

Do the Write Thing: Eight Mini-Activities to Refine Students' Scientific Writing

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Teaching our students how to improve their writing can be a challenge. It is often difficult for students and teachers to identify what makes one sentence clearer than another, or what causes some writing to flow well and other writing to flow poorly. Students and teachers need a common language, both to identify problems and to suggest solutions for murky writing. This article presents eight mini-activities or stations, each 10-15 minutes long, that can be used together or as separate activities added to other lab sessions. The activities could also potentially be used as outside of class exercises. Each activity introduces a strategy for improving students' writing and allows students to practice the strategy. These activities are used during the second semester of Washington College's Introductory Biology sequence after students have mastered the basics of the lab report and have prepared a draft of their first paper of the semester.

Keywords: Writing, lab report, revision strategies

Introduction

Teaching students to write well is a perennial challenge. Our students arrive in our labs with varying levels of experience and aptitude with writing, and it is up to us to ensure that they leave our courses as better writers than they began. The activities presented in this article are designed to highlight writing techniques that are specific and easily applied to student writing. Although students might not apply all of these techniques when working on their own writing, instructors may use the shared terminology to aid their commenting on student work.

These eight mini-activities can be used together as a station activity, although I recommend building in a break in the middle of the stations. Alternatively, each one could be used as an add-on to a peer review session or other time when students have a draft of their work available. These activities could also be used during wait time of another experiment. If students' own work is not available, they could use a sample text. An old lab report on a lab that is no longer performed is a good choice for a sample text.

This exercise incorporates a station format, in which groups of students rotate among stations that have been set up in the classroom. A timer is used to keep track of when students should rotate. Why have the students move from station to station instead of sitting in one place

for the whole activity? First, it breaks up the activity into more manageable pieces. Students get distracted more easily with a longer task, and some students struggle with time management and will not finish the task in the time allotted. If students have a limited amount of time in which to complete each part, they stay on task better and complete the activity in a timely manner. Furthermore, students' attention is refocused every time they have to get up and move to the next station. This effect can be observed in the classroom, as after each rotation, the room gets quiet as students concentrate on their next task. Finally, the physical rotation with a timer prepares the students for the format of lab practicals, which feature stations through which the students must rotate with a time allotment at each station.

Learning Outcomes

1. Introduce strategies for improving writing to students.
2. Provide experience in using those principles to revise a partner's or one's own writing samples.
3. Introduce a common language for students and teachers to use when discussing writing.

Level and Time Required

This exercise was designed to be used in an introductory biology class, when students are in the process

of learning to write in a scientific style. Students should be familiar with the format of a scientific paper so that they can focus on more stylistic concerns.

Depending on the time allotted for each station, this activity takes approximately 90 minutes (10 minutes per station).

Another possible way to use this activity is to do each station's activity as a portion of another lab exercise.

The entire class could do a single station activity in 10-15 minutes with small groups or partners.

Note: To do this activity, the students need to come to class with a full or partial draft of a scientific paper. Students can use either printed or electronic copies- each has its benefits and drawbacks.

Student Outline **Station Texts for the Activity**

Note: Print off each station as a separate page to be placed at each of the lab stations.

Station 1—The Old/New Contract

1. Read the following description of a writing concept called the Old/New Contract. (From Bean, J.C. (2011) *Engaging Ideas* (2nd ed.). San Francisco: Jossey-Bass.)

One of these explanations follows the principle of old-before-new and the other doesn't.

Version 1—Not using the old/new contract

The old/new contract is another principle for writing clear closed-form prose. Beginning your sentences with something old—something that links back to what has gone before—and then ending your sentence with new information that advances the argument is what the old/new contract asks writers to do. An effect called coherence, which is closely related to unity, is created by following this principle. Whereas the clear relationship between the topic sentence and the body of the paragraph, between the parts and the whole, is what unity refers to, the clear relationship between one sentence and the next is what coherence relates to.

Version 2—Using the old/new contract

Another principle for writing clear closed-form prose is the old/new contract. The old/new contract asks writers to begin sentences with something old—something that links back to what has gone before—and then ending your sentence with new information that advances the argument. Following this principle creates an effect called *coherence*, which is closely related to *unity*. Whereas unity refers to the clear relationship between the topic sentence and the body of the paragraph, between the parts and the whole, coherence refers to the clear relationship between one sentence and the next, between part and part.

2. Either in your own paper or a partner's paper, choose a single paragraph. Read through each sentence in the paragraph and make sure it starts with old information and ends with new. If it does not, flip around the sentence to make it this way.
3. If you have additional time at this station, read through more of your paper (or your partner's) and work on following the old/new contract.

Station 2—Subject and Verb at Beginning

1. One way to improve clarity is to be sure that your subject and verb both appear close to the beginning of a sentence. See the examples below, with subject and verb highlighted:

The hypothesis that the digestive enzyme alpha-amylase production is dependent on the presence of gibberellic acid in germinating seeds **was supported** by these results.

(Subject and verb are very far apart. Your reader may forget what the subject was by the time he/she gets there!)

These results supported the hypothesis that the digestive enzyme alpha-amylase production is dependent on the presence of gibberellic acid in germinating seeds.

(Subject and verb are close together, within the first few words of the sentence. Bonus: this sentence is now in active voice!)

2. On your own paper or a partner's paper, choose a paragraph. Highlight the subject and verb of each sentence (on a computer or on paper).
3. If both subject and verb appear at the beginning of the sentence, great! If they are far apart or buried in the middle of the sentence, rewrite the sentence to fix this problem.
4. If you have additional time at this station, continue this process with subject/verb pairs in the rest of your draft or your partner's draft.

Station 3—Consistent Subject String

1. Compare the following two paragraphs adapted from Williams (1990).

Paragraph 1—this paragraph is hard to follow because the subjects of sentences are unrelated to each other. Hint: to find the subject, look just before the verb or find what is taking action in the sentence.

In this paragraph, **boldface** indicates subjects.

Particular ideas toward the beginning of each clause define what a passage is centrally “about” for a reader, so a sense of coherence crucially depends on subjects. Cumulatively, **the thematic signposts** that are provided by these ideas should focus the reader’s attention toward a well-defined and limited set of connected ideas. **Moving through a paragraph from a cumulatively coherent point of view** is made possible by a sequence of subjects that seem to constitute this coherent sequence of topicalized ideas. **A seeming absence of context for each sentence** is once consequence of making random shifts in subjects. **Feelings of dislocation, disorientation, and lack of focus** will occur when that happens. **The seeming coherence of whole sections** will turn on a reader’s point of view as a result of subject announcement.

Paragraph 2—this paragraph is much easier to follow because the subjects of the sentences are more consistent.

In this paragraph, **I** have boldfaced the **subjects** of every clause.

Subjects are crucial for a reader because **they** focus the reader’s attention on a particular idea toward the beginning of a clause and thereby notify a reader what **a clause** is “about.” **Subjects** thereby crucially determine whether **the reader** will feel **a passage** is coherent. Cumulatively, though a series of sentences, these **ideas** provide thematic signposts that focus the reader’s attention on a well-defined set of connected ideas. If **a sequence of subjects** seems coherent, **that consistent sequence** will move the reader through a paragraph from a cumulatively coherent point of view. But if through that paragraph **subjects** shift randomly, then **the reader** has to begin each sentence out of context, from no coherent point of view. When **that** happens, **the reader** will feel dislocated, disoriented, out of focus. **Whatever the writer announces as a subject**, then, will fix the reader’s point of view, not just toward the rest of the sentence, but toward whole sections.

2. Choose 1 paragraph in either your paper or a partner’s paper. In that paragraph, underline or **boldface** the subject of each sentence or clause.
3. Read through the subjects. Are they consistent (like paragraph 2) or all over the place (like paragraph 1)?
4. Revise any sentences that are out of place by changing their structure so that the subject string is consistent.
5. If you have additional time at this station, try this technique on a different paragraph (or on your own/your partner’s paper if you did not before).

Station 4—Paragraph Structure

A paragraph can be said to consist of an issue and a discussion of that issue. The issue (main point) of the paragraph should be stated either in the first 1-2 sentences of the paragraph, or in the last sentence of the paragraph. To practice using this idea, do the following:

1. In your own or your partner's paper, take a look at the Discussion.
2. In a paragraph of the Discussion, locate a sentence that describes the main point of that paragraph.
3. If you cannot find a sentence that describes the main point, write one! Integrate it into your paragraph either at the beginning or end.
4. If you do locate a "main point" sentence, is it in the first 1-2 sentences or at the end? If not, move it!
5. If you have remaining time at this station, repeat the process for the remaining paragraphs in your Discussion, or try this technique with your Introduction.
6. This rule doesn't strictly apply to the Materials and Methods section, since you are describing a step-by-step process. However, having a good topic sentence never hurts, even in M&M!

Station 5—Read Aloud

Reading your paper aloud to yourself or someone else is a great way to find awkward sentences/grammatical errors.

1. Choose a portion of your paper.
2. Have your partner read it aloud to you while you listen. Stop them if you hear a problem, and one of you can record what needs to be changed, or change it immediately.

Station 6—Lively Verbs

1. In your own or your partner's paper, choose a section.
2. Find the verb in each sentence. Is it a version of “to do” or “to be”? If so, suggest a more active, lively, or exciting verb to replace it. Be sure to use it appropriately, though. See the lists below for ideas.

Active Verbs That Describe Work and Analytical Thinking*

yield mean prove postulate estimate compare generalize note delineate acknowledge determine set forth maintain investigate devise assume	illustrate suggest insist consider define hypothesize narrate predict depict distinguish detail deduce believe assess construct argue	illuminate clarify propose infer classify synthesize evaluate introduce construe inform sum up derive speculate determine evaluate reiterate	reveal indicate imply state invoke summarize simplify report interpret specify designate characterize present calculate attribute discover	employ represent assert extrapolate analyze disagree measure challenge provide restrict point out guide organize support obtain decide
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A Short List of Active Verbs That Describe Phenomena*

discharge exchange emit exude converge contract continue bond encompass deposit invade reclaim precede orient activate condense link appear superpose disperse accelerate	overlie separate transmit interact extend trend mix interlock access underlie permeate restore influence distribute cease enrich superimpose require crystallize disseminate transfer	emanate surround carry behave constrain plunge slow fuse traverse overlap evolve abandon saturate allow record invert rotate ascend bisect disintegrate penetrate	radiate combine bombard exchange force occur quicken deteriorate join originate divide contain circulate lag form convert rupture descend cede propel halt	scatter eliminate exert absorb elongate fracture produce migrate dominate isolate sinter accrue forecast terminate transect alter streamline collapse coalesce repel curb
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*Lists from: Penn State College of Earth and Mineral Sciences, Effective Technical Writing in the Information Age. Accessed 11/13/2018. https://www.e-education.psu.edu/styleforstudents/c1_p10.html

Station 7—The Small Stuff

Here are a few techniques for making your writing better in small ways. (BONUS HINT: you can use the Find function on Microsoft Word (control-F) to help you find specific items.)

1. To make your writing more formal, look for contractions (don't, won't, isn't) and replace them with the long form (is not, will not, etc.)
2. To make your writing more specific, look for the words “this” or “these”. Make sure that they are followed by a noun at all times. So instead of “This demonstrates that enzymes are more efficient at higher temperatures,” say “This **result** demonstrates that enzymes are more efficient at higher temperatures.”
3. To help with ambiguity, look for the word “it.” Can you immediately tell what “it” refers to? If not, replace with a noun.

Station 8—Transition Words

1. For your own or your partner’s paper, look for places where you can add transition words. These words help guide your reader through your paper and tell them what you are doing next.
2. Check any transition words that are already present, to make sure that they are being used appropriately.

Transition Words*			
Closure	Interpretation	Intention	Emphasis
In conclusion	Fortunately	For this purpose	Above all
In sum	Interestingly	In order to do this	Certainly
On the whole	Significantly	To this end	Clearly
To summarize	Surprisingly	With this in mind	Indeed
Time	Amplification	Example	In fact
Afterward	Again	For example	In short
At the same time	Also	For instance	Obviously
Before	Apparently	To demonstrate	Of course
Earlier	Besides	To illustrate	Detail
Eventually	Equally important	Causality	Especially
In the meantime	Finally	Accordingly	In particular
Sometimes	First, Second, etc.	Consequently	In regard to
Later	Further	For this reason	Namely
Next	In addition	Hence	Specifically
Preceding this	Moreover	Therefore	To enumerate
Simultaneously	Location	Thus	Similarity
Soon	Beyond	Comparison/Contrast	Likewise
Concession	Here	However	Similarly
At any rate	Nearby	In contrast	
At least	Opposite	In relation to	
	Overlying (underlying)	Nevertheless	
	There	On the other hand	
	To the right (left)	Still	

*List from: Penn State College of Earth and Mineral Sciences, Effective Technical Writing in the Information Age. Accessed 11/13/2018. https://www.e-education.psu.edu/styleforstudents/c1_p14.html

Materials

- Copies of the student handout for each student
- Each student needs a copy of a draft of a scientific paper, either on a laptop or printed out. Laptop is preferred for easier editing. Sample or practice texts could also be used.
- Signs with station text. 8.5 x 11 clear stand-up photo frames work well as station signs.
- A timer (projecting an online timer is an easy way to keep students on task)

Notes for the Instructor

Summary

This is a stations-based activity to help students with revising, editing, and writing science lab reports. Students go through 8 stations. Each one teaches a different technique for revision of writing and asks students to practice that technique on their own and/or their partner's paper.

Outline of the Activity

- 1) Introduction (5 minutes)
 - a) Instructor explains the point of the lab activity and how the stations will work. Emphasize that this should be an active process of revision, and that they will come out of this lab activity with a much improved draft. Each station focuses on a single technique and they should spend the time at that station working on that technique and revising their own and/or their partner's paper using the technique.
- 2) Stations (bulk of the time, total time depends on time per station)
 - a) Set up the 8 stations around the room with signs denoting each one.
 - b) Show students how the rotation of stations will progress.
 - c) Students spend 10-15 minutes per station.
 - d) A break is recommended after 4 stations.
 - e) Instructors should circulate and help with techniques/encourage conversation.
- 3) Wrap up/processing (10 minutes)
 - a) Hand out the "Take-Home Message" handout and ask students what is the most valuable trick/technique that they learned during this class.

Helpful Hints and Possible Modifications

There are several ways in which this activity can be modified to suit the conditions of different institutions. First, the time needed can be modified simply by changing

the available time for each station. If each station takes 10 minutes, the total activity will take about 85-90 minutes.

Students can perform these revisions on their own paper or their partner's paper. I usually let the students choose—some students have a strong preference and some do not.

Another answer to the question of time is to do the activity spread out among several labs, so that one or two stations are done and discussed by the entire class. Hence, one could integrate this content without giving up an entire lab period to the exercise

Finally, the exercises listed here could be adapted for online use or use outside of class. Students could potentially turn in "before and after" drafts as evidence that they have applied these writing principles.

For further reading on teaching writing in general and in the science classroom, see Bean (2011), Knisely (2017), Schimel (2012), and Walvoord and Anderson (1998).

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About the Author

Suzanne Thuecks received her B.A. in Interdisciplinary Science: Biology/Chemistry and French from Lawrence University and her Master of Arts in Teaching from the University of Iowa. After 11 years of teaching science in grades 8-12, she became an Instructor and Lab Coordinator for the introductory sequence for majors at Washington College. She also teaches a nonmajors Forensic Biology course. She was the recipient of an ABLÉ Charlie Drewes grant in 2015. Her interests include the teaching of science writing and college-level teacher training and mentoring.

Appendix A: The Take-Home Message: Writing Hacks

Note: This handout is meant for students take home after the lab; it summarizes what they have learned from the stations and becomes an easy reference guide.

Writing Hack #1: The Old/New Contract

- To improve the flow of your writing, put old information at the beginning of the sentence and new information at the end of the sentence.

Writing Hack #2: Subject and Verb at Beginning

- To improve clarity, subjects and verbs should be close to each other and to the beginning of the sentence.
- Highlight the subject and verb of each sentence (on a computer or on paper).
- If both subject and verb appear at the beginning of the sentence, great! If they are far apart or buried in the middle of the sentence, rewrite the sentence to fix this problem.

Writing Hack #3: Consistent Subject String

- Readers are able to follow paragraphs if the subjects of the sentences are linked and/or similar.
- In each paragraph, underline or boldface the subject of each sentence or clause.
- Read through the subjects. Are they consistent and similar, or all over the place?
- Revise any sentences that are out of place by changing their structure so that the subject string is consistent.

Writing Hack #4: Paragraph Structure

- The main point of the paragraph should be stated either in the first 1-2 sentences of the paragraph, or in the last sentence of the paragraph.
- In each paragraph, locate a sentence that describes the main point of that paragraph.
- If you cannot find a sentence that describes the main point, write one! Integrate it into your paragraph either at the beginning or end.
- If you do locate a “main point” sentence, is it in the first 1-2 sentences or at the end? If not, move it!

Writing Hack #5: Read Aloud

- Reading your paper aloud to yourself is a great way to find awkward sentences/grammatical errors.
- Even better: read your paper aloud to a friend or have them read it to you. Pause after each sentence to consider if it makes sense. If not, consider rewriting!

Writing Hack #6: Lively Verbs

- Find the verb in your sentence. Is it “to be” or some other boring verb?
- Replace with a more exciting verb! Examples: https://www.education.psu.edu/styleforstudents/c1_p9.html and https://www.education.psu.edu/styleforstudents/c1_p10.html

Writing Hack #7: The Small Stuff

(BONUS HINT: you can use the Find function on Microsoft Word (control-F) to help you find specific items.)

- To make your writing more formal, look for contractions (don’t, won’t, isn’t) and replace them with the long form (is not, will not, etc.)
- To make your writing more specific, look for the words “this” or “these”. Make sure that they are followed by a noun at all times. So instead of “This demonstrates that enzymes are more efficient at

higher temperatures,” say “This result demonstrates that enzymes are more efficient at higher temperatures.”

- To help with ambiguity, look for the word “it.” Can you immediately tell what “it” refers to? If not, replace with a noun.

Writing Hack #8: Transition Words

- To guide your reader through your paper, use “transition words” to help. Some examples are: therefore, for example, first, however, on the other hand, in conclusion.
- More examples at: https://www.e-education.psu.edu/styleforstudents/c1_p14.html

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