

Acquiring a Scientific Vocabulary

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*A Short Course for Building Lexical
Literacy for Advancing AP and
College Students*

Anthony M. Belmont



BrownWalker Press
Irvine • Boca Raton

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BrownWalker Press • Universal Publishers, Inc.
Irvine • Boca Raton
USA • 2019
www.brownwalkerpress.com

978-1-62734-732-7 (pbk.)

978-1-62734-733-4 (ebk.)

Typeset by Medlar Publishing Solutions Pvt Ltd, India

Cover design by Ivan Popov

Publisher's Cataloging-in-Publication Data

Names: Belmont, Anthony M., author.

Title: Acquiring a scientific vocabulary : a short course for building lexical literacy for advancing AP and college students / Anthony M. Belmont.

Description: Irvine, CA : BrownWalker, 2019.

Identifiers: ISBN 978-1-62734-732-7 (paperback) | ISBN 978-1-62734-733-4 (ebook)

Subjects: LCSH: Science--Terminology. | Science--Study and teaching. | Latin language--Technical Latin. | English language--Technical English. | BISAC: SCIENCE / Study & Teaching.

Classification: LCC Q179 .B45 2019 (print) | LCC Q179 (ebook) | DDC 507--dc23.

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Acknowledgments

Webster's New Collegiate Dictionary 1975 by G. & C. Merriam Company Publishers of the Merriam-Webster Dictionaries is used by permission as the source for definitions of prefixes, suffixes and root words appearing in the main body of the text, the lessons, and the exercises. The definitions were taken from both the main entries and from the etymologies.

I would also like to thank Dr. B. C Dodson, Professor of Chemistry, and Dr. Daniel England, Professor of Biology, at Southern Arkansas University for reading the manuscript while it was in the preliminary stages and for their very helpful suggestions and comments for the improvement of this book.

Introduction

THIS TEXT IS DESIGNED AS A LEARNING EXPERIENCE AND AS A REFERENCE TEXT FOR USE WITH ALL SCIENCE COURSES WHICH A STUDENT MAY TAKE.

Each and every field of specialized knowledge has its own vocabulary, its jargon (the technical terminology or language peculiar to a field of specialization). In order to learn the vocabulary or jargon peculiar to any field, it is necessary first to learn some things about the nature of words themselves.

First of all, all words are composed of one or more phonemes (or graphemes if the word is written). Phonemes are features of a spoken word, and graphemes are features of a written word. A phoneme is a speech sound, and a grapheme is the written symbol for a speech sound. For example, the different pronunciations for the letter a in the words fat and cake indicate two different phonemes of a but both of them are represented by the same grapheme. All words, then, are either single phonemes (graphemes) or a combination of phonemes (graphemes); the vast majority of words are framed by a combination of phonemes. It is extremely important that you be able to use the words of your specialized field by recognizing and using them correctly in regards to their definitions and also that you be able to pronounce the vocabulary of your specialized field correctly and to spell such words accurately.

From a study of biology, you are probably aware that the word morphology means, in general, “the study of form and structure.” The basic morphology of a word is the combination of phonemes (graphemes) of which a word is composed. In this text you will study the morphology (the structure) of words, how words are constructed,

and how to determine the very basic meanings of the scientific and technical words and terms peculiar to the study of the various sciences. You will be required to memorize a great number of combinations of phonemes (graphemes) and their definitions, but with the information which you memorize, you will be able to construct a great number of words and terms, and you will be able to recognize the basic meanings of many words and terms that may be unfamiliar to you without having to look them up in a dictionary.

Words, in their most simple functions, are names. A word names a person, place, or thing, an action, a state of being or feeling, or a position of one thing relative to another. Words can be either simple or complex. A simple word is called a “root” or “base” word. A complex word is composed of a root or a base plus affixes. An affix is any single phoneme (grapheme) or group of phonemes (graphemes) connected to a root or base. The affix can be connected to the beginning of the base or root or to the end of the base or root. For example, the word book is a base or root and is a simple word. The word books is a complex word composed of the root book plus s, the inflectional phoneme (grapheme) which denotes plural. The s an affix connected to the end of a root. An affix connected to the end of a root is called a suffix. An affix connected to the beginning of a word is called a prefix. Complex words may have “both” a prefix and a suffix connected to the same root.

There is one other type of complex word called a compound word. A compound word is formed by joining two existing words to form a compound. Each of the words used to form a compound word may itself be a complex word. For example, the compound word grasshopper is formed of the words grass and hopper, but the word hopper is formed from the root hop plus the suffix er (the suffix er meaning “one that performs or does”).

The word feed-hopper is another compound word. In this case, the root word is not hop but hopper, and it does not mean the same as it does in the word grasshopper. Here, the word hopper means “a. storage bin or tank.” You should also be aware that root words may have several definitions. One of your main problems will be to determine which

definition of a root word is the proper one in each case, but common sense will very often indicate which one to use. In other cases, you will simply have to try each definition of the root or affix and then determine the best one. to use by placing the word in its proper context, the sense of the sentence or paragraph in which it is used: e.g. Con – with or together; tex – weave; therefore, to determine the best meaning of a word in a particular context is “to weave it together into a whole which makes the best sense.”

*Although the word hopper is spelled with a double p the root is hop and the suffix is er. The extra p is a convention of English spelling and is not a part of either the root or the suffix. The student should be aware of this problem so as not to be confused by peculiarities in spelling which have no importance for the purpose of determining the parts of a complex word necessary to construct a definition. Therefore, this text provides the student with a review of the basic rules for English spelling so that he will be alerted to recognize the problems which are presented by the conventions and rules of spelling.

The following list of words was taken from page one of this chapter.

Study them as examples of how words can be analyzed to discover basic definitions.

Only words formed from Latin or Greek roots are listed.

specialized – special(is)- individual or particular; -ize – cause to be;

d – past tense; designed for one particular purpose.

vocabulary – vocabul(um) – voice or word; ary – relating to or connected with; relating to or connected with words.

terminology – termin(us) – expression, words; (o)logy – science of or study of; study of words.

technical – techni(k,c) – skillful; al – relating to or characterized by; relating to a certain skill.

technical terminology – the study of words relating to a certain skill or discipline.

peculiar – peculiar(is) – of private property; belonging exclusively to one person or group.

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phoneme – phon(e) – speech sound; eme – distinctive unit of language structure; the speech sound of language.

grapheme – graph – to write; eme – distinctive unit of language structure; a unit of a writing system.

different – di(s) – apart; (f)ferent – to carry; literally to carry apart or to be unlike.

pronunciation – pro – forth; nunc(t)ia – to report; (t)ion – result of act or process; literally the result of the act of reporting or to produce speech sound as a messenger would in making a report.

indicate – in – in or into; dic(are) to proclaim, say, show; ate – to act on or to cause to become; to act in order to say or show into or simply to point out or to point to.

combination – com(m) – with or together; bi(n) – two; (a)tion – result of act or process; the result of the act or process of putting two things together.

composed – com(m) – with or together; pose – to place or put; d – past tense; placed or put together with or formed by putting together.

morphology – morph – form; (o)logy – the study or science of; the study of form and structure.

As you can easily see by the above, many common English words as well as specialized words and scientific words and terms are composed of parts. The study of these word parts and how they are combined to form words and phrases is what this text is intended to present. You will not be able to master this overnight, but over a period of time you will find that the knowledge which you gain from such a study will enable you to increase your vocabulary and to determine the basic definitions of many unfamiliar words and terms.

Definitions and Their Uses

Definition – defini(u) – to limit; tion – result of act or process; the result of placing a limit on.

The word definition means “the result of the act or process of limiting or placing limitations or boundaries around something,” and this is the purpose we have for defining or “limiting” the meanings of words. If we did not so “define” or “limit” our meanings, we would never be able to communicate meaningfully with each other. Our speech and writing would be nothing but sound or marks on paper. Nothing would be accomplished.

The degree of precision that we can achieve with our use of words and terms will determine how well and how clearly we can communicate with each other. The sciences are concerned with and are based on precision. The scientist’s job is to systematize, to measure, to delineate, to define, to limit the materials that he deals with. A mathematician cannot work usefully if he defines the number 2 as “sometimes the sum of 1 plus 1,” or the sum of 1 plus 1 as “about 2.” The physicist cannot work accurately and well if he defines the speed of light as “somewhere around 186,000 miles a second.” He defines the speed of light as 2.997925×10^8 meters per second.

Botanists would be wasting their time if they defined a leaf as “something that grows from or sticks out from a stem”, because thorns and limbs also stick out from stems, and thorns and limbs are not leaves. Scientific terms must be defined precisely and accurately, in such a way that they will refer to one and only one phenomena as distinct from all others in the universe. scientists.

There are several different kinds of definitions: stipulative, lexical, precisising, theoretical, analytical, persuasive, and demonstrative. (These last two types will not concern us in this study.)

A stipulative definition is one which is given to a brand-new term when it is first introduced. When someone: invents or discovers or does something new, he can name it and define it as he pleases. For example, the man who invented the round, plate-like toy which is sailed through the air called it a “Frisbee,” and the word “Frisbee” means “a plastic disk several inches in diameter sailed between players with a flip of the wrist.” The inventor “stipulated” that his invention be called a “Frisbee” Scientists frequently introduce new terms as they make new discoveries or inventions.

A lexical definition is a dictionary definition. It does not give a new meaning to a thing which previously lacked a definition. It simply reports a meaning already in use. The great usefulness of such definitions is to eliminate ambiguity or vagueness for a person who is ignorant as to the meaning of a word or who is unsure of the “precise” meaning of a word.

A precising definition is one which puts limits on borderline cases where the definition already established may be vague or not limited sharply enough for easy handling. For example, almost everyone has an idea about the meaning of the word “astronaut.” However, this word may sometimes have to be given a precisising definition to separate its meaning from the word “cosmonaut.” An “astronaut” is an American space traveler and a “cosmonaut” is a Russian space traveler.

Theoretical definitions are those which attempt to characterize phenomena which are not yet completely known. Theoretical definitions change and are replaced as our knowledge and understanding increase. For example, at one time scientists defined “heat” as “a condition of being hot.” As you can realize, this is not a good definition. Now, since more knowledge has been gained about this phenomenon, it is defined as “the energy associated with random motions of: the molecules, atoms, or smaller structural units of which matter is composed.” As you can see, the second definition is far superior to the first.

An analytical definition is probably the most common and most useful to the scientist. To analyze something is to break it down into its component parts. If we can break two things down into their component parts and see that one thing has a part which is slightly different from the same part of the other thing, we can then make a definition for each one which describes each and at the same times shows the difference between them. This is the ultimate in scientific accuracy. Any group having members may be divided into subgroups. The words “genus” and “species” are often used in this manner. The group which is divided into subgroups is the “genus,” and the subgroups are the “species.” There is a simple formula for constructing analytical definitions: $T = G + D$ – term equals genus plus difference.

T equals the word or term being defined. G equals the class or group of things to which the term belongs. D equals the quality which makes the thing different from every other member of the class or group. For example, the word “heart” can be defined in this manner. The “heart” of a tree may be defined as “the central or innermost part” as distinct from the bark and all other parts of the tree. An animal “heart” can be defined as a “hollow muscular organ (as distinct from all other organs) of vertebrate animals that by its rhythmic contraction acts as a force pump maintaining the circulation of the blood.” As you can see, the word “heart” is distinguished from all other bodily parts or organs by telling its function. No other body part functions in this manner and for this precise purpose. The “heart,” therefore, is placed in its “genus” or group (an organ) and is then described to show what makes it different from all other organs (it pumps blood and not other body fluids).

Many times, students believe that they need only know where to find a definition or other information about a topic. However, the student must also be able to understand the material when he finds it. For example, one definition of the word axis in the dictionary is “any of three fixed lines of reference in an airplane which are usually centroidal and mutually perpendicular and of which the first is the principal longitudinal line in the plane of symmetry, the second is perpendicular

to the first plane of symmetry, and the third is perpendicular to the other two.” If the student does not know the meanings of the words centroidal, mutually, perpendicular, longitudinal, and plane of symmetry, the definition makes no sense. So it is not enough to be able to find the definition; one must be able to understand the terminology of the definition itself so that in reading the definition of one word, the student must look up several other words in order to understand the first definition which they originally found. This work is designed to assist the student with understanding many terms used in definitions, especially those of a scientific nature. Diligent study of the nature of word construction will make their studies much easier and less time-consuming.

Review of Spelling Rules

Because of the fact that the English language was developed from a variety of sources and because it includes many words borrowed from other languages, English spelling is, at times, very difficult and confusing. Furthermore, since most of our scientific words are based on Latin, Greek, German, Russian, and other foreign languages, there is no easily learned set of rules to help the student. An examination of any good dictionary will show a choice of spellings for many words, but this is not the case for most scientific words. Nevertheless, there are a few rules which will be very helpful to the student, but the spellings of many words will simply have to be memorized.

1. When given a choice of two or more spellings, always learn and use the more simple form: mold rather than mould, anesthetic rather than anaesthetic.
2. In adding a suffix to a word which ends in a consonant or in a consonant followed by a silent e, double the consonant only if the preceding vowel is a short vowel in an accented syllable or in a single syllable.*
3. If the final vowel is short but is in an unaccented syllable, do not double the final consonant: benefit, benefited.

* The long vowels are pronounced as follows: a as in date, e as in even, i as in item, o as in grow, and u as in youth, although there is really no long u, as such, in English words. Any other pronunciation of a vowel can, in general, be considered as a short vowel. For example, you would double the final consonant for such words as par, pet, pit, pot, put (panning, petting, pitting, potting, putting)

because the vowels are short and they are in single syllables. The final consonant is doubled in some words because the final vowel is short and is in an accented syllable: e.g. abut, abutted. But most words of this kind, because of a tendency to simplify spelling of American English, do not follow this rule. When you are in doubt about such cases, consult your dictionary.

4. Do not double the final consonant if the vowel preceding the final consonant is long: rate, rated, as opposed to rat, ratted. As always, there are some exceptions such as come, coming (a single syllable with a short vowel sound usually doubles the final consonant), but these are very few in number.
5. “In general,” most words spelled with a final silent e drop the e before suffixes beginning with a vowel and retain the e before suffixes beginning with a consonant. (The silent, usually e indicates a preceding long vowel – ride as opposed to rid; but there are exceptions, such as come.) When adding a suffix beginning with a vowel to a word with a final silent e, do not double the consonant, i.e. ride, riding. However, a few words do keep the silent e to indicate that the preceding c or g is “soft” (c pronounced as s in such words as notice or g pronounced as j in such words as jude). The problem is that the silent e is retained with some suffixes beginning with a vowel and is dropped with others, i.e. notic(e)able, noticing, and juding. Such exceptions to the rules must simply be memorized.
6. When a suffix is added to a word which ends in y, if the suffix begins with a vowel (i.e., ed) change the y to i and add the suffix, e.g. spy, spied. However, if the suffix begins with i, or if an e precedes the y in the root word, the y is retained, e.g. try, trying, monky, monkys. There are a few exceptions to this, e.g. penny, pennies.
7. The spelling of words with ie or ei combinations can best be learned by remembering the old rime, “i before e except after c, or when pronounced as long a as in neighbor or weigh.” However, as with almost all so-called rules pertaining to English, the following commonly used exceptions must be memorized: either, foreign, height, leisure, neither, seize, protein.

8. Finally, the student must remember that many English words with the same pronunciations have different spellings; for example, such words as sight, site, and cite, and there, their are frequently misused rather than misspelled, and you should be aware of the possibility of such misuse in order to avoid errors when using these words and others like them.

1. Using the rules which you have just studied, underline the incorrect spellings in the following set of words and write the correct spelling beside the word, e.g. pleasureable, pleasurable. (After your exercise has been returned, be sure to go back and review the ones which you marked incorrectly and write the correct spelling beside the misspelled words.)

finer	typeing
affecttion	frieght
retrieve	fullness
repreive	comming
shanties	labeled
penneys	quantitys
trying	recuperateing
alleys	sieze
dinned	referred
piece	spliceing

2. Correctly add the suffixes ed and ing to the following words. (e.g. cry – cried, crying), except when the past tense changes the spelling, in which case use the proper spelling of the past tense (e.g. say – said, saying).

hide	try
procure	advise
judge	stride
pay	spit
change	benefit
assent	secure
rebel	argue
challenge	refer
plan	equate

3. Correctly add the suffix ed (or d where appropriate) to form the past tense of the following words, (e.g. obscure, obscured).

rate

occur

breathe

marry

spy

recommend

busy

dine

pursue

try

bat

roll

carry

log

heighten

equip

advise

study

intend

kid

prefer

clap

Plurals, Possessives, Hyphens

1. The plural of most words is formed simply by adding the letter s. e.g. cow, cows. However, the letters es are added if when the word is pronounced the plural adds an extra syllable and if the word does “not” end in e, e.g. gas, gases (an added syllable in pronunciation and the word does not end in e), but horse, horses (note the added syllable in pronunciation, but the word ends in e).
 - a. A few plurals, dealing mainly with animals, retain the archaic form of the plural, e.g. goose, geese; one deer, two deer; ox, oxen; mouse, mice.
 - b. Some plurals have two acceptable forms, e.g. the plural of fish can be either fish or fishes.
 - c. Some words are both singular and plural in form, e.g. species, sheep, deer.
 - d. Words which end in o can present some difficulty because of words recently added to the language, such as stereo and radio, add only an s, e.g. stereos, radios; but some older words such as potato add es – potatoes.
 - e. Words ending in y drop the final y and add ies, e.g. family, families.
 - f. Generally, words ending in f or fe change the f or fe to y and add es, e.g. knife, knives; calf, calves.
 - g. The plural of many scientific words, since they are based on Latin and Greek, form the plural by adding a or i, e.g. datum (sing.), data (pl.); alumnus (sing.), alumni (pl.). When you are in doubt about the proper spelling of a plural form, consult a dictionary.

2. The apostrophe shows possession or that a letter has been omitted in a contraction; e.g. John's book is possessive, and aren't is a contraction. You should avoid contractions in FORMAL scientific writing. To show possession, the apostrophe is placed "before" the final s in the singular and "after" the final s in the plural, e.g. the cow's hooves and the two cows' hooves. Nouns that specify or modify other nouns follow the above rule, e.g. a day's work, a three days' growth.
 - a. In compound words, the last word takes the apostrophe, e.g. my mother-in-law's land.
 - b. In phrases showing joint possession, the last word takes the apostrophe, e.g. the cow and calf's feed.
 - c. The possessive pronouns his, hers, its, ours, yours, and theirs do not need an apostrophe. Be especially careful with the pronoun IT. ITS is the possessive form; IT'S is a contraction meaning IT IS.
 - d. Words ending in y show possession by adding 's, e.g. family, family's.

3. Hyphens are used to connect two or more words used as a single expression and sometimes they are used to keep parts of words distinct. A hyphen is used in the following cases:
 - a. For some family relationships such as mother-in-law, but not for grandfather, grandmother.
 - b. In numbers from twenty-one to ninety-nine and in fractions when they are used as modifiers, e.g. fifty-seven, one-fourth inch, but one half of the herd. When the number is easily understood from the context, no hyphen is necessary, e.g. at the age of twenty one (here twenty one is the object of the preposition of and not a modifier).
 - c. In compounds beginning with self, e.g. self-contained.
 - d. Between a prefix and a proper name, e.g. ex-President Hoover.