Precise Writing for a Precise Science

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Despite the pervasive necessity of effective communication skills in virtually any contemporary career endeavor, a good command of the tools of communication seems to have eluded a great many graduates of chemistry programs. Poor sentence construction and grammatical solecisms are all too common in both written and oral reports of scientific findings. The English language is the principal tool of modern scientific communication, and its effective use should be a goal of anyone preparing for a career in science.

Following is a collection of examples of familiar grammatical constructions, presented in scientific context, that could be better phrased in accordance with the commentary that follows each.

Examples

The product has a melting point similar to benzophenone.

> A melting point in no way resembles a chemical compound, but it may resemble another compound's melting point. The sentence should read ". . . a melting point similar to that of benzophenone."

Solubility was the principal criteria for choosing the nitrate salt.

> *Criterion* and *phenomenon* are two words of Greek origin often misused as their plurals. *Spectrum*, too, (of Latin origin) is often casually replaced with its plural *spectra* by those who most often utilize spectroscopy.

Pentaborane and ammonia were reacted at low temperature.

> Few besides chemists are brazen enough to use *react* as a transitive verb. The chemicals react, chemists don't react *them*. This usage is quite common, however, but it makes one wonder about the user's understanding of thermodynamics!

An historical approach to the teaching of chemistry presents a different perspective.

> The sentence begins with a construction that currently enjoys a level of snob appeal, and it avoids successive aspirations when vocalized. It is unjustified, however (the *h* is not silent), and would be better phrased as "*A* historical."

There was very little data to support the conclusion.

> In chemistry, *data* is still commonly used in the plural sense, and most chemists are careful to write *data are* instead of *data is*. The error is less obvious here, however, and this construction is often seen and heard. The sentence should read "There were very few data." (As a simple check, if a sentence doesn't sound right when *data* is replaced by *facts*, it probably isn't correct.)

A simple IR spectrum infers a highly symmetrical structure.

> Infer means to draw a conclusion—the responsibility of the spectroscopist, not the spectrum. One could say that the spectrum *implies*, but this too is a personification. A better sentence would be "A highly symmetrical structure can be inferred from a simple IR spectrum."

To we who are chemists, scientific reasoning is second nature.

> A subordinate clause must always be considered as completely independent from the rest of the sentence; the sentence must be grammatical without it. Inserting the clause *who are chemists* in no way alters the fact that the sentence must begin "To us." Similarly, the construction within the subordinate clause must be grammatical on its own. For example, "The information was given to whomever requested it." The entire clause is the object of the preposition *to*. The sentence should read "to *who*ever requested it."

Compounds which contain azido groups are often explosive.

> The subordinate clause is "restrictive"; that is, the sense of the sentence is changed if it is omitted. Restrictive clauses should begin with *that*. The sentence should read "Compounds that contain azido groups." Nonrestrictive clauses, which are not essential to the meaning of the sentence, begin with *which* and are set off with commas. The following is an example using a nonrestrictive clause: "Azido compounds, which contain the N_3 group, are often explosive."

If we lay in the sun we may increase the risk of skin cancer.

> *Lay* is a transitive verb (it requires a direct object). *Lie* is intransitive. Some of the confusion arises from the fact that in this case the past tense of the intransitive verb is the same as the present tense of the transitive verb. The sentence should read "If we lie in the sun," or, in the past tense, "If we lay in the sun we may have increased the risk of skin cancer."

The professor felt badly about the poor exam scores.

A verb that relates state of being is followed by a predicate adjective, not an adverb. That is, the word modifies *the professor*, and does not describe the manner in which he performed some action. “The professor felt *bad* about the poor exam scores.”

The project was completed by a colleague and myself.

A reflexive pronoun (*myself*) should be used only subsequent to a corresponding pronoun (*I* or *me*) in the same sentence. Correct form: “by a colleague and me.” A modern aversion to the word *me* has even engendered the use of the nominative *I* as direct object, indirect object or object of a preposition, usually in compound form. Such constructions as “for my colleague and I” are heard, unfortunately, with increasing frequency.

We abandoned our work with nitrogen trichloride when we realized it was explosive.

No chemist would misunderstand the intended meaning, but the sentence literally says that the *work* was explosive. The intended antecedent of the pronoun *it* is the object of the preposition *with*. The sentence should read “. . . when we realized the compound was explosive.” Ambiguity from a casual use of pronouns is all too common.

Applying VSEPR principles, the most likely structure was predicted to be planar.

Applying is a dangling participle. There is no noun that it could modify except *structure*, and the structure clearly did not apply the principles. The sentence should be rephrased as follows: “By application of VSEPR principles . . . .” Equally poor are sentences like “The solution was filtered, resulting in the recovery of the product.” *Which resulted* should be used in place of *resulting*.

It is important that the procedure is followed precisely.

The subjunctive mood has diminishing importance in the modern English language, but its use persists in certain instances such as “that” clauses and “if” clauses (condition contrary to fact). This sentence would be best written as “. . . that the procedure *be* followed precisely.” (The proper subjunctive form “If I were you” is common, but the equally proper “If this be true” is seldom used. There are few consistencies in the use of the subjunctive.)

The ester dissolved in benzene was saponified.

This is a very poor construction because *dissolved* could be either a verb or a participle, and the sense is not clear until the reader reaches the end of the sentence. A better construction would be “The ester was dissolved in benzene and saponified.”

I told the professor that I did not remember him lecturing on the topic.

> Students may be forgetful, but it's unlikely that he or she forgot the professor! The sentence should read "did not remember *his* lecturing." *Lecturing* is a gerund here (a noun form), not a participle.

The crystals darkened, which indicated there had been decomposition.

> The past perfect tense "had been" implies an event more remote than the past tense. Presumably the crystals darkened at the same time that the decomposition occurred, not subsequent to it. Both verb forms should be in the past tense, or both in the past perfect.

Submit your vitae and the names of three references.

> Cats, superstition has it, are endowed with multiple lives, but not chemists. Here the plural *vitae* has been used for the singular *vita* (Latin), which means life. In the above context, *vita* refers to a summary of one's professional life. This misuse is common in classified advertisements. *Curriculum vitae*, however, is a proper singular form ("course of life"), declined according to the rules of Latin.
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> And what is the name of a reference? Probably the writer meant the names of three *referees*. A citation lists a reference; a person consulted is a referee.

The coordination of metal ions in aqueous solution is generally octahedral.

> A general rule is one that always applies. A better choice for the above sentence would be *usually*, or *commonly*, or *typically* octahedral.

Ammonia readily complexes with many transition metals.

> It's been said that any noun can be "verbed," and most verbs no doubt had their origins in nouns, but *complex* is not yet widely accepted as having attained verb status. In the above sentence *complexes* could be easily (and preferably) used as a noun: "Ammonia readily forms complexes."

A scientific report ought to be presented with a level of rigor and precision of the language commensurate with those of the scientific findings. However, a rigid adherence to all grammatical "rules" would render a writing devoid of style, and such adherence is by no means mandatory or even recommended. But an understanding of the rules, their origins, and their contemporary interpretations allows the informed writer or speaker to selectively use grammatical devices to his or her advantage, to most effectively convey the information so that it will be received in the manner intended.

Recommended Reading

Schoenfeld, R. *The Chemist's English*, 3rd ed.; VCH: New York, 1989.

Morris, W.; Morris, M. *Harper Dictionary of Cotemporary Usage*, 2nd ed.; Harper & Row: New York, 1985.
Bryson, B. *The Mother Tongue*; William Morrow: New York, 1990.

General References

The ACS Style Guide, 2nd ed.; Dodd, J. S., Ed.; American Chemical Society: Washington, DC, 1997.
The Oxford Companion to the English Language; McArthur, T., Ed.; Oxford: New York, 1992.