Building English Language Skills for Scientific Writing

by Andy Halvorsen, Char Heitman, and Patricia Pashby

Preface
The following four modules are designed to help you improve your scientific writing skills in English. The modules cover a range of foundational skills such as sentence and paragraph structure as well as offer broader information on academic style, conciseness, vocabulary choices, quoting, paraphrasing, and providing accurate and complete citation information.

This material was developed in coordination with the **Introduction to Scientific Writing MOOC** offered through the American English Institute at the University of Oregon during Winter 2017. If you participated in this MOOC, you will recognize the materials as a collection of the lessons and applied discussion activities conveniently bundled into one document. If you did not participate in the MOOC, the modules can still be beneficial to you as an introduction to fundamental knowledge about scientific and academic writing.

Throughout our modules, we have used excerpts of authentic scientific articles in many of the examples. We think these authentic samples are important because they represent real scientific writing. If you find the language in these examples challenging, please don't worry. They are included only to help you see real scientific writing in action, and you certainly don't need to understand every word. Instead, focus on understanding the concepts being introduced rather than the meaning of the text itself.

Before you begin working with this booklet, you are encouraged to locate scientific articles from your specific field to use as models. Then as you work through the materials, look through your model articles to see how each language or writing point is approached in your particular field. Note whether the concepts covered in the modules seem to be true in writing from your field as well. Comparing the examples in the lessons and the writing in your field, what similarities and differences can you find?

Publication Notes
For ease of layout, full APA citation is not always used throughout the document. Example sentences that come from outside articles are indicated by the use of symbols (* and **) at the end of each example.

The use of bold throughout the document is by the developers of this publication for teaching purposes only, not for emphasis by the authors of the original articles.

MODULE 1, LESSON 1: Sentence Structure and Adverb Placement
by Char Heitman, University of Oregon

Part 1: Basic Sentence / Finite Clause Structure
A **finite clause** is a structure that expresses a complete idea. It must contain a minimum of a **subject**, a **verb**, and any **complements** required by the verb. Look at sentence examples in the chart below:

Adverb / Prepositional Phrase	Subject	Finite Verb	Other Verbs	Complements	Adverb / Prepositional Phrase
	The frequency	increased.			
	We	evaluated		the data	from the experiment.
	The river	contributes		a significant amount of organic matter	to the ocean.
In practice,	most users	were able	to use	the system	effectively.
For rabies,	vaccine availability	requires		work.	
In designing our lesson,	we	tried	to create	typographical errors.	
Finally, at the end of the experiment,	the researchers	asked		if they noticed any errors.	

1. A subject can be one word or many words. The words in bold are the subjects in these example sentences:

   We evaluated the data from the experiment.
   The transmission of disease is highly possible.
   A mobile-phone-based system was developed.

2. Similarly, a verb can be one word or many words. The words in bold are the verbs in these example sentences:

   The frequency **increased** over time.
   Most students **were able to use** the registration program without difficulty.

3. A subject does not always begin a sentence. The words in bold are the subjects in these example sentences:

   In practice, **most students** were able to use the registration program without difficulty.
   For rabies, **vaccine availability** still requires work.

4. Some sentences are complete with only a subject and verb. Other sentences require a complement. The words in bold are the complements in these example sentences:

   The researchers published **their findings**.
   The biologist collected **the samples**.
   The doctor discovered **the cause of the disease.**

5. In addition to subject, verb, and a complement if required, there are also optional sentence components. The sentence is considered complete with or without those components. The optional sentence components are often prepositional phrases or adverbs or adverb phrases which indicate the time, place, or location of the action. The words in bold are the optional complements in these example sentences:

   Last year, they published the research. (optional phrase indicates when)
   Recently, they published the research. (optional word indicates when)
   In 2015, they published the research. (prepositional phrase indicates when)
   They published the research **in the *Journal of the American Medical Association***.
   (optional prepositional phrase indicates where)
   They published the research **after they completed the study**. (optional adverb clause indicates when)

Part 2: Complete Sentences
A **complete sentence** must contain a **subject** and a **verb**. Some sentences require a **complement**. Sentences that do not contain all the required parts are called **sentence fragments**. Two sentences that are connected by no punctuation are called **run-on sentences**. Look at some examples:

Examples of complete sentences
   In the study, we observed an interaction between the two subjects.
   The effect of the bacteria seems to be less than half the effect of the virus.
   They explained more about the connection between personality and language.

Examples of sentence fragments
   The connection between personality and language. (subject only)
   Was unusual and hard to interpret. (verb only, no subject)
   Has been found. (verb only, no subject.)
   People with lower pain tolerance. (subject only, no verb)
   He conducted. (no complement)
   The researchers collected. (no complement)

Examples of run-on sentences
   The researcher was pleased with the data it was robust.
   We collected blood samples we analyzed the results.
   This is an important finding more research needs to be done in this area.

Examples of run-on sentence corrections
   This is an important finding. More research needs to be done. (with a period to make two sentences)
   This is an important finding; more research needs to be done. (with a semicolon)

Part 3: Adverb Placement

In English, **adverbs** appear at different locations in sentences, depending on function and meaning. Many of them appear in different locations than adverbs in other languages. Look at some examples and notice where the adverbs appear in each sentence (the words in bold are the adverbs). What do you notice about similarities and differences between adverb placement in English and your own language?

1. Medical availability **still** requires attention.
2. It has **already** been modified.
3. The first time, students needed **approximately** ten minutes to complete the quiz.
4. Most students **were able to use** the registration program without difficulty.
5. These results **definitely** show a decrease in traffic accidents.
6. The data is **primarily** used by the second group of researchers.
7. The system is **currently** used by over 750 education specialists.
8. **Sometimes**, they go to Paris. **Sometimes**, we do not know where they go.
9. We need to do a **timely** evaluation of the program.
10. We **randomly** chose five participants.
11. A detailed study was **previously** published.
12. Rain **typically** occurs between March and June.
13. Student grievances are **generally** low.
14. **First**, we estimated the the number of people living in the flood region.
15. **Second**, she contacted emergency personnel.
16. **Finally**, at the end of the study, the participants were told what the research was about.
17. The data was **significantly** different.
18. Medical supplies are **extremely** scarce in this region.
19. **Surprisingly**, the test was not painful.
20. **Similarly**, the subjects reported no reaction to the cold.

Look at the chart on the following page to see how adverbs can be classified according to meaning and how meaning affects adverb placement.

Meaning	Examples	Placement	Example Sentences (words in bold are adverbs)
frequency	• sometimes • occasionally • often • normally • usually • only • also • just • already • still • generally	• before main verb • between first and second auxiliary • after negative • after "be" • at beginning of sentence for emphasis or for sentence variety	1. We **never** go. 2. We **just** visited her. 3. The test has **already** been modified. 4. We don't **often** go. 5. We have not **always** visited him. 6. Attendance is **generally** low. 7. **Normally**, we take a vacation in August. 8. **Usually,** he comes in at 3:00. 9. **Sometimes**, they go to Paris.
probability	• certainly • probably • likely • definitely	• before main verb • before negative	1. We **definitely** want to see her. 2. We **certainly** won't go. 3. He will **likely** come on time. 4. They will **probably** not visit him this time.
manner	• quickly • slowly • considerably • completely • effectively	• can sometimes go before the verb but can always go after the phrase or at the end of sentence (best to memorize and use this rule)	1. We ate dinner **quickly**. 2. We **randomly** assigned five tasks. 3. This study guide will help students **considerably**. 4. Most personnel were able to use the the new program **effectively**. 5. The tutors are **primarily** used by first year students. OR First year students **primarily** use the tutors.
time	• immediately • once a week • every day • today • first • second • next	• at the end of phrase or sentence, particularly multi-word adverbs of time • at the beginning of sentence for emphasis or sentence variety	1. We called him **immediately**. 2. We went there **every day**. 3. They monitored the site **twice a day**. 4. **Today**, fewer rabies deaths occur than in prior years.

Apply Your Skills
1. Select an article from your field to serve as a model.
2. Find three sentences. Identify the components of the sentences. These include subject, verb, complement, and optional components, such as prepositional phrases, adverbial phrases, etc.
3. Find at least one example of a sentence with each type of adverb: time, probability, manner, and frequency.

MODULE 1, LESSON 2: Verb Tenses in Scientific Writing
by Char Heitman, University of Oregon

Part 1: English Verb Tenses – Forms
This table shows the forms of English tenses for a regular verb (explain) and an irregular verb (find) in the active (explain/find) and passive (was/were explained/found) voices (Caplan, 2012, p. 66).

	Simple	Perfect	Progressive	Perfect Progressive
Present Active	he explains	he has explained	he is explaining	he has been explaining
	she finds	she has found	she is finding	she has been finding
Passive	it is explained	it has been explained	it is being explained	it has been being explained
	it is found	it has been found	it is being found	it has been being found
Past Active	he explained	he had explained	he was explaining	he had been explaining
	she found	she had found	she was finding	she had been finding
Passive	it was explained	it had been explained	it was being explained	it had been being explained
	it was found	it had been found	it was being found	it had been being found

The tenses shown above account for the majority of the tensed verbs used in academic writing (Caplan, 2012). In fact, 98% of the verb tenses used in academic writing are in these three tenses: present simple (70%), past simple (23%), and present perfect (5%) (Biber et al., 1999, in Caplan, 2012, p. 66).

Additionally, verbs can occur in either **active** or **passive** voice. About 25% of verbs in academic and scientific writing are in the **passive voice** (Biber et al., 1999, in Caplan, 2012). The choice of whether to use **active** or **passive** depends on various factors. However, in general, when the agent (who or what does the action) is important, **active voice** is used. When the emphasis is on what was done or what occurred, **passive voice** is used. **Active** and **passive** are also used to increase sentence variety.

Examples
　　　The National Science Foundation (NSF) conducted the study. (active)
　　　The study was conducted last year. (passive)

In the example sentences, **passive** is used in the second sentence to avoid naming the agent again, which would be repetitive and unnecessary; the agent was already named in the first sentence. As you read articles in your field, note how often and for what purpose **active** and **passive** voice are used.

As you probably know, there are two types of verbs in English: **regular** and **irregular**. For **regular verbs**, both the past simple and present perfect are formed by adding "-ed" to the end of the main verb (help/helped, conduct/conducted). For **irregular verbs**, the past tense form does not add "–ed." Instead, the past simple and past participle are in a different form. The past participle is used for perfect tense forms and passive voice. Sometimes the past simple and past participle form of the verb are the same, but sometimes they are different. Look at some examples below:

Present Simple	Past Simple	Past Participle	Passive
say	said	has/have said	was/were said
make	made	has/have made	was/were made
find	found	has/have found	was/were found
come	came	has/have come	NA This verb does not occur in passive.
describe	described	has/have described	was/were described
include	included	has/have included	was/were included
show	showed	has/have shown	was/were shown
give	gave	has/have given	was/were given
see	saw	has/have seen	was/were seen
feel	felt	has/have felt	was/were felt
seem	seemed	has/have seemed	NA This verb does not occur in passive.
meet	met	has/have met	was/were met
tell	told	has/have told	was/were told
learn	learned	has/have learned	was/were learned
choose	chose	has/have chosen	was/were chosen
spend	spent	has/have spent	was/were spent

Remember that the past participle is used for both the **present perfect** and **past perfect** (has found, had found), as well as the **passive** (was found, were found).

Part 2: Verb Tense Use in Scientific Writing

1. **Simple present tense** is used primarily for the following purposes in academic writing:

Purpose	Examples
to frame the paper • The introduction is often in present simple tense. • The present simple tense is used to describe what is already known about the topic.	1. The widespread use of texting **means** that we often **find** written language with mistakes. 2. In this paper, we **focus** specifically on mistakes commonly found in text messages.
to make general statements, conclusions, or interpretations about previous research or general knowledge	1. Texting **includes** types of writing that **differ** from typical academic writing. 2. The impact of the weather **is** insufficiently **recognized**.
to introduce evidence or support with "there + be"	1. **There are** no clear examples used. 2. **There are** currently three researchers working on the project.

2. **Simple past tense** is used primarily for the following purposes in academic writing:

Purpose	Examples
to introduce a specific study, usually completed by a named researcher	1. Researchers at the institute **were alerted** to the potential problems. 2. Subsequent research **estimated** the impact of the disease in each community.
to describe the methods and data of a completed experiment	1. Students **completed** a 12-item evaluation tool for each course. 2. We **conducted** the experiment using two methods. 3. Differences in wind speed **were calculated** using two different instruments.
to mark time with specific time markers such as **in 2010**, **after the study**, **at that time**, and **previously**	1. **After 20 minutes of training**, most students **were able** to register using the new program. 2. **Finally**, participants **were asked** if they had any negative side effects from the immunization. 3. **On December 18, 2014**, we **observed** a significant change in the weather.

3. **Simple present perfect tense** is used primarily for the following purposes in academic writing:

Purpose	Examples
to introduce a new topic, sometimes using there has/have been	1. There **have been** few studies on this topic **done**. 2. The eating habits of these insects **have never been studied**.
to summarize previous research	1. Previous research **has focused** on the weather patterns in the summer. 2. Professor Smith and his colleagues **have shown** a connection between the eating habits of the two animals.
to describe previous findings or tell the history of an idea	1. The effect of heat on the materials **has not been well studied**. 2. Few studies about the hazardous materials **have been done** at this point. 3. A few studies **have shown** differences in reactions between males and females.
to mark time with specific time markers such as **since 2009**, **never**, **to date**, and **until now**	1. **Since 2015**, we **have registered** over 20,000 students in the program. 2. About 300 unique artifacts **have been discovered** in the region **since the 1990s**. 3. The daily habits of this isolated civilization **have never been studied**.

Apply Your Skills
1. Select an article from your field to serve as a model.
2. Find the following:
   - Two examples of sentences in the present simple. Identify why present simple tense was used and label the sentences.
   - Two examples of sentences in the past simple. Identify why past simple tense was used and label the sentences.
   - Two examples of sentences in the present perfect. Identify why present simple tense was used and label the sentences.
   - One example each of passive voice in present simple, past simple, and present perfect.

MODULE 2, LESSON 1: Connecting Sentences
by Patricia Pashby, University of Oregon

Scientific writing in English requires you to use a variety of sentence types and lengths. Sometimes you want to write a very short and simple sentence to bring extra clarity or emphasis to an idea. Other times you want to include several ideas in a sentence to show multiple connections or relationships between ideas. In other words, you need to use all kinds of sentences—short and long, simple and complex—to write about your scientific research. This requires you to be able to write sentences with more than one clause. Correct punctuation varies depending on the type of word or phrase used.

Clauses
A clause is a group of words connected by a verb. There are two types of clauses: **independent** and **dependent**. An **independent clause** is a complete sentence because it has a subject with a finite verb that can carry verb tense. A **dependent clause** is not a complete sentence and often begins with a **subordinating conjunction** such as "because" or "if."

Part 1: Using Subordinating Conjunctions to Combine Clauses
Subordinating conjunctions include the following words and phrases commonly found in scientific writing: because, if, although, while, unless, after, before, as, whereas, since, despite the fact, when, whether, in order that, once, so that, even though.

The subordinating conjunction begins the dependent clause and indicates its relation to the rest of the sentence. An example is "although the advantages were evident," which is not a complete sentence. It needs to be combined with an independent clause to create a grammatically complete sentence.

> Sometimes the dependent clause comes before the independent clause:
>> **Although** the advantages were evident, the director decided not to follow the plan.
> Other times the dependent clause comes after the independent clause:
>> The director decided not to follow the plan **although** the advantages were evident.

Punctuation Guidelines: Place a comma immediately after the dependent clause when it comes before the independent clause (see sentences above). Commas are not commonly used between the two clauses when the independent clause comes first—unless a strong contrast is expressed with "whereas" or "while" as in the examples below:

> Spiny lobsters were found in groups of 2-4 individuals and were of small size (10-15 cm total body length), **while** slipper lobsters were often found alone or in pairs and attained larger adult sizes (20-25 cm total length).*

> The former were dominated by a solitary cup coral, Tubastraea sp., **whereas** the latter were dominated by the barnacle Megabalanus tintinnabulum.*

Part 2: Using Coordinating Conjunctions to Combine Clauses
Two independent clauses are often connected with a **coordinating conjunction**. These include the following: and, but, so, or, yet, nor, for. To help us remember which words fall into this

category, we sometimes refer to them by using the acronym "fanboys"
(**f**or, **a**nd, **n**or, **b**ut, **o**r, **y**et, **s**o). The following examples use coordinating conjunctions:

> There are no true coral reefs in Gabon, **and** most of the largely unmapped reefs are rocky.*

> Extensive oil exploration and development began onshore in Gabon in the 1950s, **but** offshore exploration did not begin until the 1960s.*

> Large snappers (primarily L. dentatus) were often deeper and not easily observed, **so** the actual standing stock of fish biomass on these platforms is likely much higher than our estimates suggest.*

Punctuation Guidelines: When connecting two independent clauses with a coordinating conjunction, place a comma before the conjunction.

Part 3: Using Sentence Connectors to Combine Clauses

Another way to connect independent clauses is with **sentence connectors**, which are sometimes called transitional adverbs. These include the following words and phrases: therefore, however, in addition, nevertheless, in contrast, for example, in other words, moreover, consequently, for instance, as a result, thus. These draw more attention to themselves than do the subordinating conjunctions and coordinating conjunctions introduced above. Their size and punctuation tend to "stop" the readers and make them think about the relationship. Therefore, you want to use them sparingly.

Punctuation Guidelines: Place a semicolon between the two clauses. If the sentence connector comes at the beginning of the second clause, a comma usually follows it. If the sentence connector is not the first word in the clause, it is preceded and followed by a comma. Note: The semicolon can be replaced with a period. The following are examples:

> Most of the fish biomass on the platforms was composed of pelagic species with broad biogeographic distributions. **However,** much of the observed species richness consisted of demersal species, many of which had distinct and unique assemblages.*

The authors used the punctuation above, but they also had the options below:

> Most of the fish biomass on the platforms was composed of pelagic species with broad biogeographic distributions**; however,** much of the observed species richness consisted of demersal species, many of which had distinct and unique assemblages.

> Most of the fish biomass on the platforms was composed of pelagic species with broad biogeographic distributions. Much of the observed species richness**, however,** consisted of demersal species, many of which had distinct and unique assemblages.

Useful Subordinating Conjunctions, Coordinating Conjunctions, and Sentence Connectors (adapted from Oshima & Hogue, 2006)

Meaning / Function	Subordinating Conjunctions	Coordinating Conjunctions	Sentence Connectors
to introduce an additional idea		and	in addition furthermore moreover
to introduce an opposite idea or contrast	although though even though whereas while	but yet	in contrast however nevertheless instead
to show similarity			likewise similarly
to introduce an example			for example for instance
to introduce a result		so	as a result therefore consequently thus
to introduce a cause		for	
to introduce a choice or alternative	if unless	or nor	otherwise alternatively
to introduce a restatement or explanation			in fact indeed that is
to introduce order (time)	before after until when while as soon as since		first second next after that meanwhile subsequently finally
to introduce a summary or conclusion			clearly in brief in conclusion indeed in short in summary

Part 4: Using Relative Clauses
Another way to combine ideas (and clauses) in your sentences is through **relative clauses**. These are the parts of sentences that begin with a **relative pronoun** such as "who" or "which" (although in some cases it is possible to delete these words, leaving only a reduced version of the clause). Relative clauses are an excellent way to combine ideas or add information to a sentence in your scientific writing. There are two types of relative clauses—**non-restrictive** and **restrictive**—which vary in meaning and punctuation.

Non-Restrictive Relative Clauses
A **non-restrictive relative clause** adds extra information to a noun in the main clause for the purpose of clarifying, describing, or explaining it. Use the relative pronoun "who" (or "whom" when in object position) to refer to humans; use "which" for non-humans; and use "whose" for all possessive forms. The following are examples of sentences with non-restrictive relative clauses:

> These platforms are in sharp contrast to much of Gabon's marine environment, **which** is dominated by soft sediment communities.*

> Longitude and depth, **which** were significantly correlated with latitude and platform area respectively (p<0.05), also were excluded from the analysis.*

> Several amphi-atlantic species, **which** occur only around oceanic islands, were observed on the oil platforms off Gabon.*

Alternatively, a non-restrictive relative clause can serve to extend the meaning of the main clause (especially when placed at the end of the sentence) by adding a result or implication.

> The addition of artificial reefs in the deep sea is likely to increase ecological connectivity, **which** will have important biogeographical consequences.*

Punctuation Guidelines: Place a comma before the restrictive relative clause. If the restrictive relative clause comes in the middle of the sentence, also place a comma after the relative clause.

Restrictive Relative Clauses
The **restrictive relative clause** actually identifies the subject rather than simply provide extra information about it. Use the relative pronouns "who" or "that" (or "whom" when in object position) to refer to humans; use "which" or "that" for non-humans; and use "whose" for all possessive forms. The following is an example of a sentence with a restrictive relative clause:

> Rigs-to-reef programs **which** allow decommissioned oil platforms to stay in place have gained some support by governmental and non-governmental organizations.*

> Note: The authors could have replaced "which" with "that" in this sentence.

Punctuation Guidelines: No commas are used.

Differences in Meaning
Non-restrictive and restrictive relative clauses appear almost identical (except for the use of commas), but the meaning can be quite different.

> Non-restrictive relative clause
> Survey questions**, which** focused on attitudes toward exercise**,** were open ended.
> (Meaning: All of the survey questions on this survey were focused on attitudes toward exercise.)

Restrictive relative clause
Survey questions **which** focused on attitudes toward exercise were open ended. Survey questions **which** focused on medical history were multiple choice. (Meaning: There are different kinds of survey questions. Those focusing on attitudes toward exercise were all open-ended format. Multiple choice format was used for another topic.)

Non-restrictive relative clause
The surveys**, which** were conducted via email**,** consisted of 20 questions. (Meaning: All of the surveys consisted of 20 questions.)

Restrictive relative clause
The surveys **which** were conducted via email consisted of 20 questions. The surveys **which** were conducted in the office consisted of 25 questions. (Meaning: There were two different surveys, and they are identified by the place in which they were conducted.)

Using Reduced Forms of Relative Clauses
It is possible to reduce relative clauses to make your writing more concise. However, do not do this if it will create ambiguity or other possible confusion for the reader.

Reducing a non-restrictive relative clause
When the clause comes at the end of a sentence, the relative pronoun (which, who) can be deleted and the verb changed to an "-ing" form.

Original form
Two similar medications were distributed**, which** caused confusion among the patients.

Reduced form
Two similar medications were distributed**, causing** confusion among the patients.

If there is a "be" verb, delete both the relative pronoun (which, who) and the verb.

Original form
The first treatment, **which was** a series of five exercises, was introduced during the first week.

Reduced form
The first treatment, a series of five exercises, was introduced during the first week.

Reducing a restrictive relative clause
Delete the relative pronoun (which, who, that) and change the verb to an "-ing" form.

Original Form: Survey questions **which focused** on attitudes toward exercise were open ended.

Reduced Form: Survey questions **focusing** on attitudes toward exercise were open ended.

If there is a "be" verb, delete both the relative pronoun (which, who, that) and the "be" verb.

> Original form
> Surveys **that were completed** before the final treatment were discarded.
>
> Reduced form
> Surveys **completed** before the final treatment were discarded.

Apply Your Skills

1. Select an article from your field to serve as a model.
2. Find one example each for as many of the following different clause or sentence types listed here:
   - complex sentence with the independent clause at the beginning
   - complex sentence with the dependent clause at the beginning
   - compound sentence using a coordinating conjunction
   - sentence (or pair of sentences) with a sentence connector
   - sentence with a non-restrictive relative clause
   - sentence with a restrictive relative clause

* These examples come from the following reading:

Friedlander, A. M., Ballesteros, E., Fay, M. & Sala, E. (2014). Marine communities on oil platforms in Gabon, West Africa: High biodiversity oases in a low biodiversity environment. *PLoS One 9*, 1-15. http://dx.doi.org/10.1371/journal.pone.0103709

MODULE 2, LESSON 2: Building Paragraphs
by Patricia Pashby, University of Oregon

The way you organize information within paragraphs is central to a successful paper describing your science research. You want the reader to be able to quickly access the information with full understanding. To do this, you need to place sentences in a very logical order and pay careful attention to how one sentence "flows" into the next. Here are some questions to think about:
- What are the characteristics of a well-written paragraph in science writing?
- How long should a paragraph be?
- How do you organize the ideas/sentences within a paragraph?
- What else should you consider when writing or revising a paragraph?

Part 1: Characteristics of a Well-Written Paragraph
- Each paragraph contains one controlling idea, usually one of the following:
  - main idea with supporting explanation and details
  - main idea divided into key categories
  - one step in a process
- Every paragraph should be easy for the reader to navigate and understand.
- The first sentence of a paragraph is usually a "topic sentence" that introduces the main idea.
- The order of sentences must be logical, but this will vary depending on the topic/purpose of the paragraph.

Part 2: Paragraph Length
Usually, the length of a paragraph is a topic sentence followed by three to five sentences but can vary between one and eight sentences (Wallwork, 2016). Each sentence usually has one or two clauses. Avoid including multiple ideas in one sentence unless the results can be easily read.

Part 3: Organization of Sentences within a Paragraph
Sentences within a paragraph must be carefully organized according to a logical relationship between ideas. Common patterns for doing this in scientific writing include the following:
- moving from general ideas to more specific ideas
- introducing one theme and then dividing this into subthemes
- chronological order

Analyze the following example paragraphs to decide how the information is organized:

1. What organization pattern best describes this paragraph?

   Reaching populations in need continues to prove challenging as we at the Bill & Melinda Gates Foundation frequently observe working with partners to fulfill our mission. The challenges point to a high degree of complexity in the interplay of stakeholders in the global regulatory and delivery systems. The key stakeholders include global and regional pharmaceutical companies, non-governmental organizations, national medical product regulatory agencies, ministries of health and others who make product utilization recommendations. In particular, regulatory and procurement requirements vary widely between countries, creating a system with many inefficiencies and redundancies, only a few of which have been adequately documented.*

Answer: It moves from a general idea to consecutively more specific ideas.

2. What organization pattern best describes this paragraph?

Twenty field teams consisting of one enumerator, one field worker, and one person trained for blood sample collection were equipped with high resolution maps and a handheld GPS receiver (GPSMAP 62s; Garmin International) with preloaded waypoints for 16 randomly selected compounds and cell boundaries. Compounds were eligible for sampling if at least one adult and one child (< 15 y) were permanent residents (defined as sleeping regularly in the structure) and written informed consent was obtained. If a selected compound did not satisfy these criteria, the nearest non-selected inhabited compound was selected as a replacement. Participating individuals in the community survey were screened by axillary thermometer for fever, and those with fever were tested by RDT (HRP-2, Paracheck, Orchid Biomedical Systems) for on-site malaria diagnosis and treatment with artemether-lumefantrine (AL) (Coartem, Novartis) if RDT positive. Febrile individuals who were RDT negative, pregnant, or below 6 mo of age were accompanied to a local health facility for a full clinical assessment and treatment.*

Answer: Chronological order is used to describe the steps in this part of the data collection.

3. What organization pattern(s) best describes this paragraph?

We identified several potential root causes of this time spread. First, as mentioned earlier, large multi-national manufacturers typically did not prioritize early registration and introduction of their novel products into low-income countries. This is due to limited commercial potential in most of those countries. Additionally, varying requirements and legislative frameworks in low-income countries limit the ability of manufacturers to submit a single dossier concurrently to those countries. The enormous resources required to prepare unique submissions for each country and respond to questions from each individual NRA may have exacerbated this spread. As a result, some countries experience long waits before they even receive application dossiers for review.*

Answer: A theme is introduced and then divided into subthemes. In addition, each subtheme moves from general information to more specific information.

Part 4: Creating Flow Between Sentences in a Paragraph
The reader should be able to move easily from one sentence to the next, without stopping to wonder how the ideas connect. We often refer to this smooth relationship between sentences as "flow." In scientific writing, flow is usually created through the following three techniques (adapted from Swales & Feak, 2012): 1) placement within sentences of "old" and "new" information, 2) use of determiners and demonstratives, and 3) use of sentence connectors. See below for explanations.

"Old" and "new" information placement within a sentence
Place a reference to "old" information (which has already been presented in a preceding sentence) before introducing "new" information. This, along with logical organization of ideas, is the best way to create flow.

> Mosquito exposure was monitored in three interventions and **three control clusters**; in each of **the clusters**, four compounds within hotspot boundaries and eight compounds located in the evaluation zone were randomly selected for monitoring.**

> Parasite prevalence in the malaria hotspots and in the evaluation zones surrounding the malaria hotspots was determined based on nPCR parasite detection in **three surveys** conducted in March– April (baseline), June–July (8 wk post-intervention), and August–September 2012 (16 wk post-intervention). Each **survey** took approximately 2 wk to complete.**

> Mosquito breeding site productivity was assessed in **15 sites** per intervention hotspot (n = 75 in total). Of the **sites** sampled prior to larviciding, 45% (34/75) were positive, of which 12 had late-stage larvae and/or pupae.**

> Malaria **transmission** in the area is seasonal and associated with seasonal rains that typically **peak** between March and June and between October and November. **Transmission intensity** in the study area is generally low…**

Determiners and demonstratives
When appropriate, use demonstrative adjectives "this" or "these" or the determiner "such" to indicate previously mentioned information.

> Mosquito densities are highest in hotspots, and individuals in hotspots may amplify transmission by transmitting malaria parasites to a large number of mosquitoes that fuel transmission to wider areas. **This** amplified transmission can lead to 1.5- to 4-fold increases in the basic reproductive number of malaria parasites.**

> We hypothesized that combined malaria control interventions targeted at hotspots could reduce malaria transmission not only inside these hotspots but also in adjacent areas. To test **this**, we identified hotspots of malaria transmission in a low endemic area in the western Kenyan highlands, and conducted a cluster-randomized controlled trial to measure the effect of hotspot-targeted interventions in evaluation zones surrounding malaria hotspots.**

> Successful targeting of malaria control efforts to hotspots may therefore be a highly efficient method to reduce malaria transmission in a wider area and achieve community protection by eliminating transmission in a relatively small geographical area. **Such** targeted interventions are likely to become increasingly important tools in malaria elimination efforts once transmission in an area has decreased but is maintained in hotspots of malaria transmission.**

Sentence connectors

If necessary, and only if necessary, add a sentence connector such as "however" or "for example." Use these sparingly: Too many sentence connectors can actually break up the flow.

> Our decision to monitor the incidence of malaria cases passively was based on the low efficiency of active monitoring of infections in low endemic settings, although we acknowledge that PCD leads to a considerable loss in power compared to active case detection. **As a consequence**, our approach will have resulted in an unknown number of malaria episodes that were missed due to health care seeking behavior or other factors.**

> There are several possible reasons for the apparent failure to completely eliminate malaria transmission inside hotspots and the undetectable impact in the evaluation zones surrounding targeted hotspots. **First**, it is possible that our interventions did not clear vector populations or prevent human-vector contact inside hotspots to the extent that is required to interrupt local transmission.**

> Our trial included a total of ten clusters during a single season and was therefore not powered to detect subtle effects of hotspot-targeted interventions nor designed to detect effects of interventions that become apparent over multiple transmission seasons. **Furthermore,** we saw a higher than expected level of inter-cluster variation.**

> This amplified transmission can lead to 1.5- to 4-fold increases in the basic reproductive number of malaria parasites. Successful targeting of malaria control efforts to hotspots may **therefore** be a highly efficient method to reduce malaria transmission in a wider area and achieve community protection by eliminating transmission in a relatively small geographical area.**

Apply Your Skills

1. Select an article from your field to serve as a model.
2. Find the following:
   - a paragraph that uses general-to-specific organization
   - a paragraph that uses theme-divided-into-subthemes organization
   - an example within a paragraph that illustrates using old-to-new placement of information to create flow
   - an example within a paragraph that illustrates using "this," "these," or "such" to create flow
   - an example within a paragraph that illustrates using a sentence connector to create flow

 * These examples come from the following reading:
Ahonkhai, V., Martins, S. F., Portet, A., Lumpkin, M., & Hartman, D. (2016). Speeding access to vaccines and medicines in low- and middle-income countries: A case for change and a framework for optimized product market authorization. *PLoS One 11,* 1-12. http://dx.doi.org/10.1371/journal.pone.0166515

** These examples come from the following reading:

Bousema, T., Stresman, G., Baidjoe, A. Y., Bradley, J., Knight, P., Stone, W., . . . Cox, J.
(2016). The impact of hotspot-targeted interventions on malaria transmission in
Rachuonyo South District in the Western Kenyan Highlands: A cluster-randomized
controlled trial. *PLoS One 13,* 1-25. http://dx.doi.org/10.1371/journal.pmed.1001993

MODULE 3, LESSON 1: Academic Style and Conciseness
by Patricia Pashby, University of Oregon

Choosing words and phrasing carefully is central to expressing your scientific work clearly and accurately to your readers. There are several strategies you can follow to help guide your decisions.

Part 1: Academic Style
The guidelines below (adapted from Swales & Feak, 2012) will help you select more formal and precise vocabulary appropriate for scientific writing.

Guidelines	Less Formal/Precise	More Formal/Precise (Use of these possibilities depends on context.)
Avoid vague expressions.	etc. so forth nice good thing	including . . . such as . . . positive robust idea / item
Avoid phrasal verbs (verb plus preposition forms).	look into went down	investigate / explore decreased
Avoid informal expressions.	a lot of big little some bunch of stuff	many / much large small several / give exact number many / much ideas / items
Avoid contractions.	it's they'll aren't didn't	it is they will are not did not
Avoid lengthy negative forms.	not much not much not any	few (Few participants . . .) little (Little research . . .) no (No studies . . .)

Part 2: Writing Concisely

Scientific writing requires the use of as few words as possible to make your point. Avoid being "wordy" (using too many words). Express exactly what is needed without adding extra words. The guidelines below (adapted from Wallwork, 2016) will help you avoid unnecessary wordiness.

Guidelines	Wordy	Better
Delete redundant words.	The research focused attention on the increase of serious and dangerous cases in the month of July.	The research focused on the increase of serious cases in July.
Consider replacing nouns with verbs.	Health care workers provided information to the patients of the risks. The decision of the team was to abandon data collection at this site.	Health care workers informed the patients of the risks. The team decided to abandon data collection at this site.
Consider using one verb instead of a verb and noun combination.	We did an analysis of two samples. A decrease in temperature occurred.	We analyzed two samples. The temperature decreased.
Consider using an adverb to replace multiple words.	On an interesting note, two participants opted for additional treatments. The interventions were added in a gradual way.	Interestingly, two participants opted for additional treatments. The interventions were added gradually.
Avoid unnecessary introductions and sentence connectors.	In conclusion, it is clear to us that the treatment is effective but has risks.	[Clearly,] the treatment is effective but has risks. (The word in brackets might also be deleted for even more conciseness.)

Part 3: Additional Advice on Academic Style

Use articles in journals from your field as models for academic style and conciseness. Analyze these for the vocabulary choices of the authors and take notes when you find examples that are particularly relevant to the topics you write about. Develop a "voice" (style) suitable to the writing conventions in your field.

Edit for style and conciseness in later drafts of your paper rather than in the initial drafting stages. If you worry too much about vocabulary choices and conciseness when you first start writing your paper, you may slow your progress or even suffer from "writer's block." Wait until your ideas and organization are in good shape. Then you can turn your attention to editing for style, conciseness, grammar, and punctuation.

Apply Your Skills

1. Write three to five sentences describing your scientific work or a topic from your science field. Edit these carefully for academic style and conciseness.

MODULE 3, LESSON 2: Vocabulary Choices in Scientific Writing
by Andy Halvorsen, University of Oregon

Part 1: Distinguishing between Active and Passive Vocabulary
It is estimated that most language users have an active vocabulary of roughly 15,000 to 20,000 words, although the 1,000 most frequently used words make up approximately 90% of most written work.

- **Active vocabulary** refers to words that an individual can actively recall and use appropriately in language production (speech and writing).
- **Passive vocabulary** refers to words that an individual can recognize and understand in language reception (listening and reading) only.

Part 2: Academic and Scientific Vocabulary
Academic vocabulary can be divided into two types:

- **Technical academic vocabulary** is words that are unique to certain academic disciplines. These are specialized terms, and they are generally only learned and used by students and researchers within that discipline.
- **General academic vocabulary** is words that are used across disciplines for a broad range of academic writing purposes. Vocabulary of analysis or vocabulary related to the research process are examples of general academic vocabulary.

Part 3: Academic Word Lists and Phrasebanks
The Academic Word List (http://www.victoria.ac.nz/lals/resources/academicwordlist) was created from general academic vocabulary and contains 570 word families and over 2000 words in total (Coxhead, 2000). This word list is based on a corpus of over 3.5 million words drawn from academic books and journals in a wide range of disciplines.

The Academic Phrasebank (http://www.phrasebank.manchester.ac.uk), developed by the University of Manchester, can also be a useful resource for scientific writing. For example, by clicking the link to "explaining causality," we are presented with nouns, verbs, prepositions, and connectors used frequently to show causality.

Part 4: English Language Corpora
A language corpus (plural corpora) is a large collection of texts that have been collected and organized for the purposes of linguistic research. Corpora exist for both written and spoken speech and for general as well as academic English.

Several commonly used corpora are listed below along with features of each:

Title	Word Count	Time Period	Features and Sources
NOW (News on the Web) Corpus	2.8 billion	2010-present	• online newspapers and magazines • updates daily as new sources go online
COCA (Corpus of Contemporary American English)	520 million	1990-2015	• balanced academic and general • balanced written and spoken American English focus
BNC (British National Corpus)	100 million	1980-1993	• balanced written and spoken British English focus
TIME Magazine Corpus	100 million	1923-2006	• from 275,000 articles written in *Time* magazine

Part 5: Using COCA (Corpus of Contemporary American English)
The Corpus of Contemporary American English (COCA) (http://corpus.byu.edu/coca/) was developed by Brigham Young University and is frequently used by linguists and researchers from many academic disciplines.

Learning to search COCA is not hard. After you go to the site, you can simply type terms into the search box to find results. It is helpful to click on the "sections" button below the search box because then you are able to customize your search. For example you can specify that the search will occur only for spoken words, fiction, academic writing, newspapers, or a variety of other options.

You can also use the "insert POS" (POS stands for Part of Speech) button to ask COCA to search for only certain parts of speech for a word. Try an example yourself. Type a term such as "research" into the search box. Using the "insert POS" drop-down menu, you can add "verb.all." If you complete this search, COCA will return only examples where the word "research" is used as a verb. Many other options such as "verb.ED" and "verb.[DO]" exist as well, so you need to experiment to customize your search exactly the way you want.

Another interesting feature of COCA is that after completing a search, you are presented with an entire list showing the full range of words that appear next to your search term. Importantly, each entry is clickable as well, giving you a complete list of the exact sentences containing this combination of words. Information such as this can be invaluable for academic writers struggling to find appropriate words or phrasing in their writing.

Part 6: Using Google Search
Although not as customizable as COCA, Google (https://www.google.com) search can help as well, particularly if you use quotation marks and asterisks in your searches.

Use quotes (" ").	Find only the exact phrase you enter: "research indicates"
Use an asterisk (*).	Use an asterisk to find an unknown word: "a * amount of research"

In the above example using the asterisk, results will reveal common words that come before "amount of research." Browsing through search results reveals phrases such as "a significant amount of research."

Again, information such as this can assist scientific and academic writers in many ways.

Apply Your Skills
1. Review the [Academic Phrasebank](http://www.phrasebank.manchester.ac.uk) (http://www.phrasebank.manchester.ac.uk) website created by the University of Manchester.
2. Click on several of the links on the left side of the site. For example, you might look at "describing trends" or "describing quantities."
3. List at least five phrases that are new to you that you think would be useful to incorporate in your academic and scientific writing and list the category they belong to (e.g., Classifying and Listing, Being Critical, Describing Trends, Describing Quantities, etc.).

MODULE 4, LESSON 1: Quoting, Paraphrasing, and Avoiding Plagiarism
by Andy Halvorsen, University of Oregon

Part 1: Quoting, Paraphrasing, and Summarizing: How Are They Different?
Quoting requires taking a sentence or short passage from an original source and copying it into your own writing using quotation marks.

Paraphrasing involves using a passage from a reading and putting it into your own words. Paraphrasing generally condenses the original material slightly.

Summarizing is taking the main ideas of an extended reading and expressing them in your own words. Summaries are shorter than source material and give a broad overview.

The table below summarizes the primary differences between quoting, paraphrasing, and summarizing:

	Requires Citation	Wording	Additional Information
quote	yes	author's words	• Use quotation marks.
paraphrase	yes	your own words	• Use your own language to avoid plagiarism.
summary	yes	your own words	• Be as clear and concise as possible. • Apply this to a long passage.

Consider the following text. How would you quote or paraphrase this information?

Original text
Mobile phones are cheap and ubiquitous, with massive growth globally, especially in sub-Saharan Africa. Mobile-phone-based health applications are proliferating rapidly and there are persuasive reasons why mobile technologies offer such potential.*

Quote sample
Mobile phones have many potential applications beyond basic communication, and one of these can be found in the health sector. For example, in Tanzania today, "mobile-phone–based health applications are proliferating rapidly" (Mtema et al., 2016).

Paraphrase sample
In Tanzania and other sub-Saharan African countries, cell phones are frequently being used to track health-related data (Mtema et al., 2016).

Part 2: Avoiding Plagiarism in Your Writing
Plagiarism can be both intentional and unintentional and can happen in many forms including full papers, paragraphs, sentences, or ideas. Plagiarism can also occur when using spoken words, statistics and numbers, emails, websites, or many other sources. When you plagiarize, you
   • use someone else's words or ideas without proper citation, and/or
   • represent the words or ideas of others as your own.

You can avoid plagiarism by keeping careful track of all materials you read and review as you research. When you choose to include information from an outside source, follow the suggestions for quoting and paraphrasing above, and be careful to always include full citation information for each source.

Apply Your Skills

In order to paraphrase successfully, an author needs to fully understand the original material, and then adapt key vocabulary, sentence structure, and phrasing to create something new.

1. Look at the following quote taken from the article listed below:
   "We have demonstrated the considerable value and feasibility for mobile technologies to improve health systems."*
2. Use the strategies mentioned above to paraphrase this quote in your own words.

* These examples comes from the following reading:

Mtema, Z., Changalucha, J., Cleaveland, S., Elias, M., Ferguson, H. M., Halliday, J. E. B., . . . Hampson, K. (2016). Mobile phones as surveillance tools: Implementing and evaluating a large-scale intersectoral surveillance system for rabies in Tanzania. *PLoS Med 13*: 1-12. http://dx.doi.org/ 10.1371/journal.pmed.1002002

by Andy Halvorsen, University of Oregon

Part 1: Key Terms Related to References and Citation Formats
Before reading further, review these key terms to make sure you understand the language used in this module:
- References – alphabetical list of all sources cited in a piece of writing (used for APA format)
- Work cited – alphabetical list of all sources cited in a piece of writing (used for MLA format)
- Bibliography – list of all materials reviewed and consulted while preparing to write
- Annotated references – list of references that includes a brief summary of the content of each
- Endnotes – notes providing reference or other information placed at the end of the text (common in CMS format)
- Footnotes – notes providing reference or other information placed at the bottom of the page (common in CMS format)

Part 2: Citation Formats
Different journals and academic disciplines use slightly different citation formats. Let's look at some of the most common here:

Abbreviation	Full Name	Disciplines Used	Characteristics
APA	American Psychological Association	social sciences	• "References" page used at the end • emphasizes publication date
MLA	Modern Language Association	humanities	• "Work Cited" page used at the end • emphasizes author's name
CMS	Chicago Manual of Style	history	• allows for use of endnotes and footnotes
NLM	National Library of Medicine	medicine PLOS ONE	• similar to MLA

Differences in these formats are often small both for in-text and end-of-text citations. The table below provides samples of each for citing an academic journal. The specific formats for journal articles, books, websites, and all other material can be found in the appropriate style guides and various online resources.

	In-text Citation Example	End-of-text Citation Example
APA	(Reinhardt & Zander, 2011)	Reinhardt, J., & Zander, V. (2011). Social networking in an intensive English program classroom: A language socialization perspective. *CALICO Journal, 28*, 326-344.
MLA	(Reinhardt & Zander, 2011)	Reinhardt, Jonathon, and Victoria Zander. "Social Networking in an Intensive English Program Classroom: A Language Socialization Perspective." *CALICO Journal*, vol. 28, no. 2, 2011, pp. 326–344.
CMS	*Footnote	Reinhardt, Jonathon, and Victoria Zander. "Social Networking in an Intensive English Program Classroom: A Language Socialization Perspective." *CALICO Journal* 28, no. 2 (2011): 326-44.
NLM	(Reinhardt & Zander, 2011)	Reinhardt J, Zander V. Social Networking in an Intensive English Program Classroom: A Language Socialization Perspective. CALICO Journal. 2011;28(2):326–44.

Part 3: Use of Online "Citation Machines"

There are various sites online designed to automate the citation process. A website called Citation Machine (http://www.citationmachine.net) is very popular. Sites like these often work well and save time. You can enter or simply search for a journal article or book. Once the site finds the reference, it will automatically generate the citation in the format you choose. However, remember to check all information carefully yourself. These sites are not perfect, and mistakes often occur.

Part 4: Reference Management Tools

Reference management tools can be a great way for academics to manage large reference libraries. Many of these tools will keep track of all of your online and offline references, automatically generate reference pages for publication, and allow you to share your reference libraries with others. Four of the most common reference management tools are listed here. Be aware that each reference management tool has advantages and disadvantages. Study the features (paid and free) of each carefully before making a decision about which to use.

- Zotero (https://www.zotero.org) – Completely free and usable by all. Some universities have licenses offering additional features.
- RefWorks (https://refworks.proquest.com) – Paid service (currently 100 USD).
- Mendeley (https://www.mendeley.com/) – Completely free and usable by all.
- EndNote (http://endnote.com) – Paid service with different prices for students and faculty. Some universities have licenses available.

The University of Toronto (http://guides.library.utoronto.ca/c.php?g=250610&p=1671260) offers a nice comparison chart of the different features and prices of these four reference management tools.

Apply Your Skills

1. Look at the websites for the four reference management tools listed below:
   - Zotero (https://www.zotero.org)
   - RefWorks (https://refworks.proquest.com)
   - Mendeley (https://www.mendeley.com/)
   - EndNote (http://endnote.com/)

2. Choose two tools that meet your needs and sign up to try them out.
3. Determine the strengths and weaknesses of the citation tools you choose, and think about which might work best for your own research.

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