOF PRINCIPLE; SCHWARZ REFLECTION PRINCIPLE; SYMMETRY PRINCIPLE.

**ANTITHROMBOTIC PRINCIPLE** [pharmacology] Medical procedure or pharmaceuticals designed to prevent or inhibit coagulation, activation, thrombosis, tissue factor complex, heart disease, or biosynthesis.† See also ANTIINFLAMMATION PRINCIPLE; ANTIPHLOGISTIC PRINCIPLE.

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and mixed with the low-temperature fluid contained therein. The fluid pressure in the gas storage chamber is raised, whereby the fluid, at a temperature low enough to extinguish the arc, is blown against the arc to effect self-extinction in the process in which current decreases toward its zero point, while the low-temperature arc extinguishing fluid from the puffer chamber is forcibly blown against the arc to effect forcible extinction in the process in which the current decreases toward its zero point. See also EXTINCTION PRINCIPLE; EXTINGUISHING PRINCIPLE.

ARCHIMEDEAN PRINCIPLE [mathematics, physics] (Archimedes, c. 287–212 BC, Greek mathematician) (1) Also known as Archimedeian axiom, originally formulated for segments, it states that if the smaller one of two given segments is marked off a sufficient number of times, it will always produce a segment larger than the larger one of the original two segments. This axiom can be applied in a similar manner for surfaces, volumes, positive numbers, etc. In general, the Archimedean axiom applies to a given quantity if for any two values \( C \) and \( D \) of this quantity such that \( C < D \), it is always possible to find an integer \( n \) such that \( Cn > D \). The axiom forms the basis of the process of successive division in arithmetic and in geometry. (2) If a body is wholly or partially submerged in a fluid (liquid or gas), it experiences an upward force (upthrust) equal to the weight of fluid that it displaces. A body floating in a fluid displaces a weight of fluid equal to its own weight. Also known as the principle of buoyancy. A body wholly or partly immersed in a fluid will experience an upward thrust (upthrust) equal to the weight of fluid it displaces; the upthrust acts vertically through the center of gravity of the displaced fluid. 

ARCHIMEDES’ PRINCIPLE [mathematics, physics] (Archimedes, c. 287–212 BC, Greek mathematician) (1) Predicting a ship’s buoyancy by the distribution of weight for balance of heel and trim. (2) Correlation between surface and volume of a sphere and its circumscribing cylinder. (3) A body immersed wholly or partially in a fluid is buoyed up by a force equal in magnitude to the weight of the volume of fluid it displaces. (4) Object immersed in a fluid has an upward force equal to the weight of the fluid displaced by the object. The Archimedes thrust \( S = rgV \) (\( S = \) force, \( r = \) density, \( g = \) weight, \( V = \) volume) is generated by the resultant of all the forces that the fluid produces on the surface of the body by means of the hydrostatic or aerostatic pressure. (5) The hydrostatic pressure a liquid produces because of the gravity force, depends on both the density and the height of the liquid inside a container. (6) A hot-air balloon is subjected to an ascensional force \( Fa \), which is given by the difference between the aerostatic thrust \( S \) and the weight \( P \): \( Fa = S - P = r_c Vg - r_h Vg \), where \( r_c \) and \( r_h \) are, respectively, the density of the external cool air and the one of the hot air inside the

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balloon.* See also HYDROSTATIC PRINCIPLE, PRINCIPLE OF BUOYANCY.

AREA PRINCIPLE [mathematics] (1) (T. H. Gronwall, 1914) (theory of univalent functions) The area of the complement to the image of a domain under a mapping by a function regular in it is nonnegative. Let $B$ be a domain of finite connectivity containing point $\infty$, and let $F(z) + b_0 + b_1/z, \ldots$ be univalent in $B$. If $B_F$ is the complementary set of $F(B)$ and $Q(w)$ is regular in an open set containing $B_F$, then the area principle simply states that the area of the set $Q(B_F)$ is nonnegative. If we take $B = \{z : |z| > 1\}$ and $Q(w) = w$, we obtain the classical area theorem: $\Sigma_{n \geq 1} n|b_n|^2 < 1$. (2) The sides of a triangle are equal to the ratio of the lengths depending on whether these segments have the same or opposite directions. (3) Exchange takes place across surfaces, and an increase of the ratio of surface area to volume leads to an increase in efficiency. Also termed area ratio principle.

ARIOKHIN-PARETO INTERACTION PRINCIPLE [mathematics] Control energy lost due to mismatch in control actions with the system. Also known as PLUS/MINUS INTERACTION PRINCIPLE; INTERACTION EQUIVALENCE PRINCIPLE; GROUND SUPPORT INTERACTION PRINCIPLE; PRINCIPLE OF KUAN HSI; INTERACTION PRINCIPLE.

ARISTOTELIAN FIRST PRINCIPLES [psychology] (Aristotle, 384 BC–322 BC, Greek philosopher) Earliest text on logic formulating the historical distinction of being the first principle from the Meta ta physica, 1005b. “For the same (characteristic) simultaneously to belong and not belong to the same (object) in the same (way) is impossible.” First expression of consistency in Western thought. Any defining and reasoning in any language on any topic assumes it a priori. It cannot be doubted, as all doubting is based on inconsistency, which assumes consistency a priori.

ARISTOTLE’S THEORY OF PRINCIPLES [psychology] (Aristotle, 384 BC–322 BC, Greek philosopher) Philosophy-based concepts on science related to induction/deduction, contradictions, or other sets of fundamental principles allowing for the development of deduction toward a coherent theory of knowledge.

ARTIFICIAL IMMUNE PRINCIPLE [computer science] Simulated immune learning algorithm is used for determining the number and location of hidden layers by regarding the input data of network as antigens, and the centers of the hidden layer as antibodies.

ARYABHATA’S RELATIVITY PRINCIPLE [astronomy] (Aryabhata, c. 476–550, Indian mathematician and astronomer) Ascribes the motion of the moon to Earth’s rotation and developed an elliptical model of the heliocentric planetary system. Follows Galilean relativity supporting Earth rotation, with possible underlying theory in which Earth (and the other solar system planets) orbits the sun, rather than the sun orbiting Earth.

AS LOW AS REASONABLY PRACTICAL (ALARP) PRINCIPLE [psychology, mathematics] (1) Applied in many areas to regulate the tolerable level of risk. Usually the principle is operationalized by assigning a value per fatality. A cost/benefit analysis is used to trade the expected value of lives saved with the costs of technical measures required to reduce risks. In sectors in which risks have been reduced over a period of years, it is difficult to pinpoint those areas in which further risk reduction might be sought. In this article we show that many different risk reduction mechanisms can be considered simultaneously in a decision analysis framework. Using influence diagrams it is straightforward to build mini-decision analysis models in which competing alternatives addressing the same risk can be compared. The minimodel decision alternatives are assembled into decision strategies representing the best possible combination of alternatives at different cost/benefit ratios. Disynergies between the different alternatives are highlighted through the model. The overall aim is to build a high-level model to explore the sensitivity of risk reduction measures to the value per fatality parameter. This enables decisionmakers to gain a better understanding of the cost of measures required to obtain a global reduction in risk.*

(2) Specifies the boundary of tolerable risk at a level as low as reasonably practical, defined as falling between two limits. The top limit defines where operations should be for hidden and the bottom limit, the level below which risk is insignificant. If the process has the potential for inflicting an unacceptable level of risk, then steps must be taken to bring the risk level into the ALARP region.† Also known as ALARA; ALARP; as low as reasonably achievable.

ASSEMBLY SEQUENCE PRINCIPLE [engineering] Construction sequences should be planned in such a way as to allow the systems to work freely and have access to the site.§ See also STRONG-AXIS PRINCIPLE; SEVENTH JOINT PRINCIPLE; INTERFACE PRINCIPLE; STACKABILITY PRINCIPLE; PATH PRINCIPLE; DRILLED-CELL PRINCIPLE.

ASYMMETRIC INDUCTION PRINCIPLE [measurement, physics] Provides a simple and economical method of obtaining enantiomerically enriched products. Involves the reaction of organocopper reagents with enantiomerically enriched unsaturated esters. These esters, derived from scalemic alcohols and unsaturated carboxylic acids, react to give diastereomeric products that on hydrolysis yield enantiomers.‡ See INDUCTION PRINCIPLE.

ASYMPTOTIC MATCHING PRINCIPLE [engineering] (M. Van Dyke) The usual asymptotic expansion is called the inner expansion. The asymptotic expansion within certain powers is called the outer expansion. To obtain the inner expansion, a stretching transformation is introduced. The inner and outer expansions have a common region of validity and one can express the inner expansion of the outer expansion and the outer expansion of the inner expansion. The m-term inner expansion (of the n-term outer expansion) = the n-term outer expansion (of the m-term inner expansion, where m and n are any two integers. See also MATCHING PRINCIPLE.

AUFBAU PRINCIPLE [chemistry] (1) Governs the order in which the atomic orbitals are filled in elements of successive proton number.† (2) A description of the buildup of elements in which the structure of each in sequence is obtained by simultaneously adding one positive charge (proton) to the nucleus of the atom and one negative charge (electron)