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# **ANIMAL BEHAVIOR DESK REFERENCE**

*A Dictionary of Animal Behavior,  
Ecology, and Evolution*

**Third Edition**

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**Edward M. Barrows**

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## DEDICATION

*To my mother, M. L. Barrows, and to the memory of my father, S. E. Barrows, biophiles and bibliophiles, who encouraged my interests in nature and my keeping insect pets (even in our living room!).*



# TABLE OF CONTENTS

Introduction .....	ix
How to Use This Book .....	xi
Choose Definitions and Synonyms Carefully .....	xv
Coin Terms and Define Concepts Carefully .....	xv
Author .....	xvii
Acknowledgments .....	xvii
Alphabetical Listings .....	1
Appendix 1: Organisms .....	680
Appendix 2: Companies, Organizations, and Societies Concerned with Animal Behavior, Animal Welfare, Conservation, Ecology, Evolution, and Related Subjects .....	735
Appendix 3: Computer Databases .....	745
References .....	748



# INTRODUCTION

## Aim of this Book

*Animal Behavior Desk Reference, A Dictionary of Behavior, Ecology, and Evolution* is an annotated dictionary intended to help aid scientific communication, in particular in the fields of animal behavior, ecology, evolution, and related branches of biology. I created this book for students, teachers, researchers, writers, editors, and others active in science. This third edition contains over 800 new terms and definitions, 48 new figures, and thousands of additions to and improvements of material presented in the second edition.

A book such as this one can never be complete. Therefore, I certainly welcome constructive criticisms and further information that should be included for its improvement, such as previously published definitions, new definitions of existing terms, your view of definitions already in this book, and new terms with their definitions. Your e-mails (barrowse@georgetown.edu) and annotated reprints regarding these subjects are especially welcome. If you have coined a term(s) included in this book, and I do not attribute this properly, please let me know.

Many references are secondary ones, *e.g.*, “Smith (1946 in Jones 1990),” because I wanted to indicate the source of an author’s interpreted information, because I could not examine certain primary references, or for both reasons. If I have cited your work secondarily, I would be very pleased to receive a copy of your publication (with highlighted relevant parts) to facilitate quoting your work directly in the future. Further, if I have misinterpreted your writing with regard to a definition(s) or other information, please let me know.

## The Need for Precise Terminology

Austin (1957, 7–8) told us “... words are our tools, and, as a minimum, we should use clean tools: we should know what we mean and what we do not, and we must forearm ourselves against the traps that language sets us.” It follows that for effective, efficient communication, people should have, or at least understand, the same precise terminology. Such terminology can certainly aid the advancement of basic, theoretical, and applied science. Phenomena are often further elucidated when they are placed into proper order with useful names (Brosius and Gould 1992, 10709). Dawkins (1986, 110–111) discusses how definitions have had an enormous impact on the way people perceive, *e.g.*, in communication. “They have affected what we regard as ‘communication’ and ‘signals’ and whether we see communication as involving any sort of transfer of information. . . . Much of the confusion over ‘information transfer,’ too, appears to have been largely brought about by the way it is defined. Arguments which appear to be over something profound about animal communication (such as whether information is being transferred or not) often turn out to be nothing more than whether a protagonist is adopting the technical or the more everyday meaning of the term.” As another example, Dewsbury (1999) discusses terminological problems in a section of his paper called “the mischief of words.” He expresses his concern about how biologists use the terms “function,” “ultimate,” and “ultimate causation.”

To promote the understanding of terminology, some societies, *e.g.*, the Animal Behavior Society and American Society of Parasitologists have, or have had, committees dedicated to this subject. Because the Avian Brain Nomenclature Consortium believes “that names have a powerful influence on the experiments that we do and the way in which we think,” the Consortium published a new nomenclature for parts of bird brains (Jarvis et al. 2005, 151). The inaccurate evolution-based terminology for vertebrate brains that was used throughout the 20<sup>th</sup> century became a severe impediment to the communication of scientific discoveries and the generation of new insights (page 155). Some of the many printed dictionaries and encyclopedias that define biological terms (meaning biological in the broad sense) include Allaby 1989, Campbell and Lack 1985, Chapin 1968, Collocot and Dobson 1974, Cumming 1972, Drever 1974, Eysenck et al. 1979, Goldenson 1984, Harré and Lamb 1983, Heymer 1977, Hinsie and Campbell 1976, Hurnik et al. 1995, Immelmann 1977, Immelmann and Beer 1989, Keller and Lloyd 1992, King and Stansfield 1985, Lincoln et al. 1985, Medawar and Medawar 1983, Roe and Frederick 1981, Seymour-Smith 1986, Steen 1973, Storz 1973, Torre-Bueno 1978, and Wolman 1973.

## Confusion about Meanings of Terms

Biologists in general strive to obtain a superior terminology, unfortunately not yet with total success. Confusion and controversy about meanings are common as I indicate in many entries of this dictionary. Many terms, not to mention the concepts that they represent, are obviously in need of further study of their already designated meanings. The confusion and controversies arise for many reasons, including:

- A satisfactory definition of a term might not yet exist due to our present state of knowledge; *e.g.*, see aggression, awareness, and consciousness.
- The name of a term is a nontechnical English word(s) which already has a common dictionary definition(s); *e.g.*, see altruism, selfishness, and spite. Such nontechnical words often “have a variety of meanings and are surrounded by a dense atmosphere of values and associations” (Wilson and Dugatkin 1992, 29). Therefore, such words can confound communication even if they are precisely defined in scientific literature. Keller (1992) describes how “competition” with its established colloquial meaning permits the simultaneous transfer and denial of its colloquial connotations when it is used technically. Colloquial connotations can lead plausibly to one set of inferences about a concept and close off others. “Eugenics” was originally defined technically and nonpolitically, yet some people now find it difficult to think of eugenics without negative political connotations.
- The name of a term is a foreign word(s) that may be hard to remember and interpret accurately; *e.g.*, see *umwelt* and *zeitgeber*.

- The name of a term is a technical word that may be hard to remember and understand without an explicit definition; *e.g.*, see apotroptic behavior and epidiectic display.
- The term is only implicitly defined with regard to all, or some, of its meanings in the scientific literature. To my dismay, I have omitted some terms and some definitions from this book because I could not formulate a satisfactory definition from information provided in written material.
- The term is explicitly, but not correctly, defined in all scientific literature, textbooks, or both. For example, consider “inclusive fitness.” Grafen (1982) lists fourteen commonly used animal-behavior textbooks that defined this term erroneously or inadequately. Dawkins (1986, 44) later advises, “It is best not to read too much about inclusive fitness as much of what has been written is misleading.”
- The term has more than one technical definition that can vary in their degrees of difference from one word (such as partially, possibly, or potentially) through many words; *e.g.*, see species. In some cases the same term can even have opposite meanings; *e.g.*, see true altruism and overdispersed distribution.
- Many terms have evolved in their meanings as scientists learned more about the concepts that they represent, research focus shifted, or both. Isolation was originally used for both geographical isolation and reproductive isolation; variety was used, for instance by Darwin, for a single individual or a population; and teleological was used for four distinct phenomena (Mayr 1982, 43); *e.g.*, also see communication, evolution, fitness, gene, homology, species, and territory.
- The term may have one through many synonyms, sometimes including a perplexing one that uses the same word(s) for a very different concept; *e.g.*, see adaptation and homology. In some cases, imprecise language led to virtual synonymies of important terms that should retain distinct usages, *e.g.*, these terms and their associated ones: coevolution, guild, and keystone species (Fauth et al. 1996, 282).
- The term has more than one spelling, capitalization, or hyphenation style; *e.g.*, see homeotherm, endosymbiosis hypothesis, the Modern Synthesis, and molecular-clock hypothesis.
- The same concept is referred to using two, or more, of these words: hypothesis, law, rule, and theory. Examples are locale-odor hypothesis and Allen’s rule.
- Authors often shorten a concept’s name; *e.g.*, they use adaptation to mean a specific kind of adaptation such as physiological adaptation and selection to mean a specific kind of selection, such as artificial selection.
- Many scientific words are long. Especially long words are the chemical names for deoxyribonucleic acid (207,000 letters), tryptophan synthetase (1,900), tobacco mosaic virus (1,185), pneumonoultramicroscopic silicovolcanokoniosis (45, a lung disease caused by breathing fine dust), and hepaticocholangiocholecystenterostomies (39, a surgical operation that creates channels of communication between gall bladders and hepatic ducts or intestines) (Ash 1996, 108).
- Different dictionaries define the same term differently; *e.g.*, atavism (Hrdy 1996, 851; Thornhill and Gangestad 1996, 853).
- The original words of a term (*e.g.*, theory of mind, *q.v.*) are confusing, but researchers continue to use such a term because it has been widely used. Further, when a researcher wishes to use a non-confusing name, or less confusing name, for a concept, a publisher may talk him out of it; therefore, the original confusing name continues in the literature (Ashington 1998, 32–33).

Many concerned scientists have tried to rescue us from terminological pitfalls. I applaud them. For instance, Hailman (1976) insightfully suggests how to improve behavioral terminology by emphasizing logic, informational content, and efficiency, rather than historical origins of stability. Brown (1987, 297) lists very helpful guidelines for using biological terms. Fitch (1976) even organized others to petition against a confusing definition of *homology* that refers to similarity of nucleotide sequences (= sequence homology) (Lewin 1987a).

# HOW TO USE THIS BOOK

**Main format.** This book uses a dictionary format to present definitions in a standard, quick-to-use way and to help especially users whose first language is not English. The book's body contains terms that are not organism names. Organism names are in Appendix 1. Selected organizations are in Appendix 2, and information on databases is in Appendix 3.

**Type of terms emphasized.** I emphasize conceptual terms, not anatomical parts or taxonomic names, in this book's main body. However, it does include a small sampling of such parts including some organs and glands. It also defines a few of the millions of taxa in Appendix 1. Biology texts, taxonomic catalogs, primary literature, and Internet files have thousands of definitions of anatomical parts and taxonomic names that I do not include. This book concentrates on definitions of nouns or noun forms, rather than adjectives, adverbs, and verbs due to space limitations.

**New terms.** A term within quotation marks in an entry line is one that my correspondents, I, or both of us coined as part of producing this book.

**Superscripted entries.** When needed for clarity, a term with two, or more, distinct meanings is listed as more than one superscripted entry, *e.g.*, <sup>1</sup>sensation and <sup>2</sup>sensation.

**Term hierarchies.** As conceptual structures, relationships among many terms are summarized in tables and many terms with their definitions are organized in hierarchical clusters by conceptual relationships; under key words, combining forms, and groups of letters that they have in common; or both. A term that is not part of a hierarchy, or one that is the first term in a hierarchy (= a first-level term), is preceded by a diamond (◆). Second- through eight-level terms (or names) are increasingly indented. Second-, fourth-, and sixth-level terms are not preceded by symbols. Third-level terms are preceded by arrowheads (▶); fifth-level terms, black square (■); seventh-level terms, open squares (□); eighth-level terms, black circles (●); and ninth-level terms, open circles (○).

◆ **chemical-releasing stimulus (CRS)** *n.* A chemical that . . . .

**semiochemical, semiochemic** *n.* A chemical that . . . .

▶ **allelochemic** *n.*

1. A chemical that . . . .

**allomone** *n.* A chemical substance, . . . .

■ **allelopathic substance** *n.* A waste product, . . . .

**Definition sources.** Most references do not give definitions in the exact form used in this book. Therefore, almost all definitions are paraphrased for conciseness and to conform with the style of this book. This includes changes from British to American spelling where appropriate. Author-date citations indicate references from which I have obtained, or based, definitions. Many definitions are based on ideas combined from more than one source. In some cases, definitions are my perceptions of what authors mean by their terms because they did not present their formal definitions. I indicate this by stating "inferred from . . . ."

**See directives.** "See . . ." directs you to where a concept is defined under a synonymous name, is part of a term hierarchy in which it is defined, is defined as part of the definition of another term, or is otherwise characterized, *e.g.*, in a table. For example, *prophototaxis* is a sub-subentry under *phototaxis* which is a subentry under *taxis*. The main listing for *prophototaxis*, then, reads as follows:

◆ **prophototaxis** See *taxis*: *phototaxis*: *prophototaxis*.

Note that colons separate main entries, subentries, and sub-subentries in the context of a cross-reference. The first term listed is always a first-level entry; reference to a single term, *e.g.*, See *behavior*, directs you to the main, alphabetical listing for the term, in this case, in the B's.

**Multiple definitions.** For many terms, I document some of the diversity of meaning. When I give more than one definition for a term, I list the definitions in *chronological* order with regard to citation date. When I can, I indicate which definition seems appropriate for wide use today. One meaning of a term can often be better understood after its other definition(s), as well as those of associated terms, are examined. Some terms, *e.g.*, evolution and heterochrony, have been modified through descent by "conceptually selective forces" so that they now have families of definitions, even some with opposite meanings (Gould 1992, 158; Richard 1992, 95).

**Nontechnical and obsolete definitions.** For many terms, especially ones originally developed to refer to Humans and then extrapolated to non-Humans, I first give nontechnical English definitions, and then I list obsolete definitions when I think they are helpful in understanding the evolution of meaning of a term. One, or more, older meanings of a term, *e.g.*, evolution, can lie below the surface of a newer meaning and affect the term's significance (Richards 1992, 95).

**Pronunciations.** This book lists pronunciations for some of the terms that it defines, particularly for some acronyms and terms with words that are not normally found in standard English dictionaries. For words with more than one syllable, I indicate the stressed syllable(s) by capitalizing it, *e.g.*, apoptosis (a POE toe sis) which has silent second p.

**Common-denominator entries.** Many terms are grouped as divisions under a main entry (a key word, combining form, or terminal group of letters) that they have in common. This results in many divisions that do not have definitions that relate directly, or at all, to definition(s) in the main entry that precedes a cluster. Also, because authors often did not specify which main-entry definition relates to a division, I often could not specify this information.

The common denominators and main words are that are listed as primary entries (those preceded by diamonds) are: abundance, acme, -acmic, acoustics, action, activity, adaptation, affinity, aggression, agonist, allele, altruism, analysis, angel, animal, animal names, animal sounds, anthropic, area, attachment, attention, -auxesis, awareness, bee, behavior, beneficiary, benefit, benthic, biont (bion), -bios, biota, -biotic, biotope, bite, bond (bonding), bout, breeding, brood, buffering, calling, camouflage, canalization, cannibalism, care, caste, castration, cause (causation), cell, ceremony, chain, character, cheat (cheater), chemical-releasing stimulus, chimera (chimaera), -chore, chromosome, chronology, -cial, -cide, cline, clock, clone (clon), coefficient, -cole, colonial, coloration, communication, community, companion, competition, complementation, conflict, consciousness, consumer, copulation (copulatory behavior), correlation, cost, courtship (courtship behavior), -cron, cross, crossing over, crypsis, cue, curve, cycle, cyclic, dance, Darwinism, datum, definition, deme, density, dialect, difference, discontinuity, dispersal, display, distribution, diurnal, diversity, doctrine, dog, dominance, domatium, dormancy, dress, drift, drive, -dromous, drug, dynamic, effect, efficiency, effort, electrophoresis, elimination, emotion, endemic, energy, environment, equilibrium, error, estrus (oestrus), eugenics, evolution, evolutionism, evolutionist, experiment, experimental design, exploration, extinction, facial expression, facilitation, factor, fauna, fallacy, family, fauna, fear, feedback, feeding, -ference, fight, fitness, flight, food, forager, foraging (foraging behavior), fossil, fostering, frequency, function, game, gamete, -gametic, -gamety, -gamy, gene, gene flow, -genesis, -genetic, genetic load, -genic, -genous, -geny, gland, -grade, gradualism, -gram, -graph, graph, -graphy, greeting, gregarious, grooming, group, growth, guild, -gyny, -haline, heritability, hermaphrodite, hermaphroditism, heterochrony, hierarchy, homeostasis, homolog (homologue), homology, hormone, host, hybrid, hypothesis, illusion, inheritance, inhibition, insemination, instar, instinct, intelligence, investment, isolation, -karyon, kin, -kinesis, kinesis, kiss, Lamarckian, language, law, learning, -lectic, lek, link, locomotion, male, manipulation, map, mate choice, mating, mating system, maze, mechanism, mechanist, meiosis, memory, metamorphosis, method, -metrics, -metrosis, -metry, migration, mimicry, mitosis, -mixis, modality, model, molt, -morph-, -morphic, -morphism, morphology, -morphosis, mortality, mother, movement, mutation, need, nest, nesting, nestling, neurotransmitter (neural transmitter), niche, nucleic acid, object, observation, odor, -oecism, optimality, order, organ, organism, -orial, ovular, ovulator, p (P, *p*, *P*), -paedium, pair, parasite, parasitism, parent, parity, parthenogenesis, -patric, pattern, -pelagic, perception, period, -phage, -phagy, phase, -phile, phenomenon, -phobe, pigeon, -planetic, plankton, plasticity, -plasia, play, -ploidy, -plont, pollination, polyethism, population, posture, potential, predation, predator, preference, pregnancy, principle, probability, procedure, process, production (rate of production, primary production, productivity, basic productivity, primary productivity), program, provisioning, puzzle box, race, range, reaction, receptor, recognition, reductionism, reflex, regulation, reinforcement, relationship, reliability, repertory, replication, representation, reproduction, resource, response, revolution, rhythm, ritual, ritualization, role, rule, sample, sampling technique, scale, scientist, scratching, secretion, sex, sex termination, -sexual, sexual reproduction, sexuality, shaping, signal, sister, skewness, sleep, sociality, society, -somatic, -somy, song, -sound, speciation, species, -spermy, -sphere, stage, stasis, state, statistical test, stimulus, strategy, stress, study of, substance, success, succession, suckling, swarming, swimming, symbiont, symbiosis, synapse, syndrome, synethogametism, system, taxis, teleology, territory, test, theory, -therm, time, -toky, -topy, tradition, transport, -troph, trophallaxis, -trophy, -tropic, -tropism, -tropous, -trois, -type, value, variable, variance, variation, vitalism, -voltine, -vore, -welt, -xene, -xenia, -xenic, -xeny, yawning, -zoan, -zoic, -zoite, zone, -zoon, -zygosity, -zygote, and -zygous. Under study of, you will find terms grouped by acoustics, biology, botany, chemistry, chronology, climatology, dynamics, ecology, endocrinology, ethology, evolution, genetics, geography, ichnology, limnology, -metry, morphology, ornithology, paleontology, palynology, pathology, pharmacology, phenology, phycology, phylogeny, physics, physiology, psychology, semiotics, sociality, systematics, taxonomy, toxicology, and zoology.

**“In,” “e.g., in,” and “For example, in” statements.** I indicate when phenomena relate to particular organism groups, or taxa, by writing phrases such as “In *Apis mellifera* (Western Honey Bees):” or “e.g., in some carpenter-bee and bird species:” When I use “In” without “e.g.,” it means that to my knowledge, the concept relates only to the taxon(a) listed. “For example, in” followed by a list of organisms indicates that the phenomenon relates to these organisms and others that I have not listed.

**cf. directives.** “cf. . . .” directs you to a related term (sometimes an antonym), related information, or both.

**Synonyms.** I list synonyms known to me and suggest how each is used when I can. When it is obvious where a synonym is published from the body of a term entry, this synonym occurs in bold type right after a main entry term. Authors have sometimes used the same word for terms with very different meanings, and synonyms of many terms often do not have exactly the same meanings. Thus, synonyms should be used with care.

**Notes and comments.** A *Note*, or *Notes*, refers to a particular definition of a term, while a *Comment*, or *Comments*, refers to an entire entry.

**Hyphens and 1-en dashes.** Scientific writers follow different “rules,” or seem to follow no rules, when they use hyphens and 1-en dashes, resulting in the presence, absence, or different combinations of these marks in the same term. In this book, I attempt to standardize use of these marks by using a hyphen(s) in an adjectival phrase that includes one, or more, nouns, and that precedes the noun that it modifies. I use a 1-en dash to separate hyphenated terms within some adjectival phrases. This avoids the use of a forward slash (/) for a hyphen, or a 1-em dash, except when I am true to original published information. This book does not hyphenate certain names that are capitalized in the literature under key words, e.g., “Biological Dynamics of Forest Fragment Project” and “Deep Green Project.”

**Sex-neutral writing.** With all due respect for treating female and male Humans and other organisms equitably, in the interest of more direct writing, this book uses “he” to mean “he” or “she,” “him” to mean “him” or “her,” and so forth in many entries. Regarding historical definitions, I refer only to he, him, or his to reflect English style of those definitions.

**Nonscientific names.** Researchers and others often use nonscientific names (often called common names or English names) for organisms. Many conventions for writing such names occur in the literature. For example, different publications may write the nonscientific name for the skipper butterfly *Staphylus ceos* as Red Head Sooty Wing, Red-Head Sooty-Wing, Red-Head Sooty Wing, Red-head sooty wing, red-head sooty wing, red-head sooty-wing, and so forth. Many species have many nonscientific names which confuses matters even more. This book uses a consistent convention for writing nonscientific names, and adheres to the following “rules.” (1) Capitalize a nonscientific name if it stands for a cultivar, hybrid, species, specific kind of virus, or subspecies: *Rosa* ‘Tropicana,’ Leyland-cypress, Human, Cow Pox Virus, Xerces Blue. (2) Capitalize all words in such a name, except for the one(s) joined to another by a hyphen: White-tailed Deer. (3) Capitalize a nonscientific name when it stands for its entire taxon (*e.g.*, genus, family, order, or domain): Algae, Cyanobacteria, Elephants, Fungi, Palms. (4) Use hyphens or word joining to indicate the taxonomic group of an organism: Dragonfly, House Fly, Nodding Ladies'-tresses. Dragonfly is one word because dragonflies are in the Order Odonata, not Diptera (= the “true” Flies). The House Fly is a member of the Diptera. Nodding Ladies'-tresses belongs to the orchid genus *Spiranthes*, called Ladies'-tresses. “Tulip-tree,” for example, is hyphenated because “tree” does not stand for a particular taxonomic group. There is no plant family called the Tree Family. For this reason, one may also correctly write the nonscientific name for this species as “Tuliptree.” More details about nonscientific names are in the entry “nonscientific name” in this book’s body.

**Taxon designations in entries.** Where it is appropriate, this book includes a scientific name, a nonscientific name, or both for a species, *e.g.*, *Ovis aries* (Domestic Sheep). To indicate all members of a taxon above the species level, I use the scientific name, a capitalized nonscientific name, or both for the taxon; *e.g.*, *Ovis* (Sheep); Family Bovidae (Bovids); Class Mammalia (Mammals); and Kingdom Animalia (Animals). “Human” or “Humans” in this book refers to *Homo sapiens sapiens* (*syn.* Modern Humans). If it is unclear to me what an author means by the name of a particular taxon, I use the name that he uses in his publication. For example, if an author simply writes “sheep,” he could mean one, more than one, or all sheep species; he could mean one or more individuals of one or more species; or he could mean a combination of these animals. Due to lack of information about the author’s exact meaning of “sheep,” I also write just “sheep” when I refer to the author’s work.

**Anthropomorphic and teleological writing.** This book attempts to eliminate anthropomorphic and teleological constructions in definitions, except in directly quoted material.

**Other information.** Material within quotes (“”) includes direct quotations, the names of terms in question, and the names of terms that I coined in this book. For selected terms, this book gives further information such as etymologies, term originators, and related information. This book includes some euphemistic and obscene terms and indicates them as such at the request of some foreign scientists.



## PLEASE CHOOSE DEFINITIONS AND SYNONYMS CAREFULLY

You should certainly take care in selecting which definition to use for a term. A term can have different shades of meaning to different people and in different contexts, and, as discussed above, its meaning can change as we discover more about the parts of our natural, or hypothetical, world represented by the term. The same phenomenon can have different names depending on a person's frame of reference. One definition of a term allows us to think of certain related concepts, but not others. For example, the environmental concept of niche allows us to conceive of an empty niche, while the population definition of niche, does not (Colwell 1992). Further, perfect definitions for many terms (*e.g.*, aggression or consciousness) may not yet exist or be possible to formulate. Many of the definitions in this book are controversial (Verplanck 1957) and should be used *only* as initial attempts to understand concepts they represent. These definitions should not necessarily be regarded as the final, or best, ones that can be formulated. If you consult references to definitions listed in this book, you will often find more information that relates to their meanings and may discover useful denotations and connotations that I have not included. I indicate areas of controversy regarding terms when they are known to me. I reiterate that definitions within an entry are given in *chronological* order. Many definitions are not necessarily widely used, or considered to be correct today, but I include them because they help to understand earlier work, subsequent definitions, or both.

Some of the listed synonyms may be used by only one, or a few, authors, and their uses may be debatable. Sometimes synonyms are used for terms that have very different meanings, *e.g.*, "true altruism" for altruism involving helping only nonkin or for altruism involving helping only kin. I indicate this kind of information when it is known to me. Some entries have more than one list of synonyms because different lists refer to different meanings of a term.

## PLEASE COIN TERMS AND DEFINE CONCEPTS CAREFULLY

Coining new terms and defining them deserves special attention for enhanced communication. These are rules of thumb to consider: (1) thoroughly research your concept and related concepts and their names, (2) choose the best possible word(s) for the name of the term, and (3) write an explicit, full definition in your publication. Full dictionary-style definitions are seldom given in biological papers, yet they could certainly enlighten and reduce confusion. I urge editors to allow authors to include such definitions in their papers when they are appropriate.

### Key to Abbreviations and Conventions

<i>abbr.</i>	abbreviation
<i>adj.</i>	adjective
<i>adv.</i>	adverb
<i>ant.</i>	antonym
<i>Brit.</i>	British spelling
<i>cf.</i>	compare [Latin <i>confer</i> ]. This indicates related terms that are useful to examine in understanding the term in question
cm	centimeter
<i>comb. affix</i>	combining affix
<i>comb. f.</i>	combining form
<i>Comment(s)</i>	information that refers to an entire entry
def.	definition
dm	decimeter
<i>e.g.</i>	for example
ft	foot
Ga	billion years, billion years ago
gal	gallon
<i>i.e.</i>	that is
in	inch
km	kilometer
lb	pound
m	meter
Ma	million years, million years ago
mi	mile
μg	microgram
μl	microliter
mo	month
<i>n.</i>	noun
nm	nanometer

<i>Note(s)</i>	information that relates to a particular part of an entry
pers. comm.	personal communication
pers. obs.	personal observation
<i>pl.</i>	plural
pt	pint
qt	quart
<i>q.v.</i>	which see [Latin <i>quod vide</i> ]
<i>See</i>	“See . . .” indicates where to find a definition of a particular term given under a synonym or with associated terms elsewhere.
<i>sing.</i>	singular
<i>sp.</i>	species
<i>ssp., subsp.</i>	subspecies
<i>syn.</i>	synonym
U.S.	United States
<i>v.i.</i>	intransitive verb
<i>v.t.</i>	transitive verb
yd	yard

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## a

◆ **ABA** See hormone: abscissic acid.

◆ **abandonment call** See call: abandonment call.

◆ **abasement** *n.*

1. A person's lowering, casting down, or humbling another person, in rank or character; humiliation (Oxford English Dictionary 1972, entries from 1561); one's lowering in position, rank, prestige, or estimation (Michaelis 1963).

*syn.* cast downness, humbleness

2. A person's being debased, humiliated, degraded (Oxford English Dictionary 1972, entries from 1611).

3. A person's passive submission to external force; acceptance of injury, blame, criticism, punishment; surrender; resignation to fate; admittance of inferiority, error, wrong-doing, or defeat; confession and atonement; self-blame, belittling, or mutilation; seeking and enjoying pain, punishment, illness, and misfortune (Murray 1938, 1961–1962).

4. A person's behavior indicative of submission to another person; *e.g.*, accepting aggression or punishment (Cumming 1972, 1).

5. A person's degradation of himself; excessive complying, surrendering, accepting punishment (Wolman 1973, 1).

*v.t.* abase

*syn.* degradation, disgrace, dishonor, mortification, shame

*cf.* aggression; appeasement; need: abasement

◆ **abd-A** See gene: abdominal A.

◆ **abdominal A** See gene: *abdominal A*.

◆ **abdominal bursting** See behavior: defensive behavior: autothysis.

◆ **abdominal-up-and-down movement** See <sup>2</sup>movement: abdominal-up-and-down movement.

◆ **abient** *adj.* Referring to an animal's avoiding, or moving away, from a stimulation source (Hurnik et al. 1995).  
*ant.* adient

◆ **abiogenesis** See -genesis: abiogenesis.

◆ **abiosis** See -biosis: anabiosis.

◆ **abiotic pollination** See pollination: abiotic pollination.

◆ **ablation** *n.*

1. Surgical removal of an organism's tissue or organ (Oxford English Dictionary 1972, entries from 1846).

2. An investigator's deliberate destruction of an animal's neural tissue for experimental purposes, *e.g.*, by surgically severing a nerve tract in its brain (Immelmann and Beer 1989, 175).

*syn.* lesion (Immelmann and Beer 1989, 175)

*cf.* extirpation

◆ **abnormal behavior** See behavior: abnormal behavior.

◆ **abnormal psychology** See study of: psychology: abnormal psychology.

◆ **abominable mystery** *n.* How and when flowering plants (Angiosperms) first evolved on Earth (Charles Darwin in Weiss 1999, 5 August, A1).

*cf.* Plantae: plant: *Amborella* (Appendix 1)

◆ **abortion** *n.*

1. An artificially produced human miscarriage, including an illegal one (Michaelis 1963).

2. A mammal's expelling its fetus prematurely; a miscarriage (Michaelis 1963).

3. The defective result of a premature birth; a monstrosity (Michaelis 1963).

4. An embryo's partial through complete arrest of development in its early stages (Michaelis 1963).

5. Anything's failure during its progress and before its maturity (Michaelis 1963).

[Latin *abortio*, -*onis* < *aboriri*, to miscarry]

◆ **selective fruit abortion** *n.* A plant's dropping a particular fruit before it matures (Niesenbaum 1999, 261).

*Comment:* *Mirabilis jalapa* (Four-O'clock), tends to produce mature fruits from flowers that have higher and more diverse pollen loads on their stigmas compared to flowers that have lower and less diverse pollen loads (Niesenbaum 1999, 261).

◆ **abscissa** *n.* The horizontal, or x-axis, of a graph (Lincoln et al. 1985).

*cf.* ordinate

◆ **abscissic acid** See hormone: abscissic acid.

◆ **absconding** *n.* For example., in *Apis mellifera* (Western Honey Bees): Departure of an entire colony for a new nest site (Michener 1974, 371).

◆ **absenteeism** *n.* In some tree-shrew spp.: Parents' nesting away from their offspring and visiting them from time to time only to provide them with food and a minimum of other parental care (Wilson 1975, 577).

◆ **absolute-dominance hierarchy** See hierarchy: dominance hierarchy: absolute-dominance hierarchy.

◆ **absolute experiment** See experiment: mensurative experiment.

◆ **abstract homotypy** See homotypy: abstract homotypy.

◆ **abundance, absolute abundance** *n.* The total number of individuals of a taxon, or taxa, in an area, volume, population, or community, often measured as cover in plants (Lincoln et al. 1985).

**relative abundance** *n.* The total number of individuals of one taxon compared to the total number of individuals of all other taxa combined per unit area, volume, or community (Lincoln et al. 1985).

◆ **abundant** See frequency (table).

◆ **acarodomatium** See domatium: acarodomatium.

◆ **acarophile, acarophilous, acarophily** See <sup>1</sup>-phile: acarophile.

◆ **Acasta gneiss** See rock: Acasta gneiss.

◆ **acceleration** See <sup>2</sup>heterochrony: acceleration.

◆ **"accept a null hypothesis"** *n.* To consider a null hypothesis (*q.v.*) to be correct because one's statistical test does not reject it (pers. obs.).

*Comment:* Researchers should not use this phrase because one can *provisionally* accept a null hypothesis, but not definitely accept one.

◆ **acentric society** See <sup>2</sup>society: acentric society.

◆ **accessory chromosome** See chromosome: accessory chromosome.

◆ **accessory pigment** See molecule: accessory pigment.

◆ **acetogen** See -troph-: acetogen.

◆ **accidental osmallaxis** See osmallaxis: accidental osmallaxis.

◆ **accidental parasitism** See parasitism: accidental parasitism.

◆ **acclimation** See <sup>3</sup>adaptation: <sup>1</sup>physiological adaptation: acclimation; <sup>2</sup>physiological adaptation (comment).

◆ **acclimatization** See <sup>3</sup>adaptation: <sup>1</sup>physiological adaptation: acclimatization; <sup>2</sup>physiological adaptation (comment).

◆ **Ac-Ds** See transposable element: *Ac-Ds*.

◆ **acetylcholine** See neurotransmitter: acetylcholine.

◆ **ACG** See place: Area de Conservacin Guanacaste.

◆ **Acheulean Tool Industry** See tool industry: Acheulean Tool Industry.

◆ **achievement** See need: achievement.

◆ **A-chromosome** See chromosome: A-chromosome.

◆ **acid** *n.*

1. A compound that contains hydrogen of which all or a part of the hydrogen may be exchanged for a metal, or basic, radical, forming a salt (Michaelis 1963).

2. A compound that yields hydrogen ions when dissolved in an ionizing solvent (Michaelis 1963).

*cf.* molecule

See nucleic acid.

*Comment:* Aqueous solutions of acids are sour and red den vegetable substances such as litmus (Michaelis 1963).

[Latin *acidus*, acid]

**amino acid** *n.* A molecule composed of an amino group and a carboxyl radical; a building block of a protein (Michaelis 1963).

*Comment:* There are 20 kinds of amino acids that differ from one another only by their side chains and are universally found in proteins (King and Stansfield 1985).

◆ **acid rain** See acid deposition.

◆ **acid deposition** *n.*

1. A mixture of sulfuric acid and nitric acid that is washed out of the atmosphere by precipitation and is caused by sulfur and nitrogen emissions from volcanoes (Lean et al. 1990, 85).

2. A mixture of sulfuric acid, nitric acid, and sometimes hydrochloric acid that is washed out of the atmosphere by precipitation and is caused mainly by sulfur and nitrogen emissions from the burning of fossil

fuels such as coal and oil in power plants, industrial boilers, and car engines (Lean et al. 1990, 85).

*cf.* precipitation: acid precipitation

*syn.* acid rain (Lean et al. 1990, 85)

*Comments:* Acid deposition decreases the pH of freshwater streams, ponds, and lakes and sometimes soils (Lean et al. 1990, 85). Many bodies of freshwater are now so acidic that fish cannot live in them. Acid depositions may be causing *Waldsterben* (tree death) in Germany. Volcanic acid deposition is slight compared to artificially produced acid deposition. Rain has a pH around 5.6; acid deposition is often from pH 3.5 through 4.3. Acid deposition increases levels of toxic heavy metals in water which kill wildlife. This deposition also greatly alters the nutrient content in forest soils.

◆ **acidophile** See <sup>1</sup>-phile: acidophile.

◆ **acidosis** *n.* Too much carbon dioxide in an animal's blood that causes excess carbonic acid which can even kill the animal (Browne 1996, 30 July, C10).

*cf.* hypothesis: soda-water hypothesis; hypercapnia

◆ **acidotroph** See -troph-: acidotroph.

◆ **acme** *n.*

1. A period of maximum phylogenetic vigor in a taxon (Lincoln et al. 1985).

2. The highest point attained in a taxon's phylogenetic, or ontogenetic, development (Lincoln et al. 1985).

**epacme** *n.* The period in a group's, or organism's, phylogenetic, or ontogenetic, development just prior to its point of maximum vigor or adulthood (Lincoln et al. 1985).

**heteracme** See -gamy: dichogamy.

**paracme, phylogerontic period** *n.* The period of decline after the point of maximum vigor, or peak of development, in the phylogeny of a group (Lincoln et al. 1985).

◆ **-acmic**

**diacmic** *adj.* For example, in some *Cladocera* species: Referring to a taxon that exhibits two abundance peaks per year (Lincoln et al. 1985).

**monacmic** *adj.* For example, in some *Cladocera* species: Referring to a taxon that exhibits one abundance peak per year (Lincoln et al. 1985).

**polyacmic** *adj.* Referring to a taxon that exhibits more than two abundance peaks per year (Lincoln et al. 1985).

◆ **acoustic eucrypsis** See mimicry: acoustic eucrypsis.

◆ **acoustic window** *n.* The sound frequency range to which an animal's environment is most permeable (Immelmann and Beer 1989, 182).

*cf.* melotope

◆ **acoustics** See study of: acoustics.

◆ **acquired behavior** See behavior: acquired behavior.

◆ **acquired character, acquired trait** See character: acquired character; inheritance: inheritance of acquired characters.

◆ **acquired-hereditary immunity** See hypothesis: hypothesis of directed mutation.

◆ **acquired-releasing mechanism** See mechanism: releasing mechanism.

◆ **acquired trait** See character: acquired character.

◆ **acquisition** *n.*

1. "Progressive increments in [an animal's] response-strength observed over a series of occasions in which the response is measured" (Verplanck 1957).

2. "A modification of [an animal's] behavior in which a response changes in strength or topography, or occurs in new environments" (Verplanck 1957).

◆ **acrasin** See chemical-releasing stimulus: semiochemical: pheromone: acrasin.

◆ **acridophage** See -phage: acridophage.

◆ **acrocentric chromosome** See chromosome: acrocentric chromosome.

◆ **acrodendrophile** See <sup>1</sup>-phile: acrodendrophile.

◆ **acrophytia** See <sup>2</sup>community: acrophytia.

◆ **acrophytism** See symbiosis: acrophytism.

◆ **acrophobia** See -phobia: acrophobia.

◆ **ACTH** See hormone: adrenocorticotrophic hormone.

◆ **act** See behavior, behavior act, law.

◆ **action** *n.*

1. A domesticated animal's trained body, or limb, movement (Oxford English Dictionary 1972, entries from 1599).

*Note:* "Action" now also refers to a movement in any kind of animal.

2. An organism organ's performing its proper function (Michaelis 1963).

3. An animal's "behaviour performed in a particular situation" (Maynard Smith 1982, 204).

*cf.* behavior; <sup>3</sup>theory: game theory

**transitional action** *n.* An animal's multipurpose movement, *q.v.*, that occurs in the same, or similar, form in two of its different functional systems, and whose performance can lead to a switch in motivation from one of these systems to another (Immelmann and Beer 1989, 196, 317).

◆ **action chain** See chain: action chain.

◆ **action pattern** See pattern: fixed-action pattern.

◆ **action potential** See potential: action potential.

◆ **action-specific energy** See energy: action-specific energy.

◆ **action-specific exhaustibility, action-specific exhaustion, behavioral fatigue** *n.* A particular behavior's being refractory to a particular stimulus (quality and intensity) (Immelmann and Beer 1989, 3). *cf.* effect: Coolidge effect, fatigue, learning: habituation

◆ **action system** See behavior pattern; <sup>2</sup>system: action system.

◆ **actions** *n. pl.* A person's habitual behavior; conduct (Michaelis 1963).

◆ **actium** See <sup>2</sup>community: actium.

◆ **active** See dominant (genetic).

◆ **active-avoidance conditioning** See learning: avoidance conditioning: active-avoidance conditioning.

◆ **active-avoidance learning** See learning: avoidance learning: active-avoidance learning.

◆ **active competition** See competition: contest competition.

◆ **active ingredient (ai)** *n.* The active ingredient in a pesticide formulation, expressed as an amount of active ingredient per unit area, *e.g.*, 140 g (ai) ha<sup>-1</sup> (Johansen 1977, 184; Harrahy et al. 1993, 2192). *syn.* AI (Barrows et al. 1994), a.i. (Harrahy et al. 1994, 521)

◆ **active-nuclear species** See <sup>2</sup>species: active-nuclear species.

◆ **active process** *n.* A system, or process, that requires metabolic-energy expenditure (Lincoln et al. 1985). *cf.* passive process

◆ **active replicator** See replicator (comment).

◆ **active-sensory system** See <sup>2</sup>system: active-sensory system.

◆ **active sleep** See sleep: stage-1 sleep.

◆ **active space** *n.* The space within which the concentration of a pheromone, or any other behaviorally active chemical substance, is at, or above, threshold concentration; the chemical signal itself (Wilson 1975, 185, 577).

◆ **activity** *n.*

1. A person's physical exercise, gymnastics, athletics (Oxford English Dictionary 1972, entries from 1552).

*Note:* This is an obsolete definition.

2. An individual animal's general, or specific, movement (Immelmann and Beer 1989, 3).

**instinctive activity** *n.* An ordered sequence of fixed-action patterns (Immelmann and Beer 1989, 151). *cf.* pattern: fixed-action pattern

**overflow activity** See activity: vacuum activity.

**spontaneous activity, resting-level activity** *n.* Continuous firing of nerve cells without apparent external stimulation, *e.g.*, in cells of olfactory bulbs and vertebrate eyes (Adrian 1950 and Leyhausen 1954 in Heymer 1977, 49).

**structural activities** *n.* A group of heterogeneous behaviors, including especially feeding, grooming, and scratching, that accompany and surround the appetite for rest and require no other specific context for their occurrences (Hassenberg 1965 in Heymer 1977, 138).

**vacuum activity** *n.*

1. For example, in some bird species: An instinctive behavior that does not occur for an extended period and eventually occurs without a demonstrable eliciting stimulus (Lorenz 1937 in Heymer 1977, 110); *e.g.*, a well-fed *Sturnus vulgaris* (European Starling), that had no opportunity to catch flies for some time, suddenly goes through all the movements of searching for a fly, catching it, and killing it, although no fly is present (Lorenz 1935 in Hinde 1970, 312).

*Notes:* Lorenz (1981, 127) indicates that "vacuum activity" cannot be exactly defined. Morris and Moynihan (1953 in Heymer 1977) suggest that "vacuum activity" be replaced with "overflow activity" because one cannot be certain that no stimulus is eliciting the behavior.

2. A fixed-action pattern that occurs in the absence of any stimulus, because, according to the energy model of behavior, its action-specific energy is very great (Dewsbury 1978, 19).

3. A behavior that is normally dependent on external stimulation, but occurs spontaneously due to its extreme threshold change, *e.g.*, a weaver-bird's showing complex nest-building behavior without nest material or even a substitute object (Immelmann and Beer 1989, 290, 323).

*cf.* behavior: spontaneous behavior

◆ **activity drive**

See drive: activity drive.

◆ **activity period**

See period: activity period.

◆ **activity range** See <sup>3</sup>range: activity range.

◆ **actophile** See <sup>1</sup>-phile: actophile.

◆ **actualism** *n.* The principle "that the same causes (physical laws) have operated throughout geological time, since the immanent characteristics of the world have always remained the same" (Mayr 1982, 377).

*cf.* <sup>3</sup>theory: uniformitarianism

*Comment:* According to Lyell (1830–1833), it is legitimate to "attempt to explain the former changes of the