Paper Writing for GEOL 0160:
Monsters of the Abyss: Oceanography and Sea Tales

Baylor Fox-Kemper

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1 Contacts

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Some portions of the website are password-protected to ensure that fair use and copyrights are correctly obeyed as I share images from books, etc. You can access these by using:

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username:  io
password:  ocean
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2 Getting Help!

I am usually available by email. My office hours this semester will be most Mondays and Wednesdays 1:30-2:30PM. You can also request an appointment at other times. Just check my calendar at `http://fox-kemper.com/contact` and suggest a time that works for you.

Erica Thieleman, our CAP fellow, will also have office hours on most Fridays 2:30-4 in GeoChem 134. She will be helping you with finding journaling topics, preparing your classroom discussion leading, drafting, and peer reviewing, and you can reach her at `mailto:erica_thieleman@brown.edu`.

Finally, we have two writing fellows for the class (Sienna Zeilinger and Simon Henriques). They will also be offering help with your draft papers.

If you are having trouble with the writing, there are lots of places to find help! You can make an appointment at the writing center (`http://www.brown.edu/Student_Services/Writing_Center/`) You also might ask older students for tips. I can show you past student papers from related courses if you'd like. I've put my favorite writing style guides in the bibliography (*Turabian*, 2007; *Strunk et al.*, 2005; *Montgomery*, 2003; *Dean*, 2009).

3 General Comments on Papers

Before you get worried about writing three papers, plus peer reviews, plus journal entries for one class, let me explain the goals of the course's writing assignments. They are supposed to be practice in writing different styles, and they are interrelated so that you will be able to cross-fertilize your ideas.

3.1 You will submit your paper in pdf format.

You will submit your paper in pdf format. It should be ready to print, and line numbers are super handy for the version to be reviewed!

4 Essays: Narrative, Science, and Research Paper

In many of your past and future classes, you might be expected to write a *research paper* that involves collecting a set of ideas collected around a central *thesis*. Sometimes this is called an *essay*, which is really a general term for a short piece of writing (it roughly translates to "a try" or "an attempt" from French). Longer academic writings are usually called dissertations or manuscripts.

There are lots of different types of essays. The traditional class essay is written in third-person and collects arguments and facts to support a central theme or thesis. We will be writing in different styles in this class, both to broaden your writing skills and to honor the works we are reading, which are excellent examples of two different styles: personal narrative and scientific article.

5 Personal Narrative

A personal narrative is a form of essay that may resemble an expanded journal entry or even a college essay. It should be based on your life events, but it does not require you to have physically gone somewhere or confronted a challenge, it might just detail how a class session, a reading, or other intellectual insight came to you. Often, a physical event is used to keep the action flowing, but the realization of the personal narrative is typically about changes to your intellectual understanding or character. A personal narrative is not a biography or news report of things you did.

5.1 The Narrative Arc

Narratives generally build from a number of distinct starting points to combine at a central moment of realization, called a *climax* or *catharsis*. Franzen's essay has the clear moment of catharsis when he realizes how dangerous his climb is. Nansen's, Darwin's, and Mitchell's personal narratives are wider collections of events, that do not necessarily combine tidily, but feature multiple miniature storylines that span some of the time they are chronicling. All of the narratives we have read are roughly chronological in organization, and you may find that helpful in organizing your writing. The key to a narrative is selecting and combining a set of ideas that build upon one another and show "how you got from there to here." The story-building that goes along with making this collection is sometimes called a narrative arc, because the flow of the piece has an arc-like shape (Fig. 1).

To start on building your own narrative arc, you should identify the climax moment (or collection of these key ideas), and then build yourself a table, diagram, chart, or outline that allows you to fill in the experiences or preconceptions that lead to this moment. You will introduce each of these building blocks in the exposition, deepen them (perhaps using other references, excerpts from the reading, or cross-connections between them) in the complication phase, reach the climax moment where you describe how your opinion changed, and then wrap it up in the resolution.

5.2 Fiction or Non-Fiction?

Because of the kinds of reading we are doing, *I expect the elements of your narrative to be true.* That is, don't fabricate experiences you had just to fit the bill. However, neither do they have to be presented in complete detail, or in chronological order, if that does not serve the purpose of telling the story you want

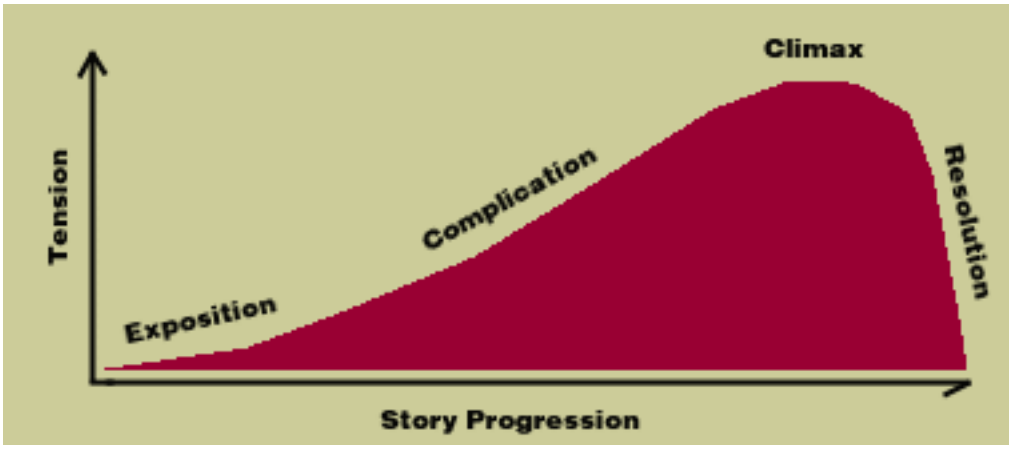

Figure 1: **The Narrative Arc**. Taken from this nice webpage `http://www.tofp.org/units/basics/plot/plot9.htm`.

to tell. In this sense, the essay is not quite an article (non-fiction) and not quite a short story (fiction), it is a rhetorical argument told in the form of a story about you.

In any case, it is understood that a personal narrative is *subjective*. The conclusions you draw are subject to your own experiences. It is not expected that someone else with different experiences or a different set of assumptions would agree with you about your catharsis, but the idea is to explain enough of your experiences that they can agree *that it makes sense given where you started out.*

5.3 Narratives: How to Succeed Or Fail

The personal narrative has a number of key elements, which you should keep in mind while writing and while peer-reviewing:

- A smoothly flowing story, without jumps or hiccups, at least during the exposition and complication. There may be small surprises as new ideas are introduced, and there may be a "leap of faith" required to reach the climax. However, the flow of a personal narrative draws the reader in most effectively when these pieces are tied together smoothly (like the segments of the arc). You may find that reading out loud and heavy editing are required to get this flow.
- A set of early ideas and pieces that, while needing explaining, are not surprising or deep when considered one at a time.
- A climax is that surprising or "deep" in comparison to the ideas in the exposition.
- A resolution that feels settled. A personal narrative does not usually have a cliff-hanger at the end!
- A personal narrative involves believable elements (the exposition), and possibly far-fetched elements (the climax) that make sense and are credible in this context.
- A personal narrative allows you to directly voice your ideas, as though you are explaining your thoughts directly to the reader, albeit in a tidy and organized way that probably wouldn't occur in conversation. You should use "I" a lot.
- The keys to a good narrative are selection and editing of the exposed ideas, flow, and climax. You can fail by having an exposition too remote from the climax–either in too many ideas or ones that are too unrelated–which will cause you to lose the reader.

5.4 Use of Cited Materials

All papers in this class will have a bibliography. However, in a personal narrative, you do not need to have a highly precise citation to indicate the page or article section. You can quote a passage or reference an idea just by mentioning the author of the idea, as Aronnax and Darwin do. You are still subject to concerns of plagiarism, so don't forget to acknowledge ideas and quotations that aren't yours. You may find it satisfying to use references during the exposition and complication, but lay claim to your own catharsis.

6 Scientific Article

A scientific article is intended to be a highly-structured, objective, fact-filled, and strictly non-fiction form of essay.

Rather than a central thesis or catharsis, a scientific article describes an experiment or set of experiments around a set of hypotheses. Hypotheses are featured early in the paper, generally in the abstract and other early sections (introduction, methods, theory), are addressed in the data and results section, and addressed again in the conclusion. For this reason, *scientific papers are logically, not chronologically, structured.* Sometimes, this organization is jokingly referred to as "Tell 'em what you'll tell 'em; Tell 'em; Tell 'em what you told 'em." The same hypotheses are repeated, and in some sense no new ideas are presented during the development of the paper, only results and supporting evidence. A story or narrative arc building toward a suspenseful moment is not desired, indeed the different sections will have much repetition of the ideas and spoilers of what's to come. The typical sections are:

- Title and Authors
- Abstract
- Introduction (or background)
- Theory
- Methods
- Results
- Discussion
- Conclusion
- acknowledgments
- Bibliography
- Appendices (probably not needed here)

A scientific article is intended to be objective. You are *not supposed to write in the first or second person.* Thus "our results indicate" is not as good as "The results indicate." You can refer to yourself in the third person: "The author designed," which is better than "I designed," but not as good as "The instrument was designed."

There is a constant struggle to avoid using the first or second person *and* to use the active rather than passive voice. The active voice is a direct relationship between an subject doing something and an object receiving the doing, such as "El Nino causes warmer temperatures in the eastern tropical Pacific Ocean." The passive voice version would be "Warming in the eastern tropical Pacific Ocean is due to El

Nino." Oddly, lots of people fall into the passive voice when trying to avoid anthropomorphizing natural phenomena (El Nino can't need or want or try to do anything, it's not a person!) and trying to avoid the first and second person. Apparently, "The phenomenon was observed by the author" seems less odd than "The author observed the phenomenon" and the former is the go to phrasing when trying to replace "I observed the phenomenon." Avoid the desire to sound "scientific" by using the passive voice excessively, and use the active for a cleaner exposition.

A scientific article is filled with facts, that deserve special treatment. Some of these are figures, some are experimental results or measurements, some are statements. In all cases, they are key aspects of science. A special subsection below describes how they must be presented in a scientific article.

As mentioned above, a personal narrative is on the line between non-fiction and fiction in that true statements are organized selectively to form an argument. A scientific article is more strict. All related evidence, whether supporting the conclusions or not, is supposed to be included. This inclusion is supposed to help in designing later experiments to understand the "outliers" of the present understanding. Sometimes, even seemingly unrelated facts are included in scientific articles, just because they were simultaneously observed along with facts related to the hypotheses. This inclusion challenges our writing skills, but smooth exposition is still possible if you insist that the facts are presented in clear, concise, and precise language.

In these senses, a scientific article is the *opposite* of a personal narrative, as it is intended to contain true facts and unambiguous explanation regardless of who the author or observer is. Some more detail on the sections and methods follows.

6.1 Abstracts: What are they and do you need them?

You need to have an abstract on every scientific paper. It is a *summary* of what you've hypothesized and concluded, with enough detail that a reader can decide whether your paper has what they need or not in it, and they can quickly refresh their memory as to which paper of yours it is, too! It's the first thing after the title and authors' names.

Imagine doing a google scholar search for a keyword when you are working on one of these papers. For example, "North Atlantic Deep Water" input to scholar.google.com just got 6,590 hits, so how do you sort through them? 1) The number of citations generally tells you if it is a useful and/or a controversial treatment. 2) You read the titles, 3) You skim the abstract, 4) you skim the figures, reading the captions only. You should write your title, abstract, and captions for this audience: someone skimming a mess of papers on a related topic trying to find the particular treatment or fact that they need without reading all of the papers.

6.2 Theory & Methods Section(s)

I require these sections *for every scientific article in this class.* After the abstract and introduction, each paper will be required to have a Theory and Methods section. (They can be joined into one section if it's not too long, or two separate ones if that gets unwieldy). In each paper's theory section you will present any equations or theories you will be using in every subsequent calculation and every figure. Each of these should be presented with correct citation format. Likewise, the methods section will describe how the data was collected (by the original investigators, not by you). That is, "Darwin spent years on the Beagle observing finches" not "I went to the library and checked out a copy of Darwin."

6.3 Results & Discussion Section(s)

Here are the data you've collected, using the methods and theories already explained. The mode of presentation is variable, but a few pieces aren't.

Graphics

A figure should be included inside the text just after the figure is mentioned in the text. Note: every figure deserves at least one sentence of explanation in the text! Every figure should have a caption, which should be short but detailed enough to understand the figure without digging in the text. Just like writing the title and abstract for the skimmer, write the figure caption so that by reading just the title, abstract, and figure captions gains an outline of the work.

A Special Role for Facts

Because of the special role for facts in the scientific method, scientific papers must be very careful when dealing with statements of fact. There are *exactly three ways to make a factual statement in a paper*. You can:

1. Prove it (in data presented or mathematical/logical analysis)
2. Cite it (and pass the buck to another source)
3. Speculate it (and clearly indicate you're doing so)

If you aren't sure which one you're doing, *you aren't allowed to make the statement*, at least not in a scientific paper.

For example, if you are trying to make a point like, "The oxygen content of NADW is anomalously high." You can 1) make a figure, 2) cite a source, or 3) hypothesize that it should be high because the NADW was recently near the surface (where it equilibrated with the atmosphere) and then sunk quickly below the depths of important biological activity. Or, if it is an important point you want to make, you can do all three!

Sometimes the connections between the results and the hypotheses isn't clear, and a separate *Discussions* section is needed to explicate. Sometimes the discussion is is combined with the results section, if the discussion isn't too long. If they are combined, call it "Results and Discussion."

6.4 Conclusions

Here you bring back the hypotheses and make a decision about them knowing the evidence presented. In the TV show "Mythbusters," they do an excellent job of concluding that myths are "busted," "confirmed," or "plausible" at the end of each episode. You can think of addressing each of your hypotheses in the conclusion the same way.

6.4.1 Where can you make a paper more interesting?

The introduction and conclusion are a good place to stimulate broader interest. In the introduction, you can *motivate the research* with whatever you like (including appropriate citations, of course). In the conclusion, you can often speculate as to the importance of what you've done or directions for potential future investigations. In the middle, don't try to push too hard, just state what's in front of you, and add more figures if you want to show something else.

6.5 Acknowledgments: Pay and Friends

Over time, the acknowledgments has become a place to state who paid for the research (you'll notice journal articles with acknowledgments that begin 'This research was funded under NSF...'). So, you can begin with this if you like, e.g., 'This research was funded by my parents or sponsored by (insert advisor/dept./fellowship here)'. More importantly, if you talked to classmates or other teachers, and they gave you a good idea it is good to mention them here for two reasons: 1) It is a nice way to recognize their help, and 2) it closes the door on plagiarism. What I mean by 2) is, if you state that someone

helped you in some regard, then they can't say that you 'stole' the idea from them. Instead, you just borrowed it, with adequate acknowledgment. You should mention your peer reviewers by name in the acknowledgments, for example, and you might attribute particular suggestions to them as well.

6.6 Other Details in Scientific Articles

6.6.1 Citations: When and Why?

Citations are a bit like the acknowledgments in that they shield you from plagiarism, but they also serve another equally important role: they allow you to pass the buck to another author/work who has proven it elsewhere.

Unlike in narratives, the method for doing citations is highly structured in scientific papers. The general idea is that every time you use a citation to indicate a fact or idea that originated in another paper, you add a citation reference at that moment in the article. The citation reference is usually either a superscript or other number, or an author name and date. If the author has more than one publication in that year, then you use a distinguishing symbol (e.g., Fox-Kemper, 2012b). There are lots of crazy formatting rules and exceptions, and every scientific magazine or journal differs. You should consult your bibliographic software program and websites to find a method you prefer. Personally, I prefer the American Meteorological Society style `http://tinyurl.com/psa5b54` or the American Geophysical Union style `http://tinyurl.com/pjep54s`.

6.6.2 Acronyms

Define upon first use, e.g., The Gulf of Mexico (GOM) is warm. The surface of the GOM is even warmer.

6.6.3 First Person

No first or second person in scientific articles (or at least very infrequently). So, instead of 'I downloaded ODV', 'ODV was downloaded'.

6.6.4 Dataset versus Plotting Program

This may be due to the nature of the first assignment, but be careful about where the data comes from. For example, the data is not from Matlab or ODV. It was from Reid and Mantyla. Matlab was just used to plot it. Often you will not need to say how you plot something, but you will *always* need to say which dataset it is (usually including a citation), so that someone else can understand what you're showing or look it up.

6.6.5 Where in the World?

On a similar note, where are your figures located in the world? Any figure you show should be labeled or captioned telling the geographic location. Latitude and Longitude may be quickest but including a map of the section/data point may be nicer (depending on the point you're making). To say that a CTD cast is located in the Atlantic is not really specific enough.

6.6.6 Piggy-back off of reading or lectures!

Many of you already realize that starting from a statement made in one of the readings makes for an easy start to the paper. This is generally true, because all of the references you need and all of the terminology is probably right there.

However, you may end up with less exciting conclusions, e.g., 'Just as Pickard and Emery said it would be, NADW was there'. Many of you will take the bolder route of just plotting something up and trying to make sense of it. This is harder, because it's not easy to figure out where to find help. You can ask me, or use google scholar, and that may help, but more importantly, be circumspect about what you say. If you say, the temperature is warmer at the top than the bottom, and that is what your figure shows, then great. If you say, the temperature is warmer at the top because of solar heating, you either need a citation or need to be obviously speculative, e.g., 'Presumably, the temperature is warmer at the top due to solar heating.'

It is best to be both interesting and correct. If one must choose, it is better to be correct and boring rather than interesting and wrong (at least for the purposes of this class!)

6.6.7 Use Google Scholar and Web of Science!

You will learn quickly the importance of writing a good abstract, because you can scan the abstracts of the papers that you find to see if they will answer the question you've got in mind. Also, a good citation will save you pages of discussion and hours of fiddling with figures!

6.6.8 Who is your audience?

Think about how to make the classroom assignment extend beyond the classroom: Can you address the underlying questions in the assignment, but do so in a way that reads like an article for the general oceanographic community? Or, at the very least, will any student taking any version of an Intro. to Physical Oceanography class get something out of it?

6.6.9 Cut off debate when you're out of time/room/ideas

It is not necessary or possible to address everything in one short paper (or even one very long paper)! So, zealously assert your right to stop somewhere, and try to choose that somewhere on a logical basis (e.g., the dataset doesn't extend there or this paper focuses on Oxygen not Nitrate, or we don't yet know how to calculate the velocity fields from the data we have, etc.) It is O.K. to stop anywhere that is convenient, but be clear about why you stop there. The reader may be interested in following up on your work, and it helps to state what you'd need to go further in that direction.

References

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